a commercial product sold by Network Associates, was created in 1991. It is one of the most popular public key exchange (PKE) schemes.

Without a functioning universal public key infrastructure, we cannot reliably and easily acquire certificates that contain public keys for persons or organizations we want to communicate with. Standards are emerging, including Public Key Infrastructure (PKI), IETF Public Key Infrastructure X.509 (PKIX), Simple PKI (SPKI), and Public-Key Cryptography Standards (PKCS).

PKI is a system that provides protocols and services for managing public keys in an intranet or an Internet environment—it involves distributing keys in a secure way. PKI secures e-business applications such as private e-mail, purchase orders, and workflow automation. It uses digital certificates and digital signatures to authenticate and encrypt messages and a CA to handle the verification process. It permits the creation of legally verifiable identification objects, and it also dictates an encryption technique to protect data transmitted over the Internet. Trusted PKI suppliers include Entrust and VeriSign. PKI technology is now moving from pilot testing into the real world of e-commerce. Web browsers such as Microsoft Internet Explorer and Netscape Navigator include rudimentary support for PKI by providing an interface into a computer's certificate store, and browsers often include the certificates for some top-level CAs, so that the users can know, incontrovertibly, that the roots are valid and trustworthy.

IKE is the key exchange protocol used by IPSec, in computers that need to negotiate security associations with one another. A security association is a connection between two systems, established for the purpose of securing the packets transmitted across the connection. It supports preshared keys, which is a simplified form of key exchange. It does not require digital certificates. Every node must be linked to every other node by a unique key, and the number of keys needed can grow out of control; for example, 2 devices need 1 key, and 8 devices need 28 keys. New versions of IKE generate new keys through a CA. Legal and political problems will most likely delay widescale use of IKE.

One of the biggest hurdles e-commerce companies face is confirming the identity of the parties involved. Ensuring identity requires an encrypted ID object that can be verified by a third party and accepted by a user's browser. Personal digital IDs contained in the user's browser accomplish this. Historically, these client certificates have been used to control access to resources on a business network, but they can also contain other user information, including identity discount level or customer type. Third parties (that is, CAs) guarantee these types of certificates. The user's browser reads the server certificate, and if it's accepted, the browser generates a symmetric session key, using the server's public key. The server then decrypts the symmetric key, which is then used to encrypt the rest of the transaction. The transaction is then signed, using the user's digital ID, verifying the user's identity and legally binding the user to the transaction.

Digital Certificates

Digital certificates, based on the ANSI X.509 specification, have become a de facto Internet standard for establishing a trusting relationship using technology. Digital certificates are a method for registering user identities with a third party, a CA (such as Entrust, UserTrust, or VeriSign). A digital certificate binds a user to an electronic signature that can be trusted like a written signature and includes authentication, access rights, and verification information. CAs prepare, issue, and manage the digital certificates, and they keep a directory database of user information, verify its accuracy and completeness, and issue the electronic certificates based on that information. A CA signs a certificate, verifying the integrity of the information in it.

By becoming their own digital CAs, service providers can package electronic security with offerings such as VPN and applications services. Vendors that provide the technology required to set up as a CA include Baltimore Technologies (in Ireland), Security Dynamics Technologies, and Xcert.

Server certificates ensure Internet buyers of the identity of the seller's Web site. They contain details about the Web site, such as the domain name of the site and who owns it. Third parties, such as Thawthe in South Africa, then guarantee this information. Sites with server certificates post the CA, and Internet browsers accept their certificates for secure transactions.

There are still many security developments to come and there is a bit of unsettlement in this area. Standards need to be defined and formalized before e-commerce will truly be able to function with the security that it mandates. For now, these are the types of mechanisms that are necessary to ensure that your data remains with you.

■ VoIP

VoIP has been drawing a lot of attention in the past couple years. This section covers the types of applications that are anticipated for VoIP, as well as what network elements are required to make VoIP work and provide similar capabilities to what we're used to from the PSTN.

VoIP Trends and Economics

Although VoIP calling is used for billions of billed minutes each year, it still represents a very small percentage of the market—less than 5% overall. According to Telegeography (www.telegeography.com), 40% of VoIP traffic originates in Asia and terminates in North America or Europe; 30% travels between North America and Latin America; one-third of U.S. international VoIP traffic goes to Mexico, with future volume increases predicted for calling to China, Brazil, and India, and the

rest moves among the U.S., Asia Pacific, and Western European regions. It is important to closely examine who will be using this and what carriers or operators will be deploying these technologies. Probe Research (www.proberesearch.com) believes that by 2002, 6% of all voice lines will be VoIP. This is still rather minor, given the fact that some have been saying that VoIP would have replaced circuit-switched calling by now. Piper Jaffray (www.piperjaffray.com) reports that minutes of communication services traveling over IP telephony networks will grow from an anticipated 70 billion minutes and 6% of all the PSTN traffic in the year 2003 to over a trillion minutes by the year 2006. In the United States alone, the PSTN is handling some 3.6 trillion minutes of traffic monthly.

Although VoIP has a very important place in telecommunications, it's important to realize that it is not yet taking over the traditional circuit-switched approach to accommodating voice telephony. The exciting future of VoIP lies in advanced and interesting new applications, an environment where voice is but one of the information streams comprising a rich media application. Many expect that sales of VoIP equipment will grow rapidly in the coming months and years. Part of the reason for this growth is that the network-specific cost for VoIP on dedicated networks is quite a bit lower than the cost of calls on circuit-switched networks—about US 1.1 cents per minute as compared with US 1.7 cents per minute. Using VoIP to carry telephony traffic greatly reduces the cost of the infrastructure for the provider, but at the expense of possibly not being able to maintain QoS. Potential savings are even greater if VoIP is implemented as an adjunct to data network.

Another factor encouraging customers to examine VoIP is the use of shared networks. Because IP emphasizes logical rather than physical connections, it's easier for multiple carriers to coexist on a single network. This encourages cooperative sharing of interconnected networks, structured as anything from sale of wholesale circuits to real-time capacity exchanges. Also, VoIP can reduce the barriers to entry in this competitive data communications world. New companies can enter the market without the huge fixed costs that are normally associated with the traditional circuit-switched network models. Furthermore, because IP telephony will enable new forms of competition, there will be pressure to better align government-controlled prices with underlying service costs. International VoIP services are already priced well below the official rates and some of VoIP's appeal is that it eliminates the access charges interexchange carriers normally have to pay to interconnect to the local exchange carrier. In the United States, these charges range from US 2 cents to US 5 cents per minute.

Advantages of VoIP

The key benefits of VoIP are cost savings associated with toll calls, enhanced voice services, and creative and innovative new applications. The key concerns related to

Regulations Related to VoIP

It's one thing to approach telephony on the Internet such that the incumbent is protected from competition with other voice telephony services on the Internet. But stating that voice on the Internet should not be allowed would be to cut your own throat. All the exciting new applications on the Internet do involve the use of multimedia applications, and voice is part of that overall stream. So, we have to be very careful about what we're regulating—whether it's voice, which is increasingly part of a larger application set, or whether it's traditional voice telephony.

VoIP are voice quality compared to that in today's PSTN; the cost of QoS to ensure the same quality as in the PSTN; security; the current lack of compelling applications; and regulatory issues, such as whether voice will be allowed on the Internet and whether voice will be treated as an altogether different environment—as a converged, integrated application.

VoIP Applications

VoIP includes any set of enabling technologies and infrastructures that digitize voice signals and transmit them in packetized format. Three major network architectures can be used in support of VoIP applications:

- Voice-over intranets, which could be based on leased lines, Frame Relay, ATM, or VPNs
- Voice-over extranets, which could also be based on leased lines, Frame Relay, ATM, or VPNs
- Voice over the public Internet

The following sections discuss some of the key issues related to VoIP applications.

IP Long-Distance Wholesale

So far, the most compelling business case for VoIP has been in IP long-distance wholesale, where there are clear financial benefits and low barriers to entry. Early pioneers in this area include iBasis, ITXC, and Level 3, which predominantly offer IP services to domestic and international carriers, but also offer services to corporations and other service providers. What the customers gain by doing business in this fashion is a reduction in cost associated with carrying their traffic over expensive toll or international transit links.

In IP long-distance wholesale, the voice service levels must match those of the PSTN. End customers of the international carriers expect to perceive the same voice

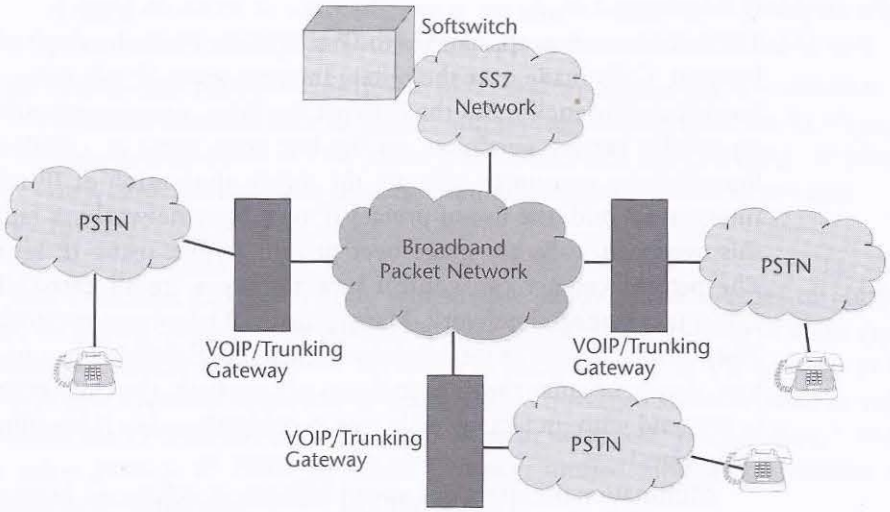

Figure 11.11 A converged long-distance network

quality throughout. How can providers guarantee that when it's almost impossible to control QoS over the public Internet? Even in the case of IP backbones, QoS depends on the underlying architecture used. The solution lies in smart management of packet latency, to ensure circuit-like behavior inside the IP network. For example, iBasis developed a proprietary routing algorithm that monitors performance on the Internet; when it detects that congestion levels may affect the quality of the voice, it switches the calls over to the circuit-switched network, thereby ensuring that customers experience the high quality that they expect end-to-end.

The IP long-distance wholesale environment takes advantage of a converged voice/data backbone by using trunking gateways to leverage the PSTN (see Figure 11.11). This allows support and processing of voice calls. The trunking gateways enable connection of the data network to the PSTN, to support long-haul carrying of the switched calls. In addition, switching services can be added to the data networks through the use of softswitches. (The functions and types of softswitches and gateways that make up the new public network are discussed later in this chapter.)

These are main issues in selecting providers of IP long-distance wholesale:

- **Voice quality versus bandwidth**—How much bandwidth do you use to ensure the best quality?
- **Connecting to the customer**—How many services need to be supported (voice, data, dialup modem, fax, ISDN, xDSL, cable modem)?
- **Maintaining voice quality**—As bandwidth becomes constrained, how do you maintain the voice quality?

IP Telephony

There are two main approaches to IP telephony. First, there's IP telephony over the Internet. Calls made over the public Internet using IP telephony products provide great cost-efficiencies. But the Internet is a large, unmanaged public network, with no reliable service guarantee, so the low costs come at a trade-off. International long-distance consumer calls are the major application of IP telephony over the Internet. Second, the use of private IP telephony networks is rapidly emerging. In this approach, calls are made over private WANs, using IP telephony protocols. The network owner can control how resources are allocated, thereby providing QoS and a managed network. Many private IP telephony networks are being built. They enable an enterprise to take advantage of its investments in the IP infrastructure. Again, because this is a single-owner network, the QoS issues are much easier to contend with; in fact, a single-owner network makes it possible to contend with QoS issues!

Multinational enterprises spend billions of dollars on international voice services each year, so the savings that IP telephony offers is compelling. The cost benefit of running voice services over a private IP network is on the order of 20% or more savings on international long distance, as compared to using traditional voice services. Private IP transport platforms will be increasingly deployed, therefore, as an enterprisewide telephony option.

Recent deployment of IP local exchange products, coupled with low-bandwidth, high-quality voice compression, creates a solid foundation for extending business telephone service to telecommuters at home or on the road. The efficiencies of IP packet technology, coupled with the ITU G.723.1 voice compression standards at 6.4Kbps, enable road warriors and small office/home office workers to have a complete virtual office over a standard 56Kbps Internet modem connection to the office. The really great feature of this environment is that your current location is your office and your IP phone rings wherever you are. However, this requires an IP local exchange—a carrier-class product that resides in the service provider network and provides PBX-like telephony service to multiple business and telecommuter customers. It also requires a softswitch (that is, call-agent software) that's used for purposes of managing call processing functions and administration. Also, end-user services are delivered via IP Ethernet phones or analog telephones that use Ethernet-to-analog adapters.

There are three major categories of IP phones:

- **POTS phone**—The advantage of the POTS phone is high availability and low price. The disadvantage is that it has no feature buttons and the required Ethernet-to-analog adapter is quite costly.
- **Soft phone**—A soft phone is software that runs on the user's PC and graphically resembles a telephone. Its advantage is low price. Its disadvantage is that

it relies on the PC sound card, and it can create volume level problems when you switch between it and other applications that use the PC sound card.

- **IP Ethernet phone**—This device looks and works just like a traditional multiline business display phone, and it plugs into an Ethernet RJ-45 jack. It's priced similarly to PBX phones, at US$300 and up. Emerging "IP phone on a chip" technologies promise dramatically lower prices in the near future.

The evolution of IP telephony will involve many different types of applications, including long-distance wholesale voice services; the support of voice applications for campus or enterprise networks in bringing VoIP to the desktop in the form of new advanced applications that involve converged streams (such as video conferencing or multimedia in the establishment of remote virtual offices); Internet smart phones; IP PBXs; IP centrex service; unified messaging; Internet call waiting; and virtual second-line applications.

VoIP Enhanced Services

Another approach to supporting voice services is to look toward enhanced services. There are two categories of enhanced services:

- **Transaction-oriented services**—These services include Click-N-Call applications, interactive chat, Surf-With-Me, videoconferencing, and varieties of financial transactions.
- **Productivity-enhancing services**—These services include worldwide forwarding, multiparty calling, a visual second line, unified messaging, collaboration, access to online directories, visual assistance, CD-quality sound, personal voice response, and video answering machines.

The key to enhanced services is not cost savings, but cost savings are realized through toll bypass, QoS differentiation, the capability to support remote access, and the capability to create new forms of messaging. Because of the cost savings and features available, the use of enhanced services will grow by leaps and bounds over the next several years.

VoIP is part of a larger trend toward innovative voice-enabled Internet applications and network interactive multimedia. This trend includes various facilities to enhance e-commerce, customer service, converged voice and visual applications, new intelligent agents and various forms of bots, and e-calling campaigns. These sorts of advanced services make it possible to gain greater value from the IP investments that have been made, and at the same time, they create interesting new revenue streams with altogether new businesses.

We'll see VoIP applications increasingly used in a number of ways. VoIP applications will be included on Web-based call centers as automatic call-backs from customer service-based phone numbers entered into a Web page; as multiparty conference calls, with voice links and data sharing, initiated also from a Web page; and in the process of reviewing and paying bills. The key is to blend rich, Internet-based content with a voice service. An example of an emerging application that illustrates such innovation is online gaming. InnoMedia and Sega Enterprises are integrating InnoMedia Internet telephony into Sega Dreamcast game consoles to allow game players worldwide to voice chat with each other while playing games. This device can also be used to cost-effectively place calls in more than 200 countries through InnoSphere, InnoMedia's global network. For example, the rate from the United States to Hong Kong will be US2 cents per minute, from the United States to the United Kingdom it will be US5 cents, and from the United States to Japan, Australia, and most of Europe, it will be US9 cents.

Another example of an interesting new VoIP application is Phonecast, a media network of Internet-sourced audio channels for news, entertainment, and shopping, available to telephones. Created by PhoneRun and WorldCom, Phonecast is modeled after television and radio broadcasting, and it allows callers to create a personal radio station and direct it by using simple voice commands. This is the first of a series of innovative content and service partnerships, assembled to form a comprehensive voice-portal product line.

VoIP Service Categories

There are several main VoIP service categories:

- **Enterprise-based VoIP**—In enterprise-based VoIP, whether for the LAN or WAN, specialized equipment is required at the customer site.
- **IP telephony service providers**—These providers are generally involved in toll-bypass operations. They do not require specialized equipment at the customer site, but they may require additional dialing procedures to gain access to the network. Currently, multistage dialing is one of the problems we still face: You have to dial a seven- or eight-digit number to gain access to your ISP, and then you have to dial a string of digits for the authentication code, and then you have to dial the string of digits corresponding to the number you want to reach. Single-stage dialing will remedy this situation in the very near future.
- **Converged service providers**—These companies will bundle together voice, data, and video services.
- **Consumer VoIP**—Consumer VoIP is generally geared toward consumer connections over the public Internet.

VoIP Network Elements

VoIP may seem like rocket science compared to conversations, but the concept is really quite simple: Convert voice into packets for transmission over a company's TCP/IP network. Two characteristics determine the quality of the VoIP transmission: latency and packet loss. Latency is the time it takes to travel from Point A to Point B. The maximum tolerance for voice latency is about 250 milliseconds, and it's recommended that the delay be less than 150 milliseconds. Small amounts of packet loss introduce pops and clicks that you can work around, but large amounts of packet loss render a conversation unintelligible. With too much packet loss, you would sound like you were saying "Da dop yobla bleep op bop," because little packets with much of your conversation would have been lost in congestion and could not be retransmitted while working within the delay requirements of voice. Hence, packet loss with VoIP can cause big chunks of a conversation to be lost. (We will talk about ways to resolve that a little later in this chapter.)

VoIP gateways have allowed IP telephony applications and new, innovative VoIP applications to move into the mainstream. Other features that have helped the development of VoIP are Internet telephony directory, media gateways, and softswitches, as well as telephony signaling protocols.

VoIP Gateways

VoIP gateways bridge the traditional circuit-switched PSTN and the packet-switched Internet. Gateways overcome the addressing problem. A couple years ago, for two VoIP users to communicate, they had to be using the same software, they had to have sound cards and microphones attached to their PCs, and they had to coordinate a common time during which both would be online in order to engage in a VoIP session. Gateways have made all that unnecessary, and now the only requirement is that you know the user's phone number. Phone-to-PC or PC-to-phone operation requires the use of only one gateway. Phone-to-phone operation requires two gateways, one at each end.

VoIP gateway functionality includes packetizing and compressing voice; enhancing voice quality by applying echo cancellation and silence suppression; dual-tone multifrequency (DTMF) signaling support (that is, touch-tone dialing); routing of voice packets; authentication of users; address management; administration of a network of gateways; and the generation of call detail records that are used to create bills and invoices.

To place a call over a VoIP network, the customer dials the number the same way as on a traditional phone. The edge device, the VoIP gateway, communicates the dialed number to the server, where call-agent software—that is, a softswitch—determines what is the appropriate IP address for that destination call number and returns that IP address to the edge device. The edge device then converts the voice signal to IP format, adds the given address of the destination node, and sends the

signal on its way. If enhanced services are required, the softswitch is called back into action to perform the additional functions. (The softswitch is also referred to as a Class 5 agent because it behaves like a local exchange or a Class 5 office.)

There are two primary categories of VoIP gateways:

- **Gateways based on existing router or remote access concentrator (RAC) platforms**—The key providers here include the traditional data networking vendors, such as 3Com, Cisco, Lucent, and Motorola. As incumbent equipment suppliers to ISPs, the data networking vendors are capturing the largest percentage of these sales. They represented the majority of VoIP gateway sales through 2000 because ISPs were buying gateways at a fast rate based on the significant wholesale opportunity available to larger carriers.
- **Server-based gateways**—These are designed from the ground up to support VoIP. Key providers of server-based gateways include telecommunications vendors, as well as companies specifically designed for this business; Clarent, Ericsson, Lucent, NetSpeak, Nortel, Nuera, and VocalTec are among the vendors involved. These gateways will overtake router and RAC solutions as incumbent carriers deploy more server-based gateways with extensive call server and signaling capabilities.

More and more merger and acquisition activities will lead to blended solutions, causing the distinction between the different types of gateways to blur. RAC- and router-based gateways will take on more enhanced call-server characteristics as a result. The market segments for the two categories, then, are composed of the following:

- **Enterprise VoIP gateways**—These gateways are customer premise equipment deployed between a PBX and a WAN device, typically a router, to provide call setup, call routing, and conversion of voice into IP packets and vice versa.
- **VoIP routers**—Voice cards perform packetization and compression functions and are inserted into a router chassis. The router then directs the packets to their ultimate destination.
- **IP PBXs**—An IP PBX is an infrastructure of distributed telephony servers that operates in packet-switched mode and offers the benefits of statistical multiplexing and IP routing. We are still in the early days for IP PBXs, although they are beginning to emerge as a viable alternative. A key concern is reliability. (IP PBXs are discussed in more detail later in this chapter.)
- **Service-provider VoIP gateways**—These are used to aggregate incoming VoIP traffic and route the traffic accordingly. The role is analogous to that of the local exchange. Challenges include the local loop competition among the incumbent carriers, quality concerns, shortage of product, interoperability

issues, the lack of hot-swappable and redundant support, and the lack of Network Equipment Building Systems (NEBS) compliance.

- **VoIP access concentrators**—VoIP cards fit into an existing dial access concentrator.
- **SS7 gateways**—SS7 gateways are critical to enabling us to tap into the intelligence services that enhance so much of the telephony activity on the PSTN.

There are many gateway vendors. All gateway vendors share the need for digital signal processors and embedded software solutions that provide for silent suppression, echo cancellation, compression and decompression, DTMF signaling, and packet management. Therefore, another very important part of this equation is the component vendors. Manufacturers of VoIP equipment need to continue to make quality improvements in the underlying technology. This includes addressing interoperability between different gateway vendors' equipment; improving the tradeoffs between cost, function, and quality; and introducing single-stage dialing and the ability to dial from any telephone.

Internet Telephony Directory

An Internet telephony directory is a vital piece of the VoIP puzzle, so this section talks a little bit about the IETF Request for Comment 2916, also known as ENUM services. ENUM services convert telephone numbers into the Internet address information required to support all forms of IP-enabled communication services, including real-time voice, voicemail, fax, remote printing, and unified messaging. In other words, ENUM is a standard for mapping telephone numbers to IP addresses. DNS translates URLs to IP addresses, and EMUM uses the DNS to map a PSTN phone number (based on the E.164 standard) to the appropriate URLs.

ICANN is considering three proposals for the .tel domain. The applicants are NetNumber, which currently runs the Global Internet Telephony Directory (an implementation of ENUM that is used by IP-enabled platforms to convert standard telephone numbers into Internet address information), Number.tel, and Telnic based in the United Kingdom. The ITU is trying to advance an implementation of the IETF ENUM standard under the domain e164.arpa. In this implementation, control of telephone number addressing on the Internet would be distributed to the more than 240 national public network regulatory bodies that administer telephone numbers for the PSTN.

Media Gateways

Media gateways provide seamless interoperability between circuit-switched, or PSTN, networking domains and those of the packet-switched realm (that is, IP, ATM, and Frame Relay networks). They interconnect with the SS7 network and enable the

handling of IP services. They're designed to support a variety of telephony signaling protocols. Media gateways are designed to support Class 4, or toll-switch, functions, as well as Class 5, or local exchange, services. They operate in the classic public network environment, where call control is separate from media flow. They support a variety of traffic—including data, voice, fax, and multimedia—over a data backbone. Enhanced applications of media gateways include network conferencing, network-integrated voice response, fax serving, network, and directory services.

As shown in Figure 11.12, media gateways fit between the access and core layers of the network, and they include several categories: VoIP trunking gateways, VoIP access gateways, and network access service devices. They provide service interconnection or intercarrier call handling. The trunking gateways interface between the PSTN and VoIP networks, terminating trunks associated with SS7 control links. These Time Division Multiplexed trunks carry media from an adjacent switch in the traditional circuit-switched network, and the adjacent switch generally belongs to another service provider. (Depending on the agreements between service providers, these are also referred to as cocarrier trunks or feature group D trunks.) The trunking gateways manage a large number of digital virtual circuits. The access gateways provide traditional analog or ISDN interfaces to the VoIP networks; they are devices that terminate PSTN signaling and media, and they connect to PBXs, as well as to traditional circuit switches, such as the Class 5 and Class 4 offices. With network access servers, you can attach a modem to a telephone circuit

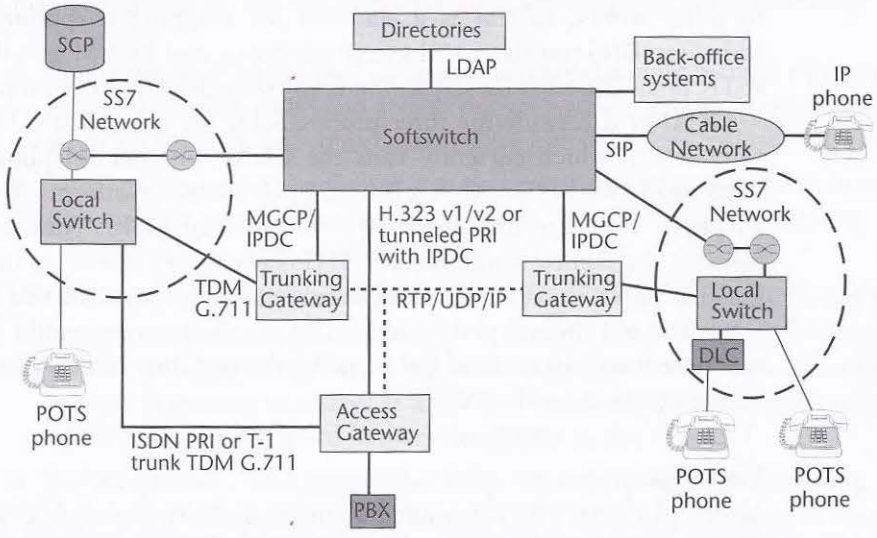

Figure 11.12 VoIP network architecture

and provide data access to the Internet, so that you can attain managed modem service by using cocarrier trunks.

VoIP Softswitches

Call-control intelligence is outside the media gateways and VoIP gateways; it is, instead, handled by a *softswitch*, also referred to as a *media gateway controller* or *call agent*. The softswitch implements the service logic. It controls external trunking gateways, access gateways, and remote access servers. Softswitches run on commercial computers and operating systems, and they provide open application programming interfaces.

A softswitch is a software-based, distributed switching and control platform, and it controls the switching and routing of media packets between media gateways, across the packet backbone. Softswitches provide new tools and technologies to build services in a more productive Internet-based service creation environment. Operators are advised to adopt a "service separation" strategy and to distribute applications throughout the network, avoiding the monolithic closed system that is similar to the circuit-switched environment. We can use application servers to partition enhanced telecommunications services and to determine what interface protocol to select for facilitating interoperability between the softswitches and the applications servers.

The softswitch functionally controls the voice or data traffic path by signaling between media gateways that actually transport the traffic (see Chapter 10). The gateway provides the connection between an IP or ATM network and the traditional circuit-switched network, acting a lot like a multiprotocol cross-connect. The softswitch ensures that a call's or a connection's underlying signaling information—automatic number identifiers, billing data, and call triggers—are communicated between the gateways. Softswitches must reuse intelligent network services through an open and flexible directory interface, so they provide a directory-enabled architecture with access to relational database management systems, and to Lightweight Directory Access Protocol (LDAP) and Transaction Capabilities Applications Part (TCAP) directories. Softswitches also offer programmable back-office features, along with advanced policy-based management of all software components.

The softswitch is a very important element in the new public network. It is what enables the media and trunking gateways to communicate with the underlying infrastructure of the PSTN and thereby to draw on the service logic needed to support telephony activities. In addition, softswitches will be able to reach to new application servers on which new generations of applications have been designed for new versions of enhanced services.

Telephony Signaling Protocols

New generations of signaling and IP telephony control protocols are emerging, and their purpose is to control the communication between the signaling gateway

and IP elements. Since the early days of exploring the nature of VoIP and creating devices to enable it, a number of telephony signaling protocols have been considered. Some of the contenders have been H.323, Internet Protocol Device Control (IPDC), Signal Gateway Control Protocol (SGCP), Multimedia Gateway Control Protocol (MGCP), Multimedia Gateway Control (MEGACO), Session Initiation Protocol (SIP), and IP Signaling System 7 (IPS7). Many of those contenders have combined, so this section focuses on the ones that have the strongest presence and potential today.

H.323 The ITU H.323 version 2 specification is based on ISDN standards and limited to point-to-point applications. Version 2 requires multipoint control units (MCUs) to manage multiple sessions. H.323 version 2 provides much of the foundation for exchange of voice and fax messages. The advantage of H.323 is that it is the most mature of the telephony signaling protocols, so many vendors offer it and vendor interoperability is good. On the other hand, H.323 is not as robust as some of the newer entrants, so other protocols on the horizon might eclipse H.323 before too long.

MCGP Bellcore and Level 3 merged their respective SGCP and IPDC specifications into MCGP. In MCGP, softswitches provide the external control and management, so MCGP is becoming a good way to connect an IAD to a gateway.

MEGACO MEGACO is also called H.248 and it is another emerging ITU standard. MEGACO describes how the media gateway should behave and function.

SIP SIP (IETF Request for Comment 2543) is an application-layer control, or signaling protocol, for creating, modifying, and terminating sessions with one or more participants. SIP is used to set up a temporary session, or call, to the server so that the server can execute the necessary enhanced service logic. These sessions may include Internet multimedia conferences, Internet telephony, or multimedia distribution. Linking caller ID to Web page content can link the status of a mobile phone with instant messaging. Members in a session can communicate via multicast or via a mesh of unicast relations, or by a combination of these. This is increasingly popular as the protocol between softswitches and application servers.

LDAP LDAP is the standard directory server technology for the Internet. LDAP enables retrieval of information from multivendor directories. In fact, LDAP 3.0 provides client systems, hubs, switches, routers, and a standard interface to read and write directory information. Directory-oriented services best suited for an LDAP lookup include unified messaging, free phone (that is toll-free number translation), calling name service, and Internet phone number hosting. Remember

that as the Internet moves forward, it must connect with the underlying intelligence in the PSTN.

IPS7 The SS7 network acts as the backbone for the advanced intelligent network. SS7 provides access to all the advanced intelligent network features, allows for efficient call setup and teardown, and interconnects thousands of telephony providers under a common signaling network. The capability to communicate with the SS7 network is essential for all service providers. It gives next-generation local exchange carriers access to an existing base of service features, and it ensures that packet-based telephony switching gateways can support key legacy service and signaling features. The interconnection between a legacy circuit switch provider, such as the incumbent local exchange carrier, and a competitive local exchange carrier operated over a packet backbone would include the gateway switch to packetize and digitize the voice coming from the Class 5 office, and the SS7 gateway to provide access into the underlying intelligent network infrastructure. (Chapter 5, "The PSTN," discusses SS7 and next-generation gateway switches in more detail.)

Next-Generation Standards and Interoperability

Next-generation network standards are widely deployed across the globe and are generating billions of dollars in service revenue. Packet-enabled intelligent networks will enhance the revenue stream with new technology to provide intelligent networking services, such as local-number portability, carrier selection, personal numbers, free phone, prepaid call screening, call centers, and voice VPNs. End-to-end, next-generation networks function as seamlessly interoperating wholes; they consist of the legacy-based circuit-switched network, with its underlying SS7 and service logic delivering today's enhanced features, as well as a packet-based network for transport efficiencies that can also be served by new-generation IP servers and enhanced applications, for features we haven't yet thought of.

There are a few key groups to be aware of in the area of standards and interoperability for next-generation networks. There's iNOW!, which stands for Interoperability NOW!, and its members include Ascend, Cisco, Clarent, Dialogic, Natural MicroSystems, and Siemens. These members will interoperate also with Lucent and VocalTec, as well as each other. iNOW! advocates interoperability and certification based on H.323.

The Technical Advisory Committee (TAC), formed by Level 3 Communications, includes 3Com, Alcatel, Ascend, Cisco, Ericsson, Level 3, and others.

The International Softswitch Consortium is focused on enabling softswitch technology and applications on an IP infrastructure. This group advocates interoperability and certification based on H.323, SIP, MGCP, and Real-Time Transfer Protocol (RTP). It is working to develop and promote new standardized interfaces for

portable applications, which ride on top of an IP-based softswitch network. The International Softswitch Consortium has more than 68 member companies.

Finally, the Multiservice Switching Forum (MSF) is an open-membership organization committed to developing and promoting implementation agreements for ATM-capable multiservice switching systems. The goal of MSF is to develop multiservice switching with both IP- and ATM-based services, and its founding members are WorldCom, Cisco Systems, Telcordia, AT&T, Alcatel, Lucent, British Telecom, Fujitsu Network Communications, Lucent Technologies, Nortel Networks, Siemens, Telecom Italia, Telia AB, and Qwest.

IP PBXs

IP PBXs are in the very early stages, and they will present some benefits as well as some challenges. Companies can take advantage of IP-based intranets that have been set up between headquarters and remote locations to cost-effectively integrate voice and data traffic. The key strength of IP PBXs is their capability to network over existing IP networks. Because the information is programmed into the phone, phones can be relocated by simply unplugging and moving them. It is also easier to network over existing IP WANs, as long as there is adequate bandwidth to support voice traffic.

Among the challenges to the convergence of IP PBXs is that we expect them to provide high reliability and high availability, which we always require with telephony. Telephony-grade servers are classified as fault tolerant when they achieve 99.99% (that is, four nines) survivability. The standard for most PBX voice systems is 99.999% (that is, five nines), so four nines is quite a bit less than what we're accustomed to. The industry is slowly embracing Windows NT and Windows 2000 for core call processing, but some feel that these products are not reliable enough in their current form. To be fair, research on NT stability and security shows that almost always the problems are a result of poor or improper administrative procedures, not a result of problems in the operating system itself. As NT administrators have gained operational experience, the reliability and security of Windows-based data centers has improved. In summary, customer concerns include security, reliability, survivability, operability, maintainability, and accountability.

Another important issue related to IP PBXs is power distribution. PBXs have internal power distribution plants to support processing memory and internal interface circuit cards. All analog and proprietary digital telephones are line powered by the centralized PBX, using standard unshielded twisted-pair (UTP) wiring. Larger PBXs often have redundant power conversion and distribution elements throughout the cabinet design, and fluctuations in power—such as spikes and surges—are also regulated by the PBXs. Although there are Ethernet switches that can deliver power to the desktop via Category 5 cabling, they are just being introduced, and standards have not yet been developed for this.

Voice quality is another big issue with IP PBXs. The voice quality delivered over an IP PBX has to match that of the PSTN, so VoIP systems will need to meet stringent technical requirements to manage delay and echo, which are affected by the amount of compression and the type of codec used, as well as by the QoS capabilities of the underlying transport network. Voice quality will become a new performance variable, with various levels available and reflected in the pricing of services.

Another issue related to IP PBXs is network QoS. Voice QoS must remain adequate when it shares the network with bandwidth-intensive data applications. Packet loss must be minimized, and latency must be reduced. We still need to figure out how much voice traffic the data network can accept before voice, data, and video start to degrade.

Features and functionality are other issues. PBXs in general have 400 to 500 features, whereas IP phone systems provide only about 100 features.

There are also issues surrounding distance limitations. Fast Ethernet Category 5 cabling is limited to distances of 330 feet (100 meters), whereas PBXs support analog phone extensions over UTP at up to 2 miles (3.5 kilometers) and proprietary digital phones at up to 1 mile (1.5 kilometers).

Another issue is the lack of management systems. Systems designed to accommodate moves, adds, and changes, as well as troubleshooting, need to be developed.

There are also security questions (for example, Will voice over the LAN demand encryption of voice traffic?) and issues related to legacy voice investments (that is, enterprises generally protect investments in their existing equipment). Finally, we face a lack of a really compelling value proposition. However, PBXs are migrating toward a future in which IP-based packet transport will replace circuit-switched Time Division Multiplexing.

This market is poised for major change in the next several years. PBXs are migrating toward telephony server models, in which a nonproprietary platform will perform the call control and feature provisioning. But these are still the early days. Through integration, we will eventually have a much more cost-efficient platform for network services.

The Future of VoIP

VoIP is very important, and it's part of a larger application set that enables the integration of voice, video, data, and images. It is the early days for VoIP as well. Today, VoIP accounts for only a very small amount of global voice traffic. With VoIP we face issues of interoperability, scalability, and the number of features that can be supported. We face issues of whether the incumbents are motivated to replace all Class 5 exchanges with next-generation telephony. IP QoS is still immature, as these are the early days.

■ Multimedia on the Internet: Streaming Media

There's such a wide variety of applications for multimedia on the Internet that we're only just beginning to consider where and how we can use visualization and other sensory information. There are three major categories of multimedia on the Internet: communications applications (including VoIP, video telephony, and video and multimedia conferencing applications), computer applications (including interactive rich media, videomail, and streaming audio, video, and media content), and entertainment applications (including broadcast video, video-on-demand, and network games). This section concentrates on streaming media, and in Chapter 15, "The Broadband Home and HANs," we'll explore the fantastic future of smart devices and sensory networks.

Streaming Media Trends

Most streaming audio and video on the Internet today (for example, music, ads) is entertainment or consumer oriented. Many companies are now also beginning to use streaming media as a business tool. For example, I offer e-learning solutions on a streaming basis.

The appeal of streaming media is evident: Audio and video grab people's attention and can quickly present information that is easy to absorb and retain. Streaming media also allows for novel ways to reach clients, employees, and prospective customers. Audio and video are highly effective in sales and marketing, advertising, corporate communications, motivation, training, instruction, and customer support. Businesses realize gains in revenues and greater efficiencies and decreased costs for information delivery by turning to streaming media. By getting audio and video content in front of an audience, you can charm that audience, but it is costly and can be difficult. Downloading big files is time-consuming. Video file sizes run into the tens of megabytes, and a 5-minute video can be as large as 55MB. Audio files are often several megabytes.

Streaming is the solution to the problem of downloading large media files. Using a streaming media player, such as Apple's QuickTime, Microsoft's Windows Media Player, or RealNetworks's RealAudio and RealVideo, a user can play audio and/or video within seconds after the first bits of the stream hit the user's computer. These players support both live Internet broadcasts and video-on-demand, in which the streaming server keeps a copy of the content so that clients can request it at any time. Millions of people access some form of streaming content—audio or video—every day, and the number of streams available on the Internet is growing phenomenally. With all these people using streaming media and so many streaming media offerings available, streaming search technology is an emerging requirement in next-generation networks.

Streaming Media Applications

There are many applications for streaming media. Streaming media can be used as a novel way to reach and communicate with employees, clients, and partners. And streaming media is becoming more and more necessary where you need to respond to regulations that require a full disclosure or a method for informing a very wide audience. Another key application is virtual roadshows, such as pre-IPO presentations to potential investors. Product demonstrations are a very strong application of streaming media (for example, launches and rollouts of new products, virtual education and training). Some of the key customers for streaming media at this point are entertainment, financial institutions, health care, and education.

With streaming media, the content provider must digitize the content and set up a server that is specific to the client. The provider's total hardware and software costs are typically only in the thousands of dollars per streaming server. All the client needs is the player software, which is free or very inexpensive, and a sound card. Companies that offer Web hosting and streaming media services, however, need to make sure that they address network latencies, bandwidth management, digital rights management, billing systems, ad insertion, player licenses, and storage space. Again, we are in the early stages with streaming media, but it is certainly going to be a very important area.

Streaming Media on the Internet

Streaming media on the Internet today suffers because of restricted bandwidth (which makes the video jerky), poor reliability in the network (resulting in missing frames or dropouts in the audio), a lack of QoS in the network (which causes various types of distortions or artifacts in the video and audio), and packet loss at Internet peering points (ranging up to 40% during peak traffic hours, which is when key problems occur). These factors are being addressed, however; therefore, streaming media has great potential in the business realm.

Businesses have spent billions of dollars on streaming media, and they are expected to spend billions each year in the next several years. Businesses are seeking content conversion or capture, hardware and software infrastructure, network access and transport services, and other services, such as installation and support. Entertainment and consumer-oriented uses of streaming media are also huge. Streaming media is becoming fundamental to the way corporations, as well as individuals, communicate. Software and service providers are addressing three basic problems: delivery, performance monitoring, and content management.

Streaming Media Delivery

Edge caching has gained considerable momentum as a solution to the peering point problem. With edge caching, Web content is duplicated on a machine close

to the end user the first time the user requests the content. Subsequent requests for this content, then, are satisfied from the nearby machine. This improves the speed and reliability of access because it avoids the Internet backbone and its peering points. Providers of edge caching include CacheFlow, InfoLibria, Inktomi, Network Appliance, and Novell.

In addition to edge caching, other techniques can be applied, such as hop-by-hop retransmission. This minimizes latency and increases the usefulness of retransmission for real-time broadcasts. With hop-by-hop retransmission, an intermediate device retransmits, so the retransmission travels a shorter path over a fewer number of hops and is therefore less delayed.

Application-layer multicasting is another technique. It ensures that just one stream goes across the backbone whenever possible. It is similar to IP multicasting, but it occurs at the application layer. FastForward Networks provides such solutions.

Streaming Media Performance Monitoring

Streaming content is vulnerable to fluctuations in bandwidth and QoS. The user's experience is closely correlated with metrics such as throughput, jitter, and dropped packets. Streaming applications require performance monitoring systems and services that track such measurements. Key providers in this realm include Mercury Interactive and WebHancer.

Streaming Media Content Management

Content management is another issue that is related to streaming media. Companies that regularly stream content need a system for making the content searchable and navigable by creating metadata that indexes it. Metadata is then stored on an application server, and the video is stored on a video server. Multimedia data search systems are automated software tools that analyze video, comparing each frame to known images and computing image similarity. They also create and index a voice-to-text transcription. Convera Corporation (which is a joint venture between Intel and Excalibur Technologies), Taalee, Virage, and WordWave are key providers of multimedia data search systems.

ISPs will look to offer new types of visually enabled services as a way to make up for reduced connection-fee revenue. Other organizations will look for ways to blend video with Web sites or portals, to improve the way they disseminate information, and to provide enhanced customer interaction. We can expect to see visually enabled call centers, visually enabled help desks, visual virtual meeting rooms, visual chat rooms, and visually enabled e-commerce.

Real-time interactive visual communications have been available for some time, but to date only niche markets (for example, distance learning, telemedicine, and corporate video conferencing) have seen their benefits and adopted their use.

Broadband Internet access with QoS is required for streaming media, and as it becomes more widely available in the near future, we will see many more adopters of this technology. Chapter 10 further discusses the demands of real-time visual streams and related QoS issues.

For more learning resources, quizzes, and discussion forums on concepts related to this chapter, see www.telecomessentials.com/learningcenter.

INTERNATIONAL TELECOMMUNICATION UNION

ITU-T E.164

(05/97)

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

SERIES E: OVERALL NETWORK OPERATION, TELEPHONE SERVICE, SERVICE OPERATION AND HUMAN FACTORS

Operation, numbering, routing and mobile services – International operation – Numbering plan of the international telephone service

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The international public telecommunication numbering plan

ITU-T Recommendation E.164

(Previously CCITT Recommendation)

ITU-T E-SERIES RECOMMENDATIONS

OVERALL NETWORK OPERATION, TELEPHONE SERVICE, SERVICE OPERATION AND HUMAN FACTORS

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For further details, please refer to ITU-T List of Recommendations.

ITU-T RECOMMENDATION E.164

THE INTERNATIONAL PUBLIC TELECOMMUNICATION NUMBERING PLAN

Summary

This Recommendation provides the number structure and functionality for the three categories of numbers used for international public telecommunication – they are geographic areas, global services and Networks. For each of the categories, it details the components of the numbering structure and the digit analysis required to successfully route the calls. Annex A provides additional information on the structure and function of E.164 numbers. Annex B provides information on network identification, service parameters, calling/connected line identity, dialling procedures and addressing for geographic-based ISDN calls. Specific E.164-based applications which differ in usage are defined in separate Recommendations.

Source

ITU-T Recommendation E.164 was revised by ITU-T Study Group 2 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 26th of May 1997.

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

INTELLECTUAL PROPERTY RIGHTS

The ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. The ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, the ITU had/had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

Recommendation E.164

THE INTERNATIONAL PUBLIC TELECOMMUNICATION NUMBERING PLAN

(revised in 1997)

1 Introduction

The rapid advances in telecommunication technology coupled with increased diversification of customer demands served by a number of different types of dedicated public switched networks (telephone, telex, data, etc.) have created a need to provide a uniform customer access to the multitude of network structures (i.e. ISDN, IN, etc.). Implementation of these network architectures has begun in a number of countries and eventually these will be able to carry the full range of existing and new services.

To provide a broad base for these new arrangements, numbering has been kept compatible with that originally established for international telephone service. As covered in this Recommendation, numbering for ISDN and the international telephone service are an integral part of this international telecommunication numbering plan.

2 Scope

This Recommendation provides the number structure and functionality for the three categories of numbers used for international public telecommunication – they are geographic areas, global services, and Networks. For each of the categories, it details the components of the numbering structure and the digit analysis required to successfully route the calls. Annex A provides additional information on the structure and function of E.164 numbers. Annex B provides information on network identification, service parameters, calling/connected line identity, dialling procedures and addressing for geographic-based ISDN calls. Specific E.164-based applications which differ in usage are defined in separate Recommendations, e.g. Recommendation E.168 – Application of E.164 numbering plan for UPT.

3 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of the publication, the editions indicated were valid. All Recommendations and other references are subject to revision. All users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendation and other references listed below. A list of the current valid ITU-T Recommendations is regularly published.

– CCITT Recommendation E.123 (1988), *Notation for national and international telephone numbers*.

– CCITT Recommendation E.131 (1988), *Subscriber control procedures for supplementary telephone services*.

– ITU-T Recommendation E.164.1[1], *Criteria and procedures for the assignment of E.164 country codes and associated identification codes*.

– CCITT Recommendation E.165 (1988), *Timetable for coordinated implementation of the full capability of the numbering plan for the ISDN era (Recommendation E.164)*.

– ITU-T Recommendation E.165.1 (1996), *Use of escape code "0" within the E.164 numbering plan during the transition period to implementation of NPI mechanism*.

[1] Presently at the stage of draft.

– ITU-T Recommendation E.166/X.122 (1996), *Numbering plan interworking for the E.164 and X.121 numbering plans*.

– ITU-T Recommendation E.168 (1993), *Application of E.164 numbering plan for UPT*.

– ITU-T Recommendation E.169 (1996), *Application of Recommendation E.164 numbering plan for universal international freephone numbers for international freephone service*.

– ITU-T Recommendation E.190 (1997), *Principles and responsibilities for the management, assignment and reclamation of E-Series international numbering resources*.

– ITU-T Recommendation E.191 (1996), *B-ISDN numbering and addressing*.

– CCITT Recommendation E.213 (1988), *Telephone and ISDN numbering plan for land mobile stations in Public Land Mobile Networks (PLMN)*.

– CCITT Recommendation E.214 (1988), *Structure for the land mobile global title for the Signalling Connection Control Part (SCCP)*.

– CCITT Recommendation E.331 (1991), *Minimum user-terminal interface for a human user entering address information into an ISDN terminal*.

– CCITT Recommendation I.330 (1988), *ISDN numbering and addressing principles*.

4 Definitions

Within the integrated service environment, the terms used for all networks and services must be compatible and consistent. This Recommendation defines the following terms.

4.1 number

F: *numéro*
S: *número*

A string of decimal digits that uniquely indicates the public network termination point. The number contains the information necessary to route the call to this termination point.

A number can be in a format determined nationally or in an international format. The international format is known as the International Public Telecommunication Number which includes the country code and subsequent digits, but not the international prefix.

4.2 numbering plan

F: *plan de numérotage*
S: *plan de numeración*

A numbering plan specifies the format and structure of the numbers used within that plan. It typically consists of decimal digits segmented into groups in order to identify specific elements used for identification, routing and charging capabilities, e.g. within E.164 to identify countries, national destinations, and subscribers.

A numbering plan does not include prefixes, suffixes, and additional information required to complete a call.

The national[2] numbering plan is the national implementation of the E.164 numbering plan.

[2] For the purposes of this Recommendation, national is defined as a country, group of countries, global service or Network.

4.3 dialling plan

F: *plan de numérotation*
S: *plan de marcación*

A string or combination of decimal digits, symbols, and additional information that defines the method by which the numbering plan is used. A dialling plan includes the use of prefixes, suffixes, and additional information, supplemental to the numbering plan, required to complete the call.

4.4 address

F: *adresse*
S: *dirección*

A string or combination of decimal digits, symbols, and additional information which identifies the specific termination point(s) of a connection in a public network(s) or, where applicable, in interconnected private network(s).

4.5 prefix

F: *préfixe*
S: *prefijo*

A prefix is an indicator consisting of one or more digits, that allows the selection of different types of number formats, networks and/or service.

4.6 international prefix

F: *préfixe international*
S: *prefijo internacional*

A digit or combination of digits used to indicate that the number following is an International Public Telecommunication Number.

4.7 country code (CC) for geographic areas

F: *indicatif de pays pour zones géographiques*
S: *indicativo de país para áreas geográficas*

The combination of one, two or three digits identifying a specific country, countries in an integrated numbering plan, or a specific geographic area.

4.8 national (significant) number [N(S)N]

F: *numéro national (significatif) [N(S)N]*
S: *número nacional (significativo) [N(S)N]*

That portion of the number that follows the country code for geographic areas. The national (significant) number consists of the National Destination Code (NDC) followed by the Subscriber Number (SN). The function and format of the N(S)N is nationally determined.

4.9 national destination code (NDC)

F: *indicatif national de destination (NDC)*
S: *indicativo nacional de destino (NDC)*

A nationally optional code field, within the E.164 number plan, which combined with the Subscriber's Number (SN) will constitute the national (significant) number of the international public telecommunication number for geographic areas. The NDC will have a network and/or trunk code selection function.

The NDC can be a decimal digit or a combination of decimal digits (not including any prefix) identifying a numbering area within a country (or group of countries included in one integrated numbering plan or a specific geographic area) and/or network/services.

4.10 national (trunk) prefix

F: *préfixe (interurbain) national*
S: *prefijo (interurbano) nacional*

A digit or combination of digits used by a calling subscriber, making a call to a subscriber in his own country but outside his own numbering area. It provides access to the automatic outgoing trunk equipment.

4.11 trunk code (TC)

F: *indicatif interurbain (TC)*
S: *indicativo interurbano (TC)*

A digit or combination of digits, not including the national (trunk) prefix, identifying the numbering area within a country (or group of countries included in one integrated numbering plan or a specific geographic area).

The trunk code has to be used before the called subscriber's number when the calling and called subscribers are in different numbering areas. The trunk code is a particular application of NDC.

4.12 destination network (DN) code

F: *indicatif de réseau de destination (DN)*
S: *indicativo de red de destino (DN)*

An optional code field within the E.164 numbering plan which identifies the destination network serving the destination subscriber. It performs the destination network selection function of the NDC. In some instances it can be combined with a trunk code to form the NDC. The DN code can be a decimal digit or a combination of decimal digits (not including any prefix).

4.13 country code (CC) for global services

F: *indicatif de pays pour les services mondiaux*
S: *indicativo de país para servicios mundiales*

A 3-digit Country Code used to identify the global service.

4.14 global service

F: *service mondial*
S: *servicio mundial*

A service defined by the ITU-T, provisioned on the public switched network, to which the ITU-T has assigned a specific country code to enable the provision of that international service between two or more countries and/or integrated numbering plans.

4.15 global subscriber number (GSN)

F: *numéro d'abonné mondial (GSN)*
S: *número de abonado mundial (GSN)*

The number identifying a subscriber for a particular global service.

4.16 country code (CC) for Networks

F: *indicatif de pays pour les Réseaux*
S: *indicativo de país para Redes*

A shared 3-digit Country Code used in combination with an identification code to identify an international Network.

4.17 Network

F: *Réseau*
S: *Red*

Internationally interconnected physical nodes and operational systems operated and maintained by one or more ROAs to provide public telecommunications services. Private networks are not included in this definition. Note that the use of capital "N" in Networks indicates that this definition applies.

4.18 identification code (IC)

F: *code d'identification (IC)*
S: *código de identificación (SC)*

The code subsequent to a shared E.164 country code that uniquely identifies an international Network.

4.19 subscriber number (SN)

F: *numéro d'abonné (SN)*
S: *número de abonado (SN)*

The number identifying a subscriber in a network or numbering area.

4.20 escape code

F: *code d'échappement*
S: *código de escape*

One or more digits which indicate that the digits that follow are from a specific numbering plan which is different from the originating numbering plan.

An escape code can be carried forward through the originating network and can be carried across internetwork and international boundaries. Therefore the digits used for escape codes should be standardized.

5 Abbreviations

This Recommendation uses the following abbreviations.

CC	Country Code
CCITT	International Telegraph and Telephone Consultative Committee
CDLI	Called Line Identity
CLI	Calling Line Identity
COLI	Connected Line Identity
DN	Destination Network
GSN	Global Subscriber Number
IC	Identification Code
IN	Intelligent Network
ISDN	Integrated Services Digital Network
ITU	International Telecommunication Union
ITU-T	International Telecommunication Union – Telecommunication Standardization Sector
NDC	National Destination Code
NPI	Numbering Plan Identifier
N(S)N	National (Significant) Number
NT2	Network Termination 2
PSTN	Public Switched Telephone Network
ROA	Recognized Operating Agency
SA	Sub-Address
SN	Subscriber Number
TC	Trunk Code

TON Type of Number

TSB Telecommunication Standardization Bureau

UIFN Universal International Freephone Number

6 International public telecommunication number structure

This clause identifies three different structures for the international public telecommunication number:

- International public telecommunication number for geographic areas.
- International public telecommunication number for global services.
- International public telecommunication number for Networks.

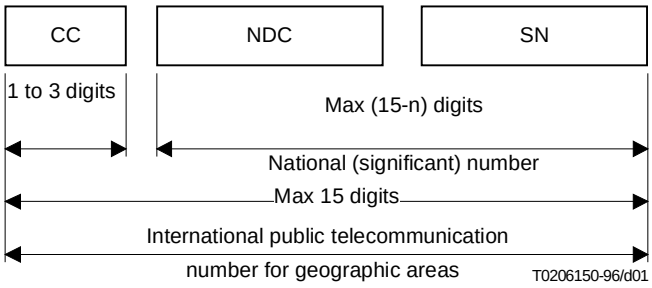
6.1 International public telecommunication number length

The ITU-T recommends that the maximum number of digits for the international geographic, global services, and network applications should be 15 (excluding the international prefix). Administrations are invited to do their utmost to limit the digits to be dialled to the degree possible consistent with the service needs.

6.2 Structure of the international public telecommunication number

6.2.1 The international public telecommunication number for geographic areas (Figure 1) is composed of a variable number of decimal digits arranged in specific code fields. The international public telecommunication number code fields are the Country Code (CC) and the National (Significant) Number N(S)N .

Figure 1 shows the international public telecommunication number structure for geographic areas.



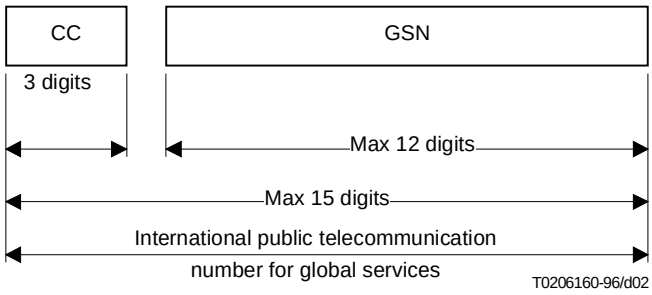
CC Country Code for geographic areas
NDC National Destination Code (optional)
SN Subscriber Number
n Number of digits in the country code

NOTE – National and international prefixes are not part of the international public telecommunication number for geographic areas.

Figure 1/E.164 – International public telecommunication number structure for geographic areas

6.2.2 The international public telecommunication number for global services (Figure 2) is composed of decimal digits that vary depending on the specific service. The international service number code fields are the 3-digit country code and the Global Subscriber Number (GSN).

Figure 2 shows the international public telecommunication number structure for global services. The use of this format is service specific and is dependent on the numbering requirements as detailed in the appropriate Recommendation, e.g. Recommendation E.169 – Application of Recommendation E.164 numbering plan for universal international freephone numbers for international freephone service.



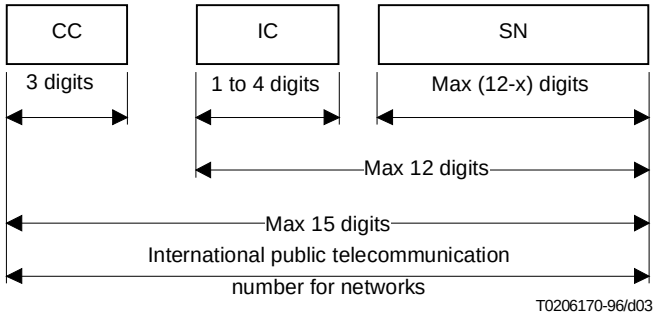
CC Country Code for Global Services
GSN Global Subscriber Number

NOTE – National and international prefixes are not considered to be part of the international public telecommunication number for global services.

Figure 2/E.164 – International public telecommunication number structure for global services

6.2.3 The international public telecommunication number for Networks (Figure 3) is composed of decimal digits arranged in three code fields. The code fields are the 3-digit shared Country Code (CC) field, the IC field, which varies in length between 1 to 4 digits, and the Subscriber Number (SN) which can be up to 15 minus the number of digits in the CC and IC fields.

Figure 3 shows the international public telecommunication number for Networks.



CC Country Code for Networks
IC Identification Code
SN Subscriber Number
x Number of digits in Identification Code (IC)

NOTE – National and international prefixes are not part of the international public telecommunication number for Networks.

Figure 3/E.164 – International public telecommunication number structure for Networks

6.3 Assignment of Country Codes (CCs)

6.3.1 Country codes may be assigned to either geographic areas, global services or shared among Networks.

6.3.2 The status of country codes for geographic areas, global services, and Networks is published periodically by the TSB.

6.3.3 All spare country codes will be assigned on a three-digit basis.

6.3.4 The assignment and reservation of country codes shall follow the criteria and procedures as defined in Recommendation E.164.1.

6.4 Assignment of Identification Codes

6.4.1 The list of assigned and reserved identification codes with their associated country codes is published periodically by the TSB.

6.4.2 The assignment and reservation of identification codes shall follow the criteria and procedures as defined in Recommendation E.164.1.

7 International public telecommunication number for geographic areas

Principles, criteria and procedures for the assignment of international public telecommunication numbers for geographic areas may be found in Recommendations E.190 and E.164.1.

7.1 Country Code for geographic areas

The Country Code is used to select the destination country[3] and varies in length from 1 to 3 digits.

7.2 National (significant) number

7.2.1 The ITU-T recommends that the maximum number of digits of the National (Significant) Number, N(S)N, should be equal to 15-*n*, where *n* is the number of digits of the country code.

7.2.2 The N(S)N is used to select the destination subscriber. In selecting the destination subscriber, however, it may be necessary to select a destination network. To accomplish this selection, the N(S)N code field comprises a National Destination Code (NDC) followed by the Subscriber's Number (SN). The NDC and SN may be inseparably connected in some national applications to form a single composite dialling sequence.

7.2.3 The NDC field, if used, will be variable in length depending upon the requirements of the destination country. Each NDC may have one of the following structures:

a) a Destination Network (DN) code, which can be used to select a destination network serving the destination subscribers;

b) a Trunk Code (TC);

c) any combination of Destination Network (DN) code and Trunk Code (TC).

The NDCs of an Administration may consist of one of the above structures or others as defined by national Administrations.

NOTE – The sequences DN-TC and TC-DN are a national matter. The various NDC options (TC/DN) are reflected in Figure 4.

7.2.4 The SN varies in length depending on the requirements of the destination country.

7.2.5 Where appropriate, identification of a specific network within the destination country shall be through the use of a NDC incorporated in the public telecommunication number.

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[3] Whenever the term country, destination country or originating country is used in this subclause, it identifies a specific country, a group of countries in an integrated numbering plan or a specific geographical area.

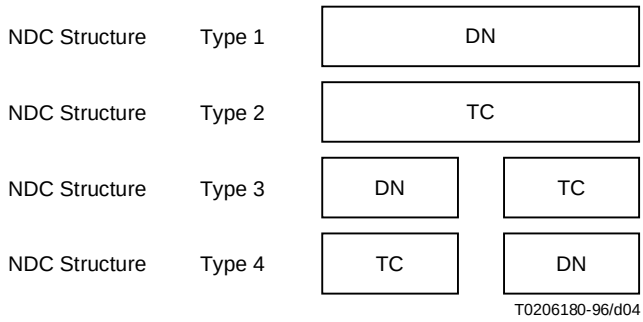

Figure 4/E.164 – Options for NDC structure

7.3 Prefixes

7.3.1 Applications

A prefix is an indicator consisting of one or more digits that allows the selection of different types of number formats, networks and/or service. Prefixes are not part of the number and are not signalled over international boundaries. It is a national matter to decide whether prefixes can be signalled between domestic networks.

Prefixes can also be used for carrier network and service selection nationally.

7.3.2 National (trunk) prefix

The national (trunk) prefix is not included in N(S)N. Accordingly, in the international service, the national (trunk) prefix of the country of destination must not be dialled.

It should be noted that, in some countries, it is customary to consider for national purposes that the national (trunk) prefix is included in the national number which is then not the N(S)N. A careful distinction must therefore be made between such national definition or practice and the ITU-T definition, which is internationally valid. In order to avoid misunderstanding, the ITU-T definition includes the word "significant" between brackets, reading as follows: "national (significant) number".

It is recommended by the ITU-T that the Administrations of countries that have not yet adopted a trunk prefix for access to their national automatic trunk network adopt a prefix composed of a single digit, preferably 0. Irrespective of what digit is adopted as a trunk prefix, this digit should be precluded from being used also as a first digit of the N(S)N.

The reasons for this recommendation are:

– to provide the maximum degree of standardization of the national (trunk) prefixes used in different countries, so that dialling is made as easy as possible for a person travelling from one country to another;

– to minimize the number of digits to be dialled;

– to reduce user problems which arise because of the requirement, in automatic international operation, that the trunk prefix of the country of destination must not be dialled.

In the automatic international service, following the international prefix and country code of the called country, the caller should dial the N(S)N of the called subscriber [i.e. without dialling the national (trunk) prefix].

The use and printing of symbols and separators in national and international telephone numbers are detailed in Recommendation E.123.

7.4 National numbering plan

7.4.1 Characteristics of national numbering plan

Each Administration should give the most careful consideration to the preparation of a national numbering plan for its own network. This plan should be designed:

a) to allow generous provision for future growth in the number of subscribers and services to the national system;

b) with the consideration that the national network will ultimately be accessible to subscribers in other countries by means of international dialling procedures;

c) so that subscribers would always be called by either the same N(S)N or SN, a national matter, regardless of where the call originated from within the national numbering plan.

The numbering plan will be based on and evolve from the existing numbering plans applicable to national and international public telephone networks.

Where multiple destinations (i.e. ROAs/networks) serve the called party's geographical area, the national numbering arrangement in the country of destination shall provide for discrimination between these ROAs/networks. The procedure for discrimination between multiple transit ROAs/networks is not considered to be a destination address requirement and shall therefore be excluded from these numbering arrangements.

The ten-digit decimal character set 0-9 is used throughout the numbering plan format including subscriber number, national (significant) number and the country code.

Prefixes and other information concerned with identifying selection procedures or Network Service parameters (such as Quality of Service or transit delay) do not form part of the number.

An integrated numbering plan shall include an unambiguous identification of a particular country. In addition, the number will identify networks within these countries, if required.

7.4.2 Notification of national numbering changes

Administrators should advise the ITU-T, on a non-binding informational basis, of significant national numbering plan changes well in advance of the event, so that this information can be published by the TSB. It is recommended that this notification be submitted at least 2 years in advance to ensure formal and timely information to the widest possible distribution.

Resource administrators are encouraged to inform other resource administrators of significant national numbering plan changes well in advance of its implementation.

7.5 Digit analysis

7.5.1 In order to determine:

– the country of destination;

– the most appropriate network routing;

– the proper charging,

the originating country must analyze a number of digits of the E.164 international number. The length of the National Destination Code (NDC) increases the potential requirement for number analysis because it provides for a combination of either a Trunk Code (TC) and/or a network identification function. Careful consideration should be given to the preparation of the National Destination Code (NDC) assignments.

7.5.2 On international calls the number analysis performed at the originating country need not be more than the country code and:

– four digits of the N(S)N in the case of a country with a three-digit country code;

– five digits of the N(S)N in the case of a country with a two-digit country code;

– six digits of the N(S)N in the case of a country with a one-digit country code.

Although the potential for seven-digit analysis exists, it is not required for every call. The terminating country will inform the originating country which of the seven dialled digits of the E.164 number will indicate when seven-digit analysis is required. Some Administrations will be able to implement the charging arrangements with seven-digit analysis at the same time as the associated routing. Others may not be able to implement the charging arrangements at the same time; bilateral arrangements should be agreed with these Administrations.

7.5.3 The national numbering plan of a country should be such that digit analysis for incoming international calls need not exceed established limits applicable to the N(S)N but allows:

a) determination of routing that reflects economic and other appropriate network factors;

b) distinctions for charging in those countries where distinctions are applicable.

8 International public telecommunication number for global services

The numbering plan for global services is service specific. Each use of an E.164 country code for a global service needs to comply with numbering assignment principles, as specified in Recommendation E.190, as identified for the specific service, and the criteria and procedures as specified in Recommendation E.164.1. Refer to the appropriate numbering Recommendation for documentation regarding the numbering scheme and any service specific principles, e.g. Recommendation E.168 – Application of E.164 numbering plan for UPT.

The international public telecommunication number for global services is composed of the 3-digit country code applied for the global service and the Global Subscriber Number (GSN). The maximum length is 15 digits (see Figure 2).

8.1 Country Code for global services

The country code for a global service is used to identify the global service and is three digits in length.

8.2 Global Subscriber Number

The Global Subscriber Number (GSN) consists of the digits following the country code for the global service. The structure and functionality of these digits is application dependent and will be addressed in the appropriate global service numbering Recommendations, e.g. Recommendation E.169 – Application of Recommendation E.164 numbering plan for universal international freephone numbers for international freephone service.

8.3 Digit analysis

Digit analysis for global services is service specific. In order to determine the specific global service, and the call routing and charging, the digit analysis should not exceed 7 digits, e.g. 3-digit CC + 4 digits of N(S)N. Refer to the appropriate ITU-T numbering Recommendation for documentation regarding the number analysis requirements for the specific global service.

8.4 Evolution path to an international public telecommunication number for global services

The development of a numbering plan for a global service should consider the possibility for the subscribers, who already have a number for the same comparable domestic service, to evolve their domestic Subscriber Number (SN) to the Global Subscriber Number (GSN).

It is assumed that ITU-T recognized global services will be location independent.

If in the implementation of the global service there are duplicate numbering requests and there are no service specific resolution procedures, then the duplicate request procedures should be invoked as defined in Recommendation E.169 – Application of Recommendation E.164 numbering plan for universal international freephone numbers for international freephone service.

9 International public telecommunication number for Networks

Principles, criteria and procedures for the assignment of international public telecommunication numbers for international Networks may be found in Recommendations E.164.1 and E.190.

International public telecommunication numbers used by Networks consist of three parts: a shared 3-digit E.164 country code; an identification code; and a subscriber number (see Figure 3). The maximum length of international public telecommunication numbers used by Networks is fifteen (15) digits.

9.1 Country Code for Networks

These digits are the first three digits of international public telecommunication numbers for Networks. A country code for networks is a shared combination of 3 digits and is used in combination with the Identification Code to identify networks.

9.2 Identification Code

An Identification Code (IC) is a combination of 1 to 4 digits used for identification of Networks. These digits follow the shared country code field within international public telecommunication numbers for Networks.

9.3 Subscriber Numbers

Subscriber numbers are the remaining digits which follow the shared country code and the IC. The structure and functionality is determined by the network operator. The maximum length of the subscriber number is 15 minus, the total of the CC and IC digits.

9.4 Digit analysis

For calls utilizing the international public telecommunication number for Networks, the maximum number of digits to be analyzed is seven, which includes the three digits of the E.164 country code, the identification code, and the initial significant digits (if any) of the subscriber number. A minimum of the 3-digit country code and IC must always be analyzed to determine the appropriate routing and charging.

10 Escape codes

The use of escape codes shall be in accordance with Recommendation E.166, which describes the use of digit "0" (zero) as an escape code for numbering plan interworking between E.164 and X.121 numbering plans until 31/12/2000 at 2359 UTC.

11 International prefix

It is recommended by the ITU-T that the Administrations of countries that have not yet introduced automatic international operation, or Administrations and international network operators that are, for various reasons, defining or revising their numbering plans, adopt an international prefix (a code for access to the international automatic network) composed of the two digits 00[4].

In accordance with Recommendation E.123, the symbol "+" is recommended to indicate that an international prefix is required.

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[4] Where there is a requirement for further discrimination between international network operators and/or the different network services they provide, the method for accommodating this need is a national matter.

12 Recommendation history

Recommendation E.163, first issue 1964 – revised at all subsequent Plenary Assemblies.

Recommendation E.163 – merged with Recommendation E.164 (see below).

Recommendation E.164, first issue 1984.

Recommendation E.164, second issue 1988.

Recommendation E.164, third issue 1991 – merged with Recommendation E.163.

Recommendation E.164, fourth issue 1997 – incorporates Recommendations E.160 and E.162.

Annex A

Clarification and explanation of the structure and function of E.164 numbers

A.1 Scope

A.1.1 E.164 numbering is the basis for global addressing in fixed and mobile terminal networks. These numbering resources uniquely identify user-network interfaces, e.g. PSTN/ISDN, mobile terminals, and individuals utilizing specific global services, e.g. Universal International Freephone Numbers (UIFNs). Most of the services/subscribers can be addressed directly, but in cases where indirect addressing is used number translation is required, e.g. for UIFNs.

A.1.2 This Annex provides clarification and explanation to the structure and functionality of E.164 numbers. These structures/functions are independent of the technical arrangement to record, charge or route the calls.

A.2 Structure

A.2.1 The international number, which is the foundation of the hierarchy, consists of the country code plus the necessary additional elements (NDC + SN, GSN or IC + SN). The international public telecommunication number exists only at the international level, i.e. the CC and GSN are combined to form a single dialling sequence.

A.2.2 In countries where NDC and SN are combined to form a single dialling sequence or where the NDC does not exist, the local and national levels are integrated and there is no difference between the subscriber number and the national (significant) number.

A.2.3 E.164 numbers have hierarchical structures as shown in Figure A.1.

A.2.4 When in the local level, typically the use of a national (trunk) prefix provides access to the national level, and the use of an international prefix provides access to the international level.

A.2.5 Numbers that only exist in the local, intraNetwork and/or national level are not considered E.164 numbers.

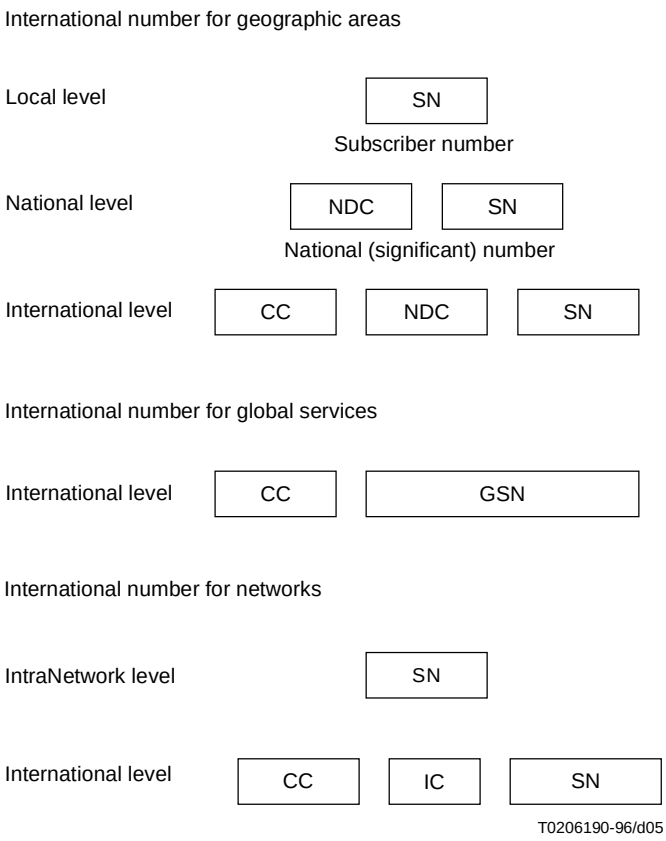
A.3 Number length

A.3.1 International number for geographic areas

A.3.1.1 International numbers for geographic areas have a maximum length of 15 digits.

A.3.1.2 The maximum length of national (significant) numbers is 15 digits minus the length of the country code.

A.3.1.3 The maximum length of subscriber numbers is 15 digits minus the length of the country code and the national destination code.



NDC	National Destination Code
CC	Country Code
IC	Identification Code
SN	Subscriber Number
GSN	Global Subscriber Number

NOTE – IntraNetwork level is used when calling and called parties are within the same network.

Figure A.1/E.164 – Hierarchical structures of E.164 numbers

A.3.2 International number for global services

The maximum length of a global subscriber number is 12 digits since the country code assigned to global services is always 3 digits in length.

A.3.3 International number for Networks

The maximum length of the combined identification code and subscriber number is 12 digits since the country code for networks is always 3 digits in length.

A.3.4 Summary of number length

Table A.1 summarizes the maximum number length on each level for the three categories of international numbers.

Table A.1/E.164 – Maximum number length

Level	Geographic areas	Global services	Networks
Local	15 minus (number of digits in CC + NDC)	NA	NA
National	15 minus (number of digits in CC)	NA	NA
IntraNetwork	NA	NA	15 minus (number of digits in CC + IC)
International	15	15	15

NA Not Applicable

A.4 Unique identification of international number for geographic areas

A.4.1 An international number for geographic areas uniquely identifies a subscriber within a geographical area locally, nationally and internationally, i.e. dialling the subscriber number locally, the national (significant) number nationally and the international number internationally always provides identification of the same subscriber.

A.4.2 The national (significant) number provides unique identification of one subscriber irrespective of where the call is generated from within the country or geographical area characterized by CC.

A.4.3 The subscriber number provides unique identification of one subscriber irrespective of where the call is generated from within a local area identified by NDC, where applicable. The subscriber number is a complete number and can therefore not be separated.

A.4.4 Use of prefixes to distinguish the national (significant) number and the international number from the subscriber number does not alter the uniqueness of E.164 numbers.

A.5 Unique identification of international number for global services

The international number for global services uniquely identifies subscribers only at the international level. The international number for global services is a complete number, and can therefore not be separated.

A.6 Unique identification of international number for Networks

For illustrative purposes only, it is assumed that intraNetwork dialling is by subscriber number.

A.6.1 An international number for Networks uniquely identifies a subscriber within a Network, and internationally, i.e. dialling the subscriber number and the international number, always provides identification of the same subscriber.

A.6.2 The subscriber number provides unique identification of one subscriber irrespective of where the call is generated from within the Network identified by CC + IC. The subscriber number is a complete number and can therefore not be separated.

A.6.3 Use of an international prefix to distinguish the subscriber number and the international number for Networks does not alter the uniqueness of E.164 numbers.

A.7 Non-E.164 numbers

A.7.1 Any international number for geographical areas, global services or Networks which does not conform to the structure, length and uniqueness as defined in this Annex or in the main body of this Recommendation is not an E.164 number.

A.7.2 Non-E.164 numbers may not be passed across any Network boundaries without a specific bilateral agreement.

A.7.3 Listed below are some examples of non-E.164 numbers from the first category of numbers. These examples are not exhaustive.

A.7.3.1 Local special numbers

For example Local Special Numbers (LSPNs) with significantly fewer digits than subscriber numbers, and which are valid for a specific purpose only, within a limited part of the same NDC area.

The LSPNs are part of a hierarchical structure with three levels as follows:

– Local level: LSPN.

– IntraNetwork level: NDC + LSPN.

– International level: CC + NDC + LSPN.

Since LSPNs are significantly shorter than the subscriber numbers, they are within the limits of Table A.1.

If LSPNs and NDC + LSPN terminate at the same service then LSPN would be an E.164 number, but this is not the case in this example. In our example the LSPN terminates at, for instance, two different services within the NDC area, depending upon from where the calling user is located. LSPN and NDC + LSPN are ambiguous and therefore not E.164 numbers.

A.7.3.2 International special numbers used nationally

In this example, the International Special Numbers (ISPNs) are numbers with significantly fewer digits than ordinary subscriber numbers, and which only exist in an international format within the country which provides it. The digits of ISPN are identical to the leading digits of one or more subscriber numbers.

Nationally, the ISPNs exist only at the international level as follows:

– International level: CC + NDC + ISPN.

Since ISPNs are significantly shorter than the subscriber numbers, they are within the limits of Table A.1.

Nationally the CC + NDC + ISPN could terminate at a service center. As the digits of ISPN are identical to the leading digits of a subscriber number, all incoming international calls to the service center will fail because the CC + NDC + ISPN and the leading digits of CC + NDC + SN are ambiguous, and therefore not E.164 numbers.

A.7.3.3 Network specific numbers

In this example network specific numbers are numbers that belong to subscribers connected to one network operator in a country with more than one operator, but where the network operator demands that the calling user dials some additional digits.

The network specific numbers have a hierarchical structure with 3 levels as follows:

– Local level: SN.

– National level: NDC + SN.

– International level: CC + AD + NDC + SN (see Note.)

NOTE – ADs (Additional Digits) are the network operator identification digits that would have to be added by the calling users abroad to remove ambiguity and reach a particular subscriber in specific national network.

The international number does not fit in the hierarchical structure because it consists of more than the country code plus the national (significant) number. AD is not part of the national (significant) number, but may be part of a national prefix used to distinguish the national (significant) numbers from the subscriber numbers.

The numbers are not unique because NDC + SN and CC + NDC + SN lead to two different subscribers.

Network-specific numbers that are manipulated in this way are not E.164 numbers.

A.7.3.4 National (significant) numbers with excessive length

In this example, the national (significant) numbers (NDC + SN) as used nationally have differing lengths, and the longest national (significant) numbers violate the maximum given in Table A.1.

The numbers have a hierarchical structure as follows. The structure is independent of the number length.

– Local level: SN.

– National level: NDC + SN.

– International level: CC + NDC + SN.

Some of the national (significant) numbers (NDC + SN) and international numbers (CC + NDC + SN) are longer than the maximum given in Table A.1. These numbers are not E.164 numbers. The most significant part of the national (significant) numbers, truncated to the limits given in Table A.1, are E.164 numbers provided that they are unique.

Annex B

Application of international public telecommunication numbers for ISDN

B.1 Scope

This Annex describes the application of international public telecommunication numbers to ISDN numbering and addressing. Additional numbering and addressing requirements are covered in separate Recommendations, e.g. B-ISDN is contained in Recommendation E.191.

B.2 ISDN numbers

Numbering for ISDN is an integral part of the international public telecommunication numbering plan.

The ISDN number is an application of international public telecommunication numbering for geographic areas and for international networks, to the ISDN user-network interface/network termination.

B.3 Addressing

B.3.1 Identification

Identification within a subscriber's installation of a point beyond the ISDN boundary requires the transfer of address information from the public network to the subscriber's equipment. Two cases can apply:

– identification by an ISDN number;

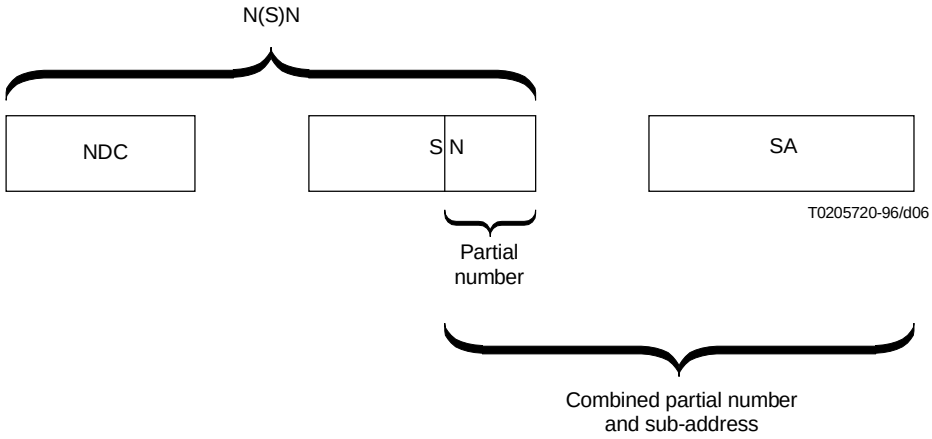
– identification by an ISDN number plus additional address information.

B.3.2 Addressing by an ISDN number

When selecting a destination in the subscriber installation, digits forming the end of the ISDN subscriber number are transferred to the called subscriber's installation as a partial number (see Figure B.1). The number of digits used depends upon the requirements of the called subscriber's equipment and the capacity of the numbering plan used.

In instances where a partial number is utilized, e.g. Network Termination 2 (NT2), the number will be used in the context of the direct-dialling-in supplementary service.

If the subscriber's installation consists of terminal equipment only, the transferred digits will be used in the context of the multiple-subscriber-number supplementary service.



NDC National Destination Code (optional)
N(S)N National (Significant) Number
SA Sub-Address
SN Subscriber Number

NOTE – The multiple-subscriber-number application is not covered in the diagram.

Figure B.1/E.164

B.3.3 Sub-addressing (network address extension)

Sub-addressing provides an additional addressing capacity outside the ISDN numbering plan but constitutes an intrinsic part of the ISDN addressing capabilities. The sub-address is a sequence of digits, following the ISDN number. The maximum length should be 20 octets (40 digits). As shown in Figure B.1, the sub-address may follow the ISDN number and form the ISDN address, which is transferred to the equipment at the subscriber's premises.

When required, the sub-address is sent by the calling party within the call set-up procedure and is passed transparently through the network as a separate entity from both the ISDN number and user-to-user information. Sub-address information is not required to be processed within the public network.

B.3.4 Combination of addressing and sub-addressing

Sub-addressing may be used separately or in combination with a partial number (see Figure B.1).

B.4 Dialling procedures

B.4.1 The subscriber dialling procedures for local, national and international calls shall be in accordance with clause 7. However, subscriber's control procedures for supplementary services will be as defined in Recommendation E.131 or in separate Recommendations for each service.

B.4.2 ISDN subscribers will always be called by the same subscriber number irrespective of where in the public network the call originates. For calls in the same numbering area or local network, the subscriber number alone is dialled. For national calls between numbering areas or local networks, the subscriber number may be preceded by the national prefix and the national destination code.

B.4.3 The addressing procedures for calls using sub-addressing are described in B.3.

B.5 Network identification

B.5.1 Geographic areas

In countries served by more than one ISDN and/or Public Switched Telephone Network (PSTN), the network identification of each is a national matter.

Network identification within the national (significant) number shall be such that:

– in a country all destination ISDN and PSTN networks shall operate under a single country code;

– the international number maximum length of 15 digits shall not be exceeded, nor shall it be necessary for the number of digits for number analysis to exceed that specified in 7.5;

– provision of network identification is not mandatory for countries using a single integrated numbering plan arrangement for their ISDNs and PSTNs.

B.5.2 Networks

In all cases when Network codes are assigned, they are supplemented with Identification Codes (ICs) which uniquely identify each international Network.

Digit analysis of the CC + IC provides the required network identification.

B.6 Service parameters

The ISDN number by itself will not identify the particular nature of the service, which is derived from particular signalling parameters that are not part of the numbering plan. For example, for ISDN calls, in addition to a number and possible prefix, there is a requirement to provide a choice of bearer capability in the signalling protocol. One number can therefore facilitate access to more than one service.

B.7 Calling/connected line identity

Calling/Connected Line Identity (CLI/COLI) is address information which is passed across the network to provide supplementary services such as calling (or connected) line identification presentation. The format of the CLI and COLI for international calls should be the full international number, i.e. Country Code (CC), National Destination Code (NDC) and Subscriber Number (SN). No other information, such as prefixes or symbols (e.g. "+"), should be included, although a sub-address may be associated with the CLI/COLI. However, in a country where network-specific numbers are utilized for identifying customers or network services it remains a national matter. When implemented, the NPI (Numbering Plan Identifier) TON (Type of Number) mechanism should define the numbering status of the calling/connected line. The authorization to pass CLI/COLI across an international boundary is a national matter.

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Related documents:

SR-NOTES-SERIES-01, *Telcordia Notes on the Synchronous Optical Network (SONET)*
SR-NOTES-SERIES-02, *Telcordia Notes on Dense Wavelength-Division Multiplexing (DWDM) and Optical Networking*
SR-NOTES-SERIES-03, *Telcordia Notes on Number Portability and Number Pooling*
SR-NOTES-SERIES-04, *Telcordia Notes on the Evolution of Enhanced Emergency Services.*

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3.6.3 Coin Station Numbering

It has been recommended that public and semipublic stations be assigned line numbers in the 9000 series (for example, NXX-9XXX). Generally, current operating practices include a check for public/semipublic telephones on collect or third-number calls to 9000 series numbers only.

Many public/semipublic telephones meet the requirements for an automated check. In those cases where the automated public/semipublic station check can be applied, there is no need to have the called public station numbered in the 9XXX series.

However, there are still many situations in which the 9XXX line number is the only indication of a public/semipublic station. Therefore, it is still suggested that companies assign public/semipublic stations in this 9XXX line number series when possible.

3.7 Dialing Procedures

Dialing refers to the *use* of certain digits or special characters as prefixes or appendixes to the number address as defined by the NANP. In the U.S., dialing is regulated by local public utility commissions, and as a result, dialing patterns vary from one jurisdiction to another. For example, the digit "1" is used in the NANP to indicate that the full 10-digit NANP number will follow. The prefix "1" is also used in many areas of the NANP to indicate that a call within the "home" NPA will incur a toll charge. In such a use, the "1" is part of the dialing plan. Table 3-3 illustrates the major dialing options in use.

Table 3-3. Major Dialing Options

	Option I	Option II	Option III
Local call within home NPA	7 digits	7 digits	7 digits
Toll call within home NPA	7 digits	1 + 10 digits	1 + 10 digits
Local call across NPA boundary	1 + 10 digits	10 digits	1 + 10 digits
Toll call across NPA boundary	1 + 10 digits	1 + 10 digits	1 + 10 digits

In all options, 7-digit local calling is permitted for calls within the home NPA, except in areas where NPA overlays have been implemented. In these areas, all calls must be dialed on a 10-digit basis as directed by the FCC in its Second Report and Order in CC Docket 96-98.

Several different dialing arrangements are in use for local calls that cross NPA boundaries. In some locations these calls may be dialed on a 10-digit basis, without the prefix "1." In other locations, 7-digit dialing to foreign NPAs is retained through the use of "protected" NXX codes. The use of protected codes is discouraged because it uses central office codes inefficiently and may contribute to the premature exhaust of an NPA.

Because dialing patterns vary in the NANP, the industry felt it was important to develop and recommend a uniform dialing plan. The resulting document, INC 97-0131-017, *Industry Numbering Committee Uniform Dialing Plan*, recommends that all calls be dialed on a uniform 10-digit basis, eliminating the use of the prefix "1" as a toll indicator. If required, however, toll indication could be provided in another manner such as a tone indicating that the caller will incur additional charges. Although the industry has made its recommendation, no decisions have been made on implementation.

Tables 3-4 through 3-6 show additional details of dialing procedures available for use with FGD.

Table 3-4. Recommended Dialing Procedure for Directory Assistance Under Feature Group D

Type of Call	Dialing Procedure	Operator Reached
IntraLATA		
HNPA*	411 or 555-1212	LEC
FNPA	1+ NPA-555-1212	LEC
HNPA**	101XXXX-555-1212	IntraLATA Carrier
FNPA**	101XXXX-1+NPA-555-1212	IntraLATA Carrier
InterLATA		
HNPA*	555-1212	LEC
FNPA	1 + NPA-555-1212	IC†
HNPA	101XXXX-555-1212	IC†
FNPA	101XXXX-1+NPA-555-1212	IC†

Legend:

FNPA = Foreign Numbering Plan Area
HNPA = Home Numbering Plan Area
IC = Interexchange Carrier
LATA = Local Access and Transport Area
LEC = Local Exchange Carrier
NPA = Numbering Plan Area

* Use of the prefix 1 is acceptable in areas where Centralized Automatic Message Accounting (CAMA) access is required.

** Only applies in those areas where intraLATA competition is allowed.

† Presubscription applies to interLATA directory assistance calls. The call will be handed off to the IC, but the IC business arrangement with a LEC to provide directory assistance may result in reaching a LEC operator.

Table 3-5. Treatment of 0 and 00 Dialed Calls from Equal-Access End Offices

Dialing Format	Suggested Disposition Equal-Access End Office
0	LEC
00	IC*
101XXXX + 0	IC
101XXXX + 00	IC**
101XXXX + 0+7/10D	IntraLATA - IC, if permitted†
00 + 7/10D	IntraLATA - LEC‡ IntraLATA - IC‡

Legend:

IC = Interexchange Carrier
LATA = Local Access and Transport Area
LEC = Local Exchange Carrier
X = Any digit 0 through 9
D = Digits

* Assumes subscriber is presubscribed.

** While this is not a NANP dialing standard, to avoid customer confusion 101XXXX + 00 dialed calls should be processed and routed to the IC operator facility.

† Because regulatory treatment of IntraLATA competition varies widely, this section does not specifically address dialed 0+ 7/10D where such competition is allowed.

‡ 00 + 7/10D and 101XXXX + 00 + 7/10D dialed calls are not defined in the NANP. Upon completion of dialing 00, the call would generally be routed to the IC operator facility, and subsequent digits would be acknowledged. This may only apply to subscribers with DTMF telephones; calls of this type generated by rotary dial customers may not be processed.

Table 3-6. Dialing Procedures Available with Feature Group D

Dialing Format	Destination
101XXXX + (1) + (NPA) + NXX + XXXX	Carrier specified by 101XXXX.
101XXXX + 011 + CC + NN + (#)**	
011 + CC + NN + (#)**	Presubscribed carrier.
01 + CC + NN + (#)**	Presubscribed carrier operator function.
(1) + (NPA) + NXX + XXXX (InterLATA)	Presubscribed carrier
(1) + (NPA) + NXX + XXXX (IntraLATA)	LEC
(0) + (NPA) + NXX + XXXX (InterLATA)	Presubscribed carrier operator function.
(0) + (NPA) + NXX + XXXX (IntraLATA)	LEC operator function.
101XXXX + 0+ (NPA) + NXX + XXXX	Operator function of carrier specified by 101XXX.
101XXXX + 01 + CC + NN + (#)†	LEC operator.
0	Presubscribed carrier operator function.
00	Operator of carrier specified by 101XXX.
101XXXX + 0	Carrier determined by 6-digit or 10-digit translation of ERC+ NXX.
1 + ERC+ NXX + XXXX	Carrier specified by 101XXXX.
101XXXX + (0/1) + SAC + NXX + XXXX	Carrier specified by 101XXXX.
101XXXX + #‡	

Legend:

CC = Country Code
ERC = Easily recognized code
N = Any digit 2 through 9
NPA = Numbering Plan Area code
X = Any digit 0 through 9

** ( ) indicates optional dialing digits.

† (#) indicates that dialing the character # (on DTMF touch-tone telephones) at the end of an international address is desirable but not required. If used, it eliminates the need for timing in some cases.

‡ # indicates that the character # at the end of a dialed Carrier Access Code (CAC) is required.

3.8 Dialing Prefixes for Carrier Selection

As a result of the Modification of Final Judgment (MFJ), the GTE consent decree, and the implementation of access change plans in state as well as federal jurisdictions, many callers are required to select an IC for calls that cross LATA boundaries. ICs connect their facilities to many LEC networks using several different access arrangements. The most common access arrangements are Feature Group B (FGB) and Feature Group D (FGD).

FGB callers reach an IC's facility by dialing 950-XXXX. The XXXX digits in the 950 number identify the IC and are called the Carrier Identification Code (CIC). CICs are assigned in accordance with industry-approved guidelines documented in INC 95-0127-006, *CIC Administrative Guidelines*. When the call is "cut through," the IC switching equipment provides a second dial tone indicating that the caller must dial a Personal Identification Number (PIN) plus the number to be called.

FGD permits callers to *presubscribe* to or *select* a specific IC on a per-call basis. If the caller wants to use the presubscribed carrier, only the called number need be dialed. FGD also allows the caller to override presubscription on a per-call basis and choose an alternate IC by dialing 101XXXX + 0/1 + 10 digits. The 101XXXX dialing prefix is called the Carrier Access Code (CAC). The last four digits of the 101XXXX CAC are the CIC.

Note that CICs for FGB and FGD access are assigned from separate pools.

3.9 Operator Assistance

Callers reach the LEC operator by dialing 0 (zero). To reach the presubscribed IC operator, 00 (zero zero) is dialed, where available. A presubscribed customer should also be able to dial 101XXXX + 0 to reach an alternate IC operator facility. In non-equal access end offices, 00 can be routed either to the LEC operator facility, to a single IC's operator facility, or it can be blocked.

3.10 International Direct Distance Dialing

There are three major types of carriers involved in international calling.

- *International Carriers (INCs)* provide call transport between a United States gateway and a foreign country's gateway where the international carrier connects to the foreign terminating network.
- *Interexchange Carriers (ICs)* provide call transport between the originating LATA and the IC's gateway office.
- *Interexchange/International Carriers (IC/INCs)* provide transport between the originating LATA and a foreign country's gateway.

Most international calls are handled by INCs. On some international calls, however, both ICs and INCs are involved, which implies that two carriers are selected by a single CAC - the INC indirectly.

- A single carrier (IC/INC) provides both interLATA and international transport, and uses a single CAC that includes both.
- An IC and an INC, having separate CACs, can agree to handle each other's traffic. A customer placing an International Direct Distance Dialing (IDDD) call could use either carrier's CAC. The interLATA portion would be handled by the IC and the international portion would be handled by the INC. An IDDD caller is not able to independently specify both an IC and an INC for an international call. Except in the case of a carrier that provides both functions, the caller will specify either the IC or INC of choice. The other carrier (INC or IC, respectively) involved will be the result of a prearranged business agreement.

When an international call is dialed by a customer in a national network, the local switching system must be able to recognize that it is receiving an international address. In the NANP, a local switching system with IDDD capability is alerted to the fact that an international number is being dialed by use of a special prefix code. The following dialing patterns are used for IDDD in the NANP.

For station-paid direct-dialed calls:	011 + country code + national number
For operator-assisted calls:	01 + country code + national number

The list of current country code assignments can be found in Section 1.10 of the *LERG*.

3.11 0XX and 1XX Codes

Within the NANP there are two series of 3-digit codes — 0XX and 1XX — that are not used as NPA or central office codes but are used for various specialized interoffice purposes. End offices or their associated Centralized Automatic Message Accounting (CAMA) offices will not accept a 7-digit or 10-digit address having a 0XX or 1XX code in the NPA or central office code field. Although not subscriber-dialable, such codes are accepted and routed by switching systems when received via an intermachine trunk or a source authorized to generate them (for example, a testboard). In the past, 0XX codes were typically used as a pseudo-central office code to route special calls to a switching office that did not have a normal central office code assigned (for example, a toll office). These codes were also used to route special calls to a switching office termination that a LEC did not want dialed using a normal address. When 0XX codes serve a pseudo-central office code function, they are used in conjunction with an NPA code so most of the codes can be reused in each NPA.

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certain position and are switched to a different position. The position to which bits are switched is determined by a combination of one or more of three dimensions: space (that is, the interface or port number), time, and wavelength. Packet switching is based on labels; addressing information in the packet headers, or labels, helps to determine how to switch or forward a packet through the network node.

Circuit Switching

Circuit switching has been the basis of voice networks worldwide for many years. You can apply three terms to the nature of a circuit-switched call to help remember what this is: continuous, exclusive, and temporary. One of the key attributes of a circuit-switched connection is that it is a reserved network resource that is yours and only yours for the full duration of a conversation. But when that conversation is over, the connection is released. A circuit-switched environment requires that an end-to-end circuit be set up before a call can begin. A fixed share of network resources is reserved for the call, and no other call can use those resources until the original connection is closed. A call request signal must travel to the destination and be acknowledged before any transmission can actually begin. As Figure 4.1 illustrates, you can trace the path from one end of the call to the other end; that path would not vary for the full duration of the call, and the capacity provisioned on that path would be yours and yours alone.

Advantages and Disadvantages of Circuit Switching Circuit switching uses many lines to economize on switching and routing computation. When a call is set up, a line is dedicated to it, so no further routing calculations are needed.

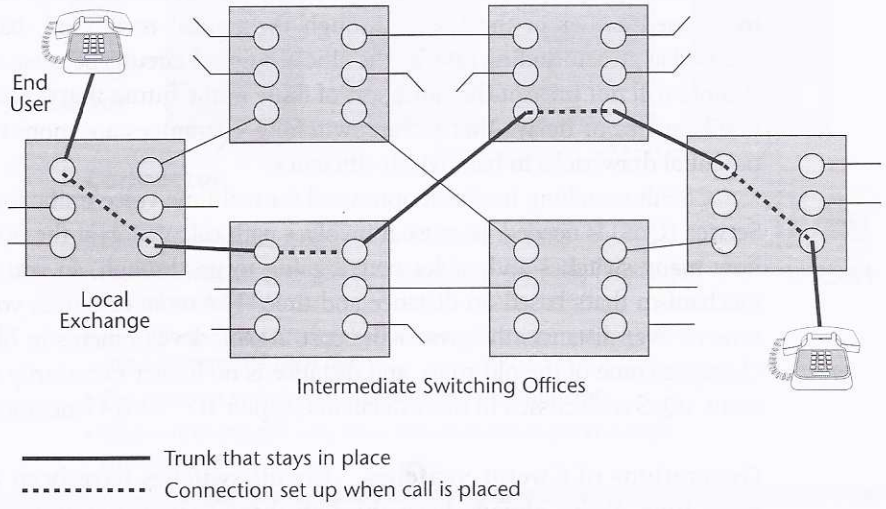

Figure 4.1 A circuit-switched call

Since they were introduced in the mid-1980s, digital cross-connect systems (DCSs) have greatly eased the process of reconfiguring circuit-switched networks and responding to conditions such as congestion and failure. DCSs create predefined circuit capacity, and then voice switches are used to route calls over circuits that are set up by these DCSs. DCSs are analogous to the old patch panels. You may have seen a main distribution frame (MDF) on which twisted-pair wiring is terminated. The MDF is a manual patch panel, and before DCSs were introduced, when it was necessary to reconfigure a network based on outage, congestion, or customer demand as a result of shifting traffic patterns, technicians had to spend days or even weeks, manually making changes at the MDF. The DCS is a software patch panel, and within the software are databases that define alternate routes—alternate connections that can be activated in the event that the network encounters a condition that requires some form of manipulation. DACSs are one of the elements of the PSTN that contribute to its reliability: When network conditions change, in a matter of minutes, a DCS can reconfigure the network around those changes. With such tools, the PSTN is able to offer five 9s reliability—in other words, 99.999% guaranteed uptime. (DCSs are discussed in more detail in Chapter 5.)

Circuit switching offers the benefits of low latency and minimal delays because the routing calculation on the path is made only once, at the beginning of the call, and there are no more delays incurred subsequently in calculating the next hop that should be taken. Traditionally, this was sometimes seen as a disadvantage because it meant that the circuits might not be used as efficiently as possible. Around half of most voice calls is silence. Most people breathe and occasionally pause in their speech. So, when voice communications are conducted over a circuit that's being continuously held, and half the time nothing is being transmitted, the circuit is not being used very efficiently. But remember that this is an issue that is important when bandwidth is constrained. And as mentioned earlier in the book, through the optical revolution, bandwidth is being released at an astounding rate, so the efficient use of circuits because of bandwidth constraints will not present the same sort of issue in the future that it once did. Hence, the low latencies or delays that circuit switching guarantees are more important than its potential drawbacks in bandwidth efficiency.

Circuit switching has been optimized for real-time voice traffic for which Quality of Service (QoS) is needed. Because it involves path calculation at the front end, you know how many switches and cables you're going to go through, so you can use a pricing mechanism that's based on distance and time. The more resources you use, either over time or over distance, the greater the cost. Again, developments in fiber economics are changing some of the old rules, and distance is no longer necessarily an added cost element. (QoS is discussed in more detail in Chapter 10, "Next-Generation Networks.")

Generations of Circuit Switches Circuit switches have been around for quite some time. We've already been through three basic generations, and we're beginning to see a fourth generation.

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Performance from Experience

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18. IP Networking and Next Generation Networks

18.1 Introduction to Next Generation Networks

Telecommunications networks have traditionally focused on the support of voice traffic and voice services. As a result, the Public Switched Telephone Network (PSTN) has been optimized for voice traffic and services through a combination of circuit-switching, Time-Division Multiplexing (TDM), and Signaling System Number 7 (SS7). This voice infrastructure, developed and refined over the past century, has matured into a high-quality, reliable network. The network is ubiquitous and highly secure. Over the past decades, numerous voice services have been introduced in the PSTN.

With the growth of computing and networking, there has been a significant development of a data communications infrastructure. The data communications infrastructure was primarily developed to help corporations and other private networks (such as Universities) send information within a defined and closely managed group. The role of the public network infrastructure was to connect numerous private networks, using two distinct approaches:

1. Using either dedicated digital switched circuits or dedicated T1/E1 lines
2. Building and operating separate parallel networks to carry high-capacity data traffic.

The explosive growth of the Internet, with its accessibility to businesses and residences, has led to a new way of looking at the data communications infrastructure. The growth in the Internet has popularized the deployment of packet switching, and more and more public carriers have had to start considering using packet switching for the parallel data infrastructure. The Internet (and, in particular, use of the Internet Protocol) is providing a framework for sending and receiving voice, data, video, and multimedia over a common infrastructure. The Internet also provides a model for an infrastructure that can support a wide variety of applications, that could be rapidly introduced, often relying on intelligence being distributed at the “edges” of the network.

As technology has evolved, it is clear that Next Generation Networks (NGNs) are emerging. The goal of NGNs is to use the best from both the voice and data communications infrastructures. Thus, the vision of NGN is to provide a common infrastructure that supports a wide range of applications, including voice, data, video, and multimedia, while maintaining the high reliability, security, ubiquity, and controlled Quality of Service (QoS) offered by today's voice infrastructure. The NGN is intended to be able to support users with a wide range of Customer Premises Equipment (CPE), from the telephony phones in the PSTN to Internet appliances including PCs and PDAs, using a variety of wireline and wireless access technologies. NGN is intended to provide an infrastructure to rapidly offer new innovative applications and services and offer service providers the option of time or usage-sensitive billing.

18.1.1 Motivation for Next Generation Networks

Various industry experts have published numerous forecasts about the amount of voice and data traffic that will be transmitted over worldwide networks. Their published forecasts seem to support just about every point of view, from the wildly optimistic, to the rather conservative, with a variance of over 100 percent for the years 2002 and 2003. A composite of forecasts by these industry experts suggests that, while voice traffic is growing at 6 to 9 percent a year, data traffic is expected to grow at rates between 45 and 100 percent, leading to a dominance of data traffic over voice.

NGN would allow carriers to take advantage of savings as a result of the consolidation of voice and data networks. Today, many large carriers have independent networks for transporting voice and data. While the existing circuit-switched network is mainly used for voice calls, newer packet-based networks are being deployed to handle data transport. However, maintaining two independent networks is inherently expensive. One important component of NGN is Voice Over Packet (VOP). VOP transports voice calls on packet-based data networks. The NGN/VOP thus presents carriers with an opportunity to migrate all information transport, i.e., voice, data, fax, image, and video, onto a single medium. This would likely create significant cost reductions on transport, switching, on-site cabling and equipment, and administration and management, with the single network for both voice and data communications.

Given the much higher growth in data traffic, carriers are being forced to make investments to upgrade their packet networks. VOP would allow the carrier to use the same packet network to handle the growth in its voice traffic. For newer carriers who do not have their own infrastructure, the economics are even more compelling. Given the faster growth in data traffic, the carrier is likely to deploy a packet network to handle its data traffic. NGN/VOP would allow the carrier to use the same network for voice. Another motivation is that NGN/VOP provides the opportunity for additional revenues for service providers that have data network with spare capacity, which can be used for voice calls. Many service providers, such as ICs, CLECs, and alternate access providers, have already deployed high-capacity digital networks to key enterprise sites. The same scenario is true in many other countries, where INCs have bypassed the incumbent's PSTN to selected large business sites. These same high-speed networks, which were originally used for data, can be utilized using VOP for long-distance and international voice calls.

Another key motivation for service providers is that NGN can provide the necessary infrastructure for offering bundled services to its key customers. There are industry studies that indicate that a residential customer is much more likely to change service providers if the customer obtains only a single service from a provider. An example, is the high "churn" among long-distance customers of major ICs. However, if a customer is offered multiple services such as wireless, local phone, long-distance phone, and Internet access bundled together as a single offering by a service provider, then the customer is much less likely to switch to another carrier.

Over the longer term, arguably the most significant motivation is that NGN provides carriers with the potential for new service offerings. Such newer services, most of which are still in the conceptual stage, could take advantage of both voice and data offerings. In addition, packet networks offer a more “open” environment with greater flexibility for service creation and customization than the relatively “closed” telephony environment. NGN could allow the option of supporting Application Programming Interfaces (APIs) that are open and available to any developer or in-house development group, to create custom services for each enterprise. Large businesses, such as banks, government, transportation companies, hi-tech, and health care concerns, who are likely to be a carrier's key customers, would be able to create and deploy custom telecommunications services to meet their unique requirements. This is in contrast to traditional telephony networks where there are few open APIs. For example, a traveling employee can connect a notebook computer to the public Internet or a corporate Intranet to obtain information, access databases, and send/receive e-mail. However, on the same call, the user can also use the speaker and microphone built into the notebook PC to check voice mail, and make voice calls through an office PBX.

In addition, there are studies that suggest cost advantages of NGN. Analyses show that NGN offers cost advantages for both switching and transport. Some studies have suggested that the combined infrastructure and operations cost savings could be as much as 30 to 50 percent. However, such analyses depend on the specific assumptions used, and are often based on market forecasts and assumptions that may or may not be applicable to a particular situation. The cost-savings potential of NGN is realistic, but needs to be quantified on a case-by-case basis to develop a sound business case for migration to NGN.

Another consideration for NGN is that, despite the much faster growth of data traffic, most revenues and profits for service providers today are obtained by supporting voice and voice services. As a result, support for voice and voice services over a packet infrastructure can be considered a critical component of NGN deployment. As such, VOP, which provides a carrier class solution for supporting voice, should be viewed as the first step toward NGN.

The technology that enables VOP is not new. Technologies such as voice packetization, data detection, and silence suppression have been used for many years as a means of improving the trunking efficiencies for international submarine cable systems and other transport systems, with a relatively high cost of bandwidth and low flexibility in system bandwidth upgrade. What is new is this:

1. Signal processing technology has advanced enough to allow these systems to be implemented on single chip digital signal processors and personal computers
2. Protocols have been developed which standardize the means for packetized voice to be transmitted and controlled over ordinary data networks, based on the Internet Protocol stack.

Many of the initial NGN/VOP solutions are based on the H.323 family of standards, which is published by the ITU-T. However, existing standards do not address all the needs of a carrier wanting to deploy VOP. For example, H.323 does not address

guaranteed QoS, and it is generally acknowledged that, in order to have acceptable voice quality using VOP over wide area networks, some control over such parameters as packet latency and packet loss is required. NGN/VOP solutions that are considered for wide deployment in public networks may have to demonstrate suitability from several different perspectives. The NGN/VOP solution would have to provide necessary reliability and security that is expected in public networks. It would also be critical for the NGN/VOP solution to be scalable (lack of scalability is one of the inadequacies of initial NGN/VOP solutions). In addition, the following issues are important:

- Interoperability

  The NGN/VOP deployed in the network would have to interwork not only with other VOP networks, but also with the legacy PSTN for support of end-to-end voice calls and other narrowband services.

- Voice Quality

  The NGN/VOP would have to offer voice quality comparable to that offered by the PSTN.

- Telephony Features and Services

  The NGN/VOP would have to be able to support the suite of telephony features and services offered by the typical PSTN. This would, in many cases, imply that the NGN/VOP would be able to interact with the Common Channel Signaling (CCS) network and Service Control Points (SCPs) in the PSTN. In addition, the NGN/VOP would need a framework to support new services.

- Accounting and Settlements

  The NGN/VOP would have to provide necessary capabilities for billing and accounting management. In many cases, this implies the ability to interact with legacy billing systems.

- Network Management

  The NGN/VOP would need to support the necessary operations and network management capabilities expected in public networks. This implies that the elements of the NGN/VOP architecture would need to have built-in capabilities to support operations and network management. These capabilities would have to be integrated into an overall operations architecture.

18.1.2 Next Generation Network Framework Architecture

Figure 18-1 illustrates the functional elements in a typical NGN framework architecture. The key functional elements shown in the figure are described below. In addition, the architecture relies on a Core Network and an Access Network for providing the necessary connectivity and transport. The Core Network is the packet transport network (typically based on IP-networking) that provides connectivity to the functional elements in the NGN. The Access Network represents the local loop

network of the NGN. There are various ways of offering access to the NGN. The Access Network could be based on the existing copper plant of LECs or could use other technical options such as Hybrid Fiber-Coax (HFC), Digital Subscriber Loop (xDSL), wireless access, etc.

However, the descriptions of the Functional Elements (FEs) and the interfaces do not imply any specific physical implementation. Various suppliers have developed products with functional elements within a single node that communicate with the relevant elements in other nodes. This architecture framework does not endorse any particular physical architecture.

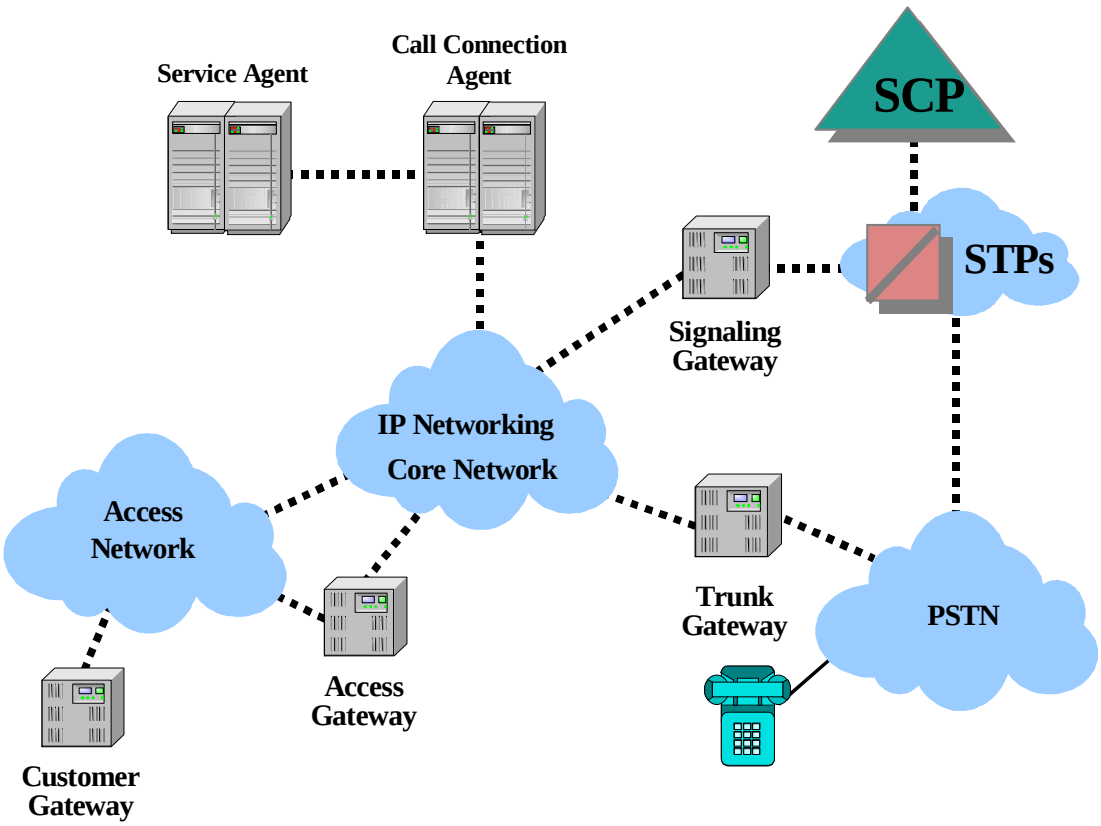

Figure 18-1. NGN Basic Framework Architecture

The FEs in this architecture include:

- Access Gateway (AG)

  An AG supports the line side interface to an NGN. Traditional phones and PBXs currently used for the PSTN can access the network through this FE. As such, this FE provides functions such as packetization, echo control, etc. It is associated with a specific Call Connection Agent (CCA) that provides the

necessary call control instructions. On receiving the appropriate commands from the CCA, the AG also provides functions such as audible ringing, power ringing, miscellaneous tones, etc. It is assumed that the AG has the functionality to set up a transport connection through the core network when instructed by the CCA. An AG is also commonly referred to as a "Media Gateway."

- Customer Gateway (CG)

  A CG provides access to the network to some of the non-traditional CPEs that could have an associated IP address, such as IP-phones, personal computers, etc. Although a CG provides many of the functions associated with the AG, this FE is associated with a particular customer (business or residence). The CG is associated with a specific CCA that provides the necessary call control instructions. Calls originating in the CG would by-pass the AG and go directly into the core network.

- Trunk Gateway (TG)

  A TG supports a trunk side interface to the PSTN. The TG terminates circuit-switched trunks in the PSTN and virtual circuits in the packet network (the core network) and, as such, provides functions such as packetization. Even though a TG terminates trunks in the PSTN, this FE does not provide the resource management functions for trunks it terminates. However, the TG has the capability to set up and manage transport connections through the core network when instructed by the CCA. It is associated with a specific CCA that provides it with the necessary call control instructions.

- Signaling Gateway (SG)

  An SG interconnects an NGN to the PSTN signaling network. An SG terminates SS7 links from the PSTN CCS networks and thus provides the MTP Level 1 and Level 2 functionality. An SG communicates with the CCA to support the end-to-end signaling for calls with the PSTN. Each SG is associated with a specific CCA.

- Call Connection Agent (CCA)

  A CCA provides much of the necessary call processing functionality to support voice on the packet network. A CCA processes messages received from various other FEs to manage call states. A CCA communicates with other CCAs to set up and manage an end-to-end call. Although each gateway (AG, CG, SG, and TG) is associated with a specific CCA, a CCA would typically interact with several gateways. A CCA instructs gateways with call control commands. A CCA interacts with the Billing Agent to generate usage measurements and billing data such as Call Data Records (CDRs). A CCA is also commonly referred to as a "Call Agent," "Media Gateway Controller," or "Soft Switch."

- Service Agent (SA)

  An SA supports supplementary services and generates TCAP messages to interact with SCPs for vertical services (Intelligent Network [IN] services) such as 800 and Local Number Portability (LNP). An SA interacts with multiple CCAs.

The preceding list provides a high-level view of the key FEs involved in the typical service in an NGN. A more comprehensive view of an NGN framework architecture is shown in Figure 18-2. In addition to the FEs described above and shown in Figure 18-1, Figure 18-2 shows the various user devices (e.g., IP-phones, traditional phones, etc.) that could be used to initiate a voice call on an NGN, and some other FEs that are also important in the network. The additional FEs include the following:

- Domain Name Server (DNS)

  A DNS is used to translate IP names to routable addresses.

- Routing and Translation Server (RTS)

  An RTS is used by the CCAs during a call setup to determine the CCA and gateways (CG, TG, SG or AG) associated with a particular called number.

- Billing Agent (BA)

  A BA supports much of the billing functionality needed in the VOP network. It collects the necessary usage measurements from the CCAs and processes them for use by downstream billing systems.

- Voice Feature Servers

  Voice Feature Servers are special purpose servers that support various voice features and services. Examples include Announcement Servers, Interactive Voice Response Units, etc. In addition, the Announcement Server would also be used as part of call processing to generate necessary tones and announcements.

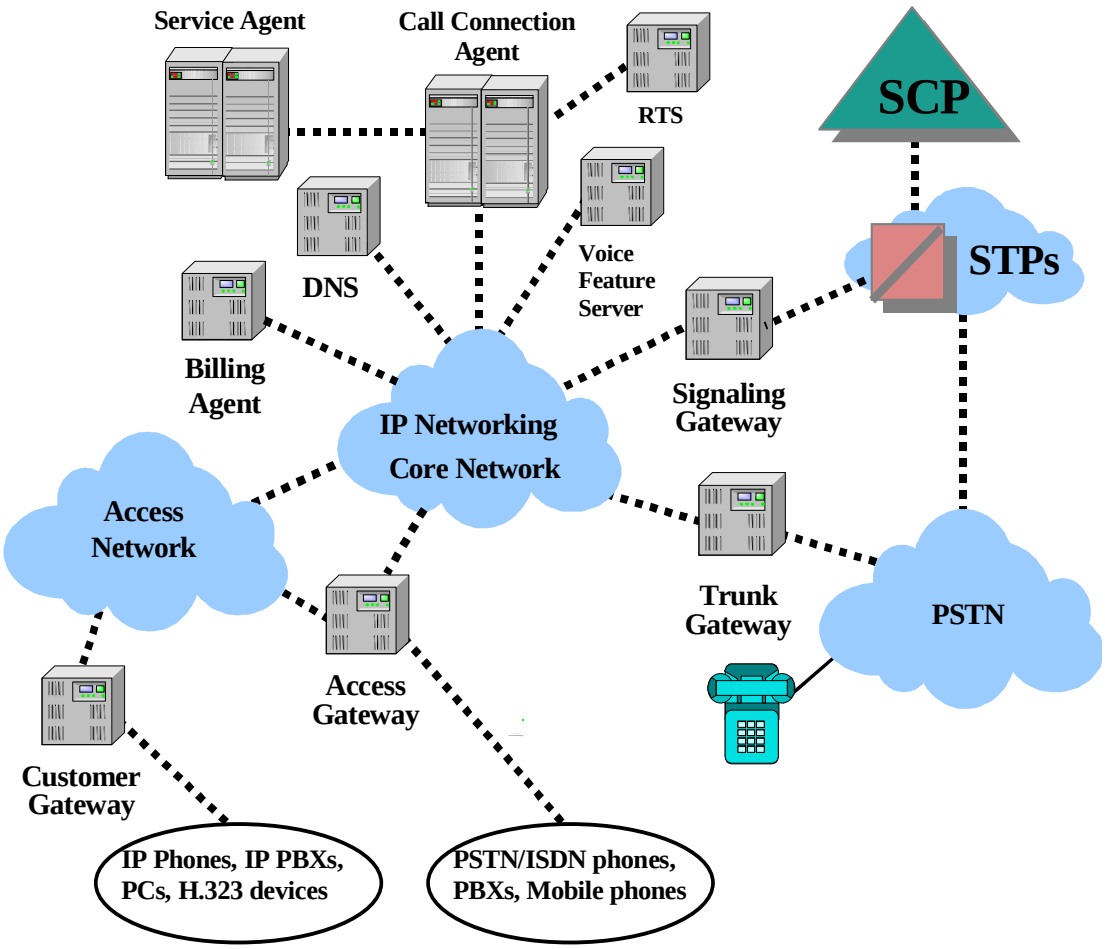

Figure 18-2. NGN Extended Framework Architecture with CPE Examples

18.2 Survey of IP Networking

18.2.1 Introduction

18.2.1.1 Circuit versus Packet Switching

This section introduces IP networking to readers who are interested in understanding the transition of communications technologies from circuit switching to IP-based packet switching. IP networking is a specific instance of

packet switching, so understanding packet switching in general is a first step in understanding IP networking.

In circuit switching, data transfer has three phases:

1. A circuit is established
2. Information is transferred
3. The circuit is disconnected.

Because the two end-points are connected by a dedicated link for the duration of a circuit-switched connection, there is no contention for the resources of that link once the circuit is established. For example, once a telephone call is set up across the PSTN, the two end points have full use of that circuit until the call is ended.

A packet switching environment is different. In some cases, a packet containing data is simply dispatched to its destination. The sending entity may not necessarily determine that the receiving entity is available, and the recipient is not necessarily required to acknowledge receipt. In other cases, the two entities may follow a higher layer protocol to establish a relationship, transmit data, and close off the relationship, but this session does not guarantee them resources on their communications channel. This synchronization is for the end-to-end relationship, not for the end-to-end circuit. A variety of issues arise because a packet-switched connection does not generally offer full use of the intervening physical media. These issues include unpredictable delay, lost or corrupted packets, and the overhead needed to overcome these problems and route packets correctly. In spite of these shortcomings, however, one type of packet switching-IP networking is moving toward dominance in the communications industry.

Packet-based IP networks rely on deterministic routing protocols and intelligence within each network element to deliver data, rather than an end-to-end call setup common within a circuit-switched network. Each IP aware hop, or router, within the network needs to know only what the next hop is to best deliver a packet through the network, rather than require full knowledge about the end-to-end path as in a circuit-switched network. This reduction in overhead leads to efficiencies within the packet-switched network as compared to a circuit-switched network.

In the IP packet-switched network, higher layer protocols and handshakes are used to guarantee delivery of data and recover from delivery errors within the “best effort” network model. As more time-sensitive and delivery-critical data are moved onto IP-based networks (due to their inherently lower cost models), additional protocols are being developed and deployed to manage intra-layer performance characteristics better ensuring data delivery across the network. Protocols such as Multi Protocol Label Switching (MPLS) and Differentiated Services (DiffServ) are used to create guaranteed QoS channels within a packet-based IP network.

18.2.1.2 History of the Internet and Success of IP

In packet switching, equipment and software can provide multiple virtual connections over single network connections. The economic value of this approach has been proven in the market. The shortcomings of this approach, however, represent areas that must be addressed for IP to complete its migration to being the common technology that underlies all business-critical applications and voice/ telephony services.

The Internet is the most visible example of IP networking, and some of its key characteristics can be traced to the underlying technology of IP networking.

Table 18-1. Internet Characteristics

Internet	IP Technology
Affordable	Cost-effective
Changing rapidly	Rapidly evolving
Robust	Designed to survive component failures
Does not guarantee reliable service	A “best-effort” technology

18.2.1.3 Recent Developments

The success of the Internet has fueled the expansion of IP networking into new areas. These expansions are motivating changes in IP networking technologies.

18.2.1.3.1 Intranets

IP networking has moved into corporate networks and begun replacing older network protocols. IP networking offers several important advantages in this environment. First, IP is not a proprietary protocol; therefore, it does not tie an enterprise to a particular vendor. Second, IP is often more cost effective, thanks to vendor competition and IP’s widespread deployment. Third, IP expertise is relatively easy to find, compared to expertise in niche or proprietary protocols. Fourth, key IP-based applications such as web browsers and email fit well into the corporate environment.

18.2.1.3.2 E-commerce

As the Internet has reached critical mass and become commercialized, IP technologies have faced challenges related to security and reliability. The first generation of commercially viable solutions to these challenges has matured. Concerns about the security of transactions conducted over the Internet have not

become a roadblock to the explosive "dot-com" marketplace. Technologies such as Secure Sockets Layer (SSL) are well-accepted, and more extensive capabilities for further encryption and certification are reaching the broader commercial market. Behind the scenes, technical support personnel have become more aware of security tools such as intrusion detection systems, firewalls, and router filters. The general issue of reliability is being addressed on a number of fronts, ranging from server mirroring, load balancing, and managed web hosting.

18.2.1.3.3 Multimedia and Voice

IP and voice networks are beginning to converge. However, multimedia and voice calls are sensitive to delay. If a person is browsing the Internet, a slight delay in the midst of downloading a web page does not present an unacceptable barrier to communication. However, a user engaged in a voice call may find performance to be unacceptable when resource contention causes delays or lost information. Creating solutions to these challenges includes some of the most interesting and dynamic areas of work in communications technology today.

18.2.1.4 Architecture of Internetworks

18.2.1.4.1 Conceptual Overview

The term "IP Networking" is actually shorthand for a whole group of technologies, many of which are introduced in this chapter. These technologies range from lower layer protocols such as Ethernet, to applications, to network architectures. They are grouped under the title of "IP" because the Internet Protocol is the single technology that is common among these technologies.

The fundamental role of IP is to ensure that information (e.g., packets) gets from its source network to its destination network. IP provides the addressing to accomplish this task. All other technologies and protocols exist to "take care of the details."

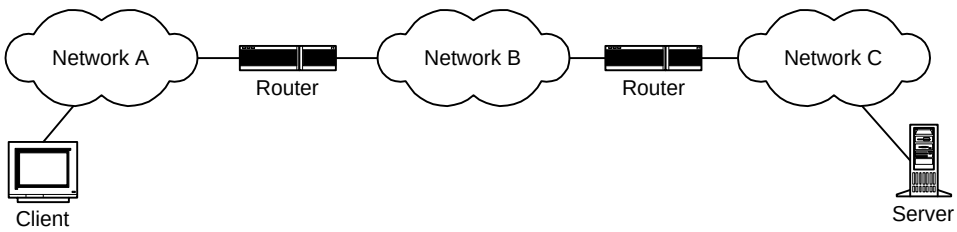

Figure 18-3. A Simple Internetwork

Consider the simple internetwork depicted in Figure 18-3, which comprises three networks. If Network A represents a LAN at home, Network B could represent a nationwide ISP, and Network C could be a corporation's intranet. The essential point is that IP is the common basis for communicating from one endpoint (the client PC) across multiple networks to the other endpoint (the enterprise's server). This communication link may include a variety of physical media (e.g., twisted pair wire, coaxial cable, fiber), a variety of transmission protocols (e.g., Ethernet, ATM, FDDI), and a variety of applications (e.g., file transfer, electronic mail, web browsing). What is common, however, is the IP. The relations and roles of these various media, protocols, and applications is described in further detail in Section 18.2.2.

18.2.2 IP Protocol Suite

Before examining the many aspects of IP networking, one must first understand IP as a communications protocol, some of its related protocols, and their relationship.

18.2.2.1 OSI Model

Before IP became ascendant, a good deal of standards work under the sponsorship of ISO was completed under the Open Systems Interconnect (OSI) umbrella. One of the benefits of this effort is the OSI seven-layer model, which is represented in Figure 18-4.

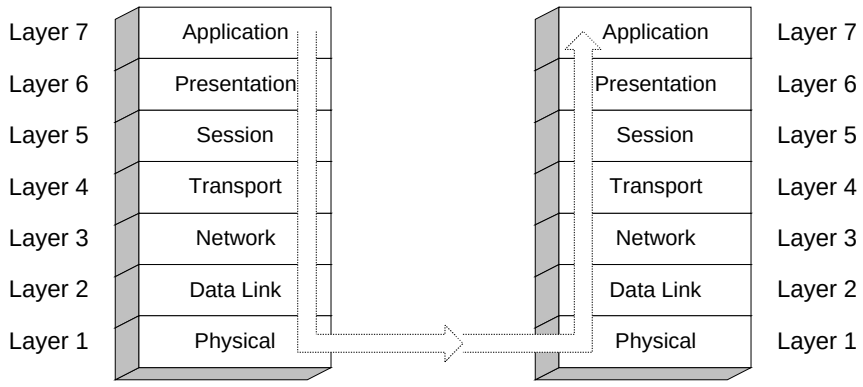

Figure 18-4. OSI Conceptual Model

The chief value of this model is that it provides a common framework for understanding end-to-end communications between computers. Upper layers are typically implemented as protocols in software; lower layers are typically implemented as protocols in hardware. Each layer is generally self-contained and

provides services to the layer above it. Note that these layers represent network communications functionality. So, the application layer does not represent computer applications (e.g., an email application), but instead refers to network applications (e.g., the Simple Mail Transfer Protocol [SMTP]) that provide network services. Information originates at the top of one stack, and is processed by each layer until it reaches the physical media that connect the two stacks at the bottom. As it emerges at its destination, the information moves back up to the top of the stack until it reaches the peer application.

A key concept for understanding this model is that lower-layer protocols encapsulate adjacent higher-layer protocols. Figure 18-5 depicts the basic concept of encapsulation.

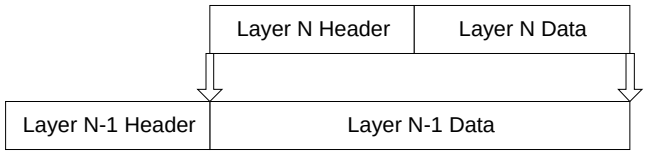

Figure 18-5. Encapsulation

In Figure 18-5, the Layer N header and data are encapsulated by a lower layer, thereby becoming its data payload. A typical metaphor for understanding encapsulation is that one writes a message in a letter and encapsulates it into an envelope; the envelope then gets encapsulated in a mail bag. The postal carrier transports the mail bag and decapsulates the letter into the mailbox; the recipient then decapsulates the letter by opening the envelope. Through encapsulation, lower-level processes provide services to higher-level processes.

18.2.2.2 IP Protocol Suite

For historical and practical reasons, the IP protocol suite does not implement all seven layers of the OSI model separately. The OSI model provides a conceptual model, while the IP protocol suite is an implementation of working software and hardware (see Figure 18-6).

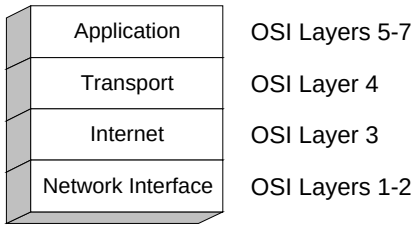

Figure 18-6. Protocol Layering in TCP/IP

Figure 18-7 illustrates how the principle of encapsulation described in the OSI model comes to be applied with representative protocols of the IP suite.

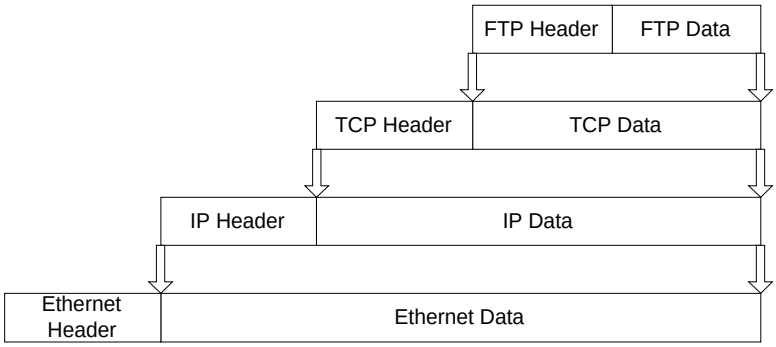

Figure 18-7. Encapsulation in the IP Protocol Suite

In this case, a file transfer application would use FTP to transfer data. TCP would be used to encapsulate FTP to provide a reliable connection to protect against information corruption or loss. IP would encapsulate FTP to provide end-to-end addressing across multiple networks. When the IP packet is on an Ethernet network, that packet would be encapsulated in an Ethernet frame to provide addressing and transport on the LAN.

Ultimately, the Ethernet frame comprises an Ethernet header, followed by an IP header, followed by a TCP Header, followed by an FTP header, and finally concluding with the FTP data, which all this overhead is designed to support. The following sections provide more detail about the services provided by the different layers and their protocols.

18.2.2.2.1 Network Interface

The network interface layer[1] accepts IP datagrams from the IP layer and transmits them to the appropriate physical address on the network. The diagram of an Ethernet frame in Figure 18-8 depicts how IP datagrams can be carried as the data payload of the frame.

1. Some sources choose to distinguish the data link and physical layers. However, this document maintains the 4-layer convention because IP is concerned with *inter*working. Therefore, it only needs to deal with a single interface to "networking." That is, the details of how data link layers interface with physical media are out of the scope of internetworking.

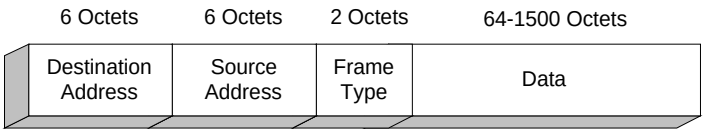

Figure 18-8. Ethernet Frame Structure

In this frame, the destination and source addresses refer to the hardware addresses of the network interface cards of the two communicating endpoints on a network. If this frame were transmitted across the internetwork illustrated earlier, then the source address would be the hardware address of the Ethernet card in the client PC, and the destination address would be the hardware address of the first router (sometimes referred to as a "gateway").

That is, the Ethernet frame carries its data across a network, and the router marks the end of the first network of the figure. At this point, the router strips away (decapsulates) the Ethernet headers and examines the data field (i.e., the IP packet). For example, the IP destination address would be examined to determine what the next hop physical address should be. After interpreting the IP fields, the router re-encapsulates the packet in another frame appropriate to the outgoing network, such as Ethernet, Token Ring, or PPP. The source address of the new frame would be the router's (outgoing) port. The destination address would be the physical address that was determined from applying the routing table rules to the IP destination address.

18.2.2.2.2 Internet Protocol (IP)

Decapsulation yields an IP packet, whose structure is depicted in Figure 18-9. It is beyond the scope of this survey of IP networking to describe the IP datagram in detail. Note, however, that decapsulation has revealed another source and destination address pair. An IP address is a logical address, in contrast to the hardware address of an Ethernet frame. While the Ethernet address is typically "burned into" the Ethernet hardware (e.g., an Ethernet card in a PC), the IP address is typically assigned through software. The IP addresses represent the ultimate source or destination. The section on IP addressing discusses some of these issues in more detail, including why intelligent IP address assignment is essential to good network performance.

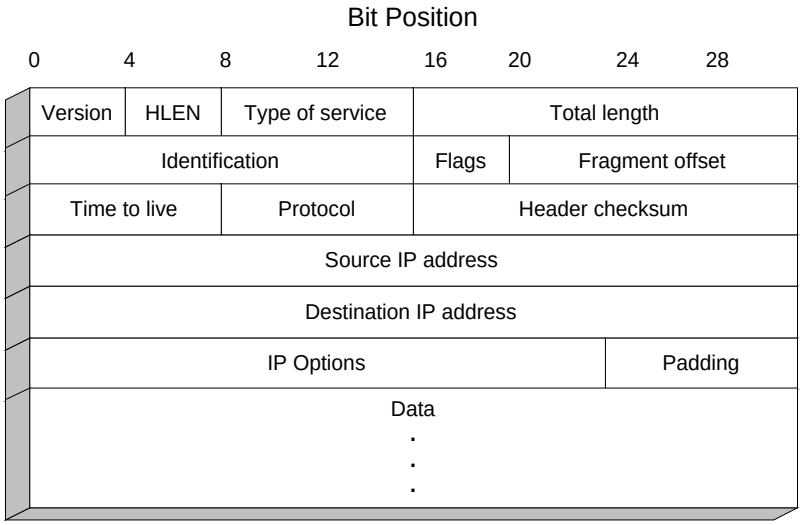

Figure 18-9. IP Packet Format[2]

18.2.2.2.3 Transport (TCP and UDP)

Once an IP datagram has arrived at its destination, the receiving host must decide what application is expected to deal with the incoming data. Consequently, the IP datagram is decapsulated so that transport layer information can be examined. In most cases, one of two transport layer protocols is used: the Transmission Control Protocol (TCP) or User Datagram Protocol (UDP). A common feature of both these protocols is that they use source and destination port numbers to control the flow of information between sending and receiving applications within the end hosts.

TCP and UDP are designed for different types of applications. In particular, TCP is designed for guaranteeing (via acknowledgment numbers) the orderly (via sequence numbers) delivery of data. It essentially provides a virtual circuit for applications (e.g., file transfer) that require such services.

By comparing the TCP and UDP packet figures (Figures 18-10 and 18-11), it is obvious that TCP requires overhead for providing its services. In contrast, the UDP packet sacrifices these sequencing and delivery guarantees for faster service. If an application that uses UDP needs to be concerned with guaranteed delivery or sequencing, then the application itself is responsible for those services.

2. For those unfamiliar with this type of representation, note that there are 32 bits across, but that the bit count begins with 0.

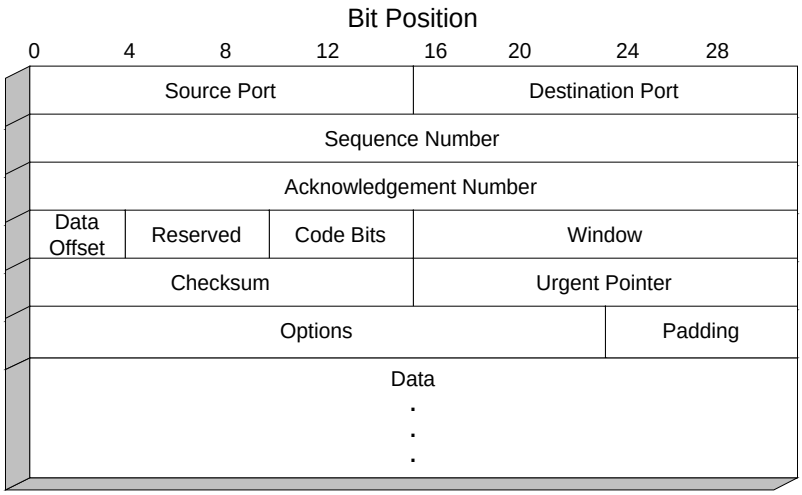

Figure 18-10. TCP Segment Format

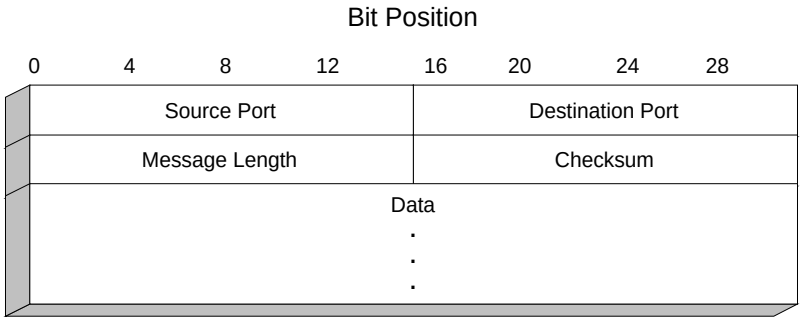

Figure 18-11. UDP Datagram Format

18.2.2.2.4 Applications

At the highest layer of the IP protocol suite are protocols that support network applications. Several familiar protocols include:

- HTTP, the HyperText Transfer Protocol, which underlies communications between entities on the world-wide web (not to be confused with HTML, the set of rules for structuring information to be transferred via HTTP).
- FTP, the File Transfer Protocol, which supports file transfers.
- SMTP, the Simple Mail Transfer Protocol, which supports electronic mail.
- Telnet, which provides a virtual terminal interface to a host machine.
- NTP, the Network Time Protocol, for ensuring accurate time synchronization across internetworked devices.

- DNS, or Domain Naming Service, which associates a familiar user-friendly name with an IP address. DNS is used transparently to the end user to resolve host and domain names such as www.telcordia.com to an IP address with which a user layer application will complete an application layer connection.

18.2.3 IP Addressing

18.2.3.1 Basics of Addressing

IP addresses are typically represented in a "dotted-decimal" format, which formats the underlying binary address as four groups of decimals (digits 0-9) separated by decimal points, or "dots." The native binary address is 32 bits long and each of the four groups of decimal numbers represents 8 bits. Therefore, each of the four groups can range from 0 (i.e., binary 00000000) to 255 (i.e., binary 11111111). For example, the native binary address 11000000 10101000 00110111 00101010 would be represented (for the convenience of humans) as dotted decimal address 192.168.55.42.

Each properly configured host on the Internet must uniquely possess one of the addresses in this 32-bit space. The full requirements are more complex and are discussed in sections on addressing immediately following, on Network Address Translation (NAT), and on routing in Section 4.

18.2.3.2 Classful Addressing

A general strategy to addressing is to use hierarchical addresses. In surface mail, this principle is applied by specifying a country (usually with a default value), state or province, street, house number, and perhaps apartment or room number. However, the original IP addressing scheme was a two-level hierarchy comprising a network address and a host address.

Table 18-2 depicts the three primary original classes of IP address. In addition, there is also a Class D address space (224.0.0.0 - 239.255.255.255), which is allocated for multicast, and a Class E address space above that which is held in reserve.

This classful approach seemed to be an effective way to allocate network numbers across a range of network sizes. Organizations could choose an address space that roughly suited their needs, and routers in the Internet would be able to route packets based on the network number. So, for example, an organization that needed 150 IP addresses could acquire a Class C address (e.g., 192.168.22.0 through 192.168.22.255) that would provide room for growth. Routers outside that organization would only need to store one entry summarizing 192.168.22.0 in their routing tables, thus conserving resources.

However, the tremendous growth of the Internet was not foreseen in its early days. Addresses were assigned upon request, rather than upon need. Internet planners became concerned about finding ways to assign addresses more efficiently to prevent address exhaustion while keeping routing tables at a manageable size.

Table 18-2. Classful Addresses

Class	Range	Network Prefix	No. of Networks	Hosts/Network
Class A	0.0.0.0-127.255.255.255[a]	8 bits[b]	127	16,777,216
Class B	128.0.0.0-191.255.255.255	16 bits	16,384	65,536
Class C	1192.0.0.0-223.255.255.255	24 bits	2,097,152	256

a. The 127 network is reserved for use as a loopback network.

b. Of these 8 bits, the first is always 0, so 7 bits are free to be used to identify unique networks. Fixing the first binary digit also implies that Class A addresses consume half the total address space. Similarly, the first two binary digits of a Class B address are fixed at 10, implying that Class B consumes 1/4 of the total address space. Finally, the first three binary digits of a Class C address are fixed at 110, implying that Class C consumes 1/8 of the total address space.

18.2.3.3 Subnetting

The original "classful" addressing scheme breaks an IP address into two parts: a network address and a host address. With this two-layer hierarchy, an organization would advertise its network address (e.g., a Class C of 192.168.55.0) outside to the Internet, and then deal with routing data to and from a specific host (e.g., 192.168.55.12) based upon its host number only (i.e., 12). If all the organization's hosts in this network were topographically related, all would be well. If, however, the organization had two locations (e.g., two buildings on a campus), it would need to request an additional network (e.g., 192.168.2.0). This caused two problems. First, it wasted addresses since an enterprise's request for an additional network would not be based on host number exhaustion, but on internal routing needs. Second, it increased the size of routing tables because the enterprise now had additional networks that needed to be advertised to the outside world.

This problem was ameliorated in the mid-1980s by the introduction of subnetting, which essentially takes some of the host address space and uses it for an additional layer of addressing.

As Figure 18-12 shows, a traditional Class B address uses the first 16 bits of the 32-bit address space to indicate the network with 16 bits remaining for the host address. This may be referred to as a "/16" network. Subnetting allows additional bits from the host space to be used to indicate the subnet. In Figure 18-12, 8 bits have been allocated to the subnet, yielding a total of 24 bits for the Extended Network Prefix, which includes both the network and subnetwork space. Similar subnetting examples could be applied to other traditional class addresses with various subnet sizes (e.g., a /25 prefix that adds an additional bit to a Class C address prefix).

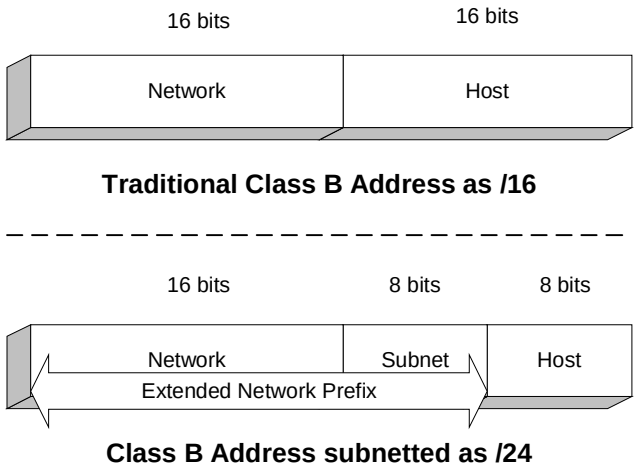

Figure 18-12. Class B Addresses

Subnetting has the advantage of allowing an enterprise network manager to subdivide a network into smaller subnets for efficient internal routing, while not requiring additional networks to be advertised to the world outside the enterprise.

18.2.3.4 Classless Addressing

By the mid-1990s, it became clear to the Internet community that additional steps were needed to make addressing more efficient and prevent address depletion. The essence of the solution, called Classless Inter-Domain Routing (CIDR), was to do away with the traditional concepts of Class A, B, and C addresses and replace them with addresses whose network component was arbitrary in length. That is, a network manager was not limited to choosing from networks with only a /8-, /16-, or /24-bit network prefix, but could select with greater granularity based upon need (for example, a /21 network). In addition to conserving numbers, CIDR makes routing more efficient because, unlike subnetting, CIDR networks are actually routed in the Internet based upon the prefix. In the case above, the manager who required 2000 addresses would have previously needed to obtain either a Class B address (thereby wasting about 62,000 addresses), or eight Class C addresses (each of which would need to be added to routing tables throughout the Internet).

Thanks to CIDR, the impending depletion of IP addresses was averted with minimal growth in the number of entries in routing tables.

Softswitch
Architecture for VoIP

Franklin D. Ohrtman, Jr.

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CHAPTER 2

The Public Switched Telephone Network (PSTN)

An understanding of the workings of the *Public Switched Telephone Network* (PSTN) is best grasped by understanding its three major components: access, switching, and transport (see Figure 2-1). Each element has evolved over the 100-plus year history of the PSTN. Access pertains to how a user accesses the network. Switching refers to how a call is "switched" or routed through the network, and transport describes how a call travels or is "transported" over the network.

Access

Access refers to how the user accesses the telephone network. For most users, access is gained to the network via a telephone handset. Transmission and reception is via diaphragms where the mouthpiece converts the air pressure of voice into an analog electromagnetic wave for transmission to the switch. The earpiece performs this process in reverse. The most sophisticated aspect of the handset is its *Dual-Tone Multifrequency* (DTMF) function, which signals the switch by tones. The handset is usually connected to the central office (where the switch is located) via copper wire known as *twisted pair* because, in most cases, it consists of a twisted pair of copper wire. The stretch of copper wire connects the telephone handset to the central office. Everything that runs between the subscriber and the central office is known as *outside plant*. Telephone equipment at the subscriber end is called *customer premise equipment* (CPE).

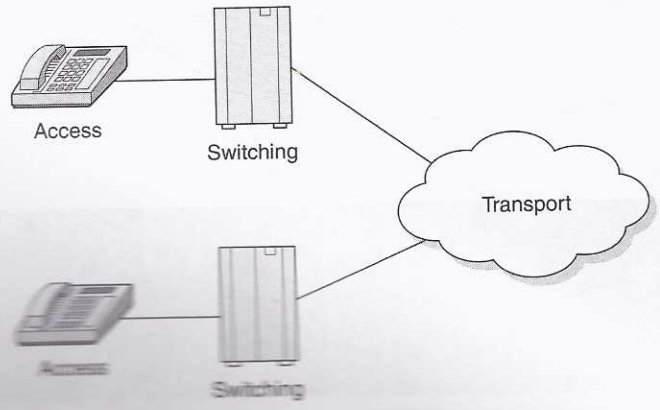


Figure 2-1
The three components of a telephone network: access, switching, and transport

Switching

The PSTN is a star network; that is, every subscriber is connected to another via at least one if not many hubs known as offices. In those offices are switches. Very simply, local offices are used for local service connections and tandem offices for long-distance service. Local offices, better known as central offices, use Class 5 switches, and tandem offices use Class 4 switches. Figure 2-2 details the relationship between Class 4 and 5 switches. A large city might have several central offices. Denver (population 2 million), for example, is estimated to have almost 40 central offices. Central offices in a large city often take up much of a city block and are recognizable as large brick buildings with no windows.

The first telephone switches were human. Taking a telephone handset off hook alerted a telephone operator of the caller's intention to place a call. The caller informed the operator of their intended called party and the operator set up the call by manually connecting the two parties.

Mechanical switching is credited to Almon Stowger, an undertaker in Kansas City, Missouri, who realized he was losing business when families of the deceased picked up their telephone handset and simply asked the operator to connect them with "the undertaker." The sole operator in this

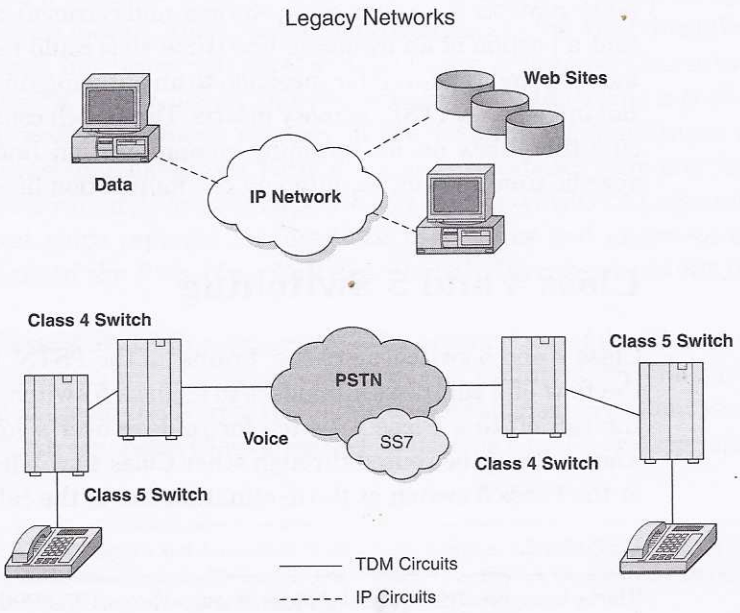


Figure 2-2 The traditional relationship of Class 4, Class 5, and data networks

town was engaged to an undertaker competing with Stowger. This competing undertaker had promised to marry the operator once he had the financial means to do so. The operator, in turn, was more than willing to help him achieve that goal.

Stowger, realizing he was losing business to his competitor due to the intercession of the telephone operator, proceeded to invent an electromechanical telephone handset and switch that enabled the caller, by virtue of dialing the called party's number, to complete the connection without human intervention. Telephone companies realized the enormous savings in manpower (or womanpower as the majority of telephone operators at the time were women) by automating the call setup and takedown process. Stowger switches (also known as crossbar switches) can still be found in the central offices of rural America and lesser developed countries.

Stowger's design remained the predominant telephone switching technology until the mid-1970s. Beginning in the '70s, switching technology evolved to mainframe computers; that is, no moving parts were used and the computer telephony applications made such features as conferencing and call forwarding possible. In 1976, AT&T installed its first *#4 Electronic Switching System* (4ESS) tandem switch. This was followed shortly thereafter with the 5ESS as a central office switch. ESS central office switches did not require a physical connection between incoming and outgoing circuits. Paths between the circuits consisted of temporary memory locations that enabled the temporary storage of traffic. For an ESS system, a computer controls the assignment, storage, and retrieval of memory locations so that a portion of an incoming line (time slot) could be stored in temporary memory and retrieved for insertion to an outgoing line. This is called a *time slot interchange* (TSI) memory matrix. The switch control system maps specific time slots on an incoming communication line (such as a DS3) to specific time slots on an outgoing communication line.[1]

Class 4 and 5 Switching

Class 4 and 5 switches are the "brains" of the PSTN. Figure 2-3 illustrates the flow of a call from a handset to a Class 5 switch, which in turn hands the call off to a Class 4 switch for routing over a long-distance network. That call may be routed through other Class 4 switches before terminating at the Class 5 switch at the destination end of the call before being passed

[1]Harte, Lawrence. *Telecom Made Simple*. Fuquay-Varina, NC: APDG Publishing, 2002.

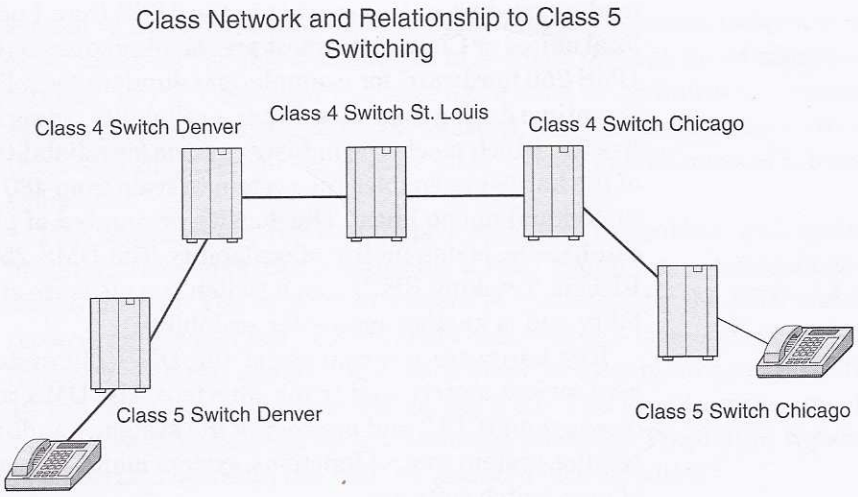


Figure 2-3
Relationship of Class 4 and 5 switching

on to the terminating handset. Class 5 switches handle local calling and Class 4 switches handle long-distance calls. The performance metrics for the Class 4 and 5 have been reliability, scalability, *quality of service* (QoS), signaling, and features.

Class 4 and 5 Architecture One reason for the reputation of Class 4 and 5 switches being reliable is that they have been tested by time in the legacy market. Incremental improvements to the 4ESS included new interfaces, hardware, software, and databases to improve *Operations, Administration, Maintenance, and Provisioning* (OAM&P). The inclusion of the 1A processor improved memory in the 4 and 5ESS mainframe, allowing for translation databases. Ultimately, those databases were interfaced with the *Centralized Automatic Reporting on Trunks* (CAROT). Later, integrated circuit chips replaced the magnetic core stores and improved memory and boosted the *Busy Hour Call Attempt* (BHCA) capacity to 700,000 BHCAs.[2]

Class 4 and 5 Components The architecture of the Class 4 and 5 switch is the product of 25-plus years of design evolution. For the purposes of this discussion, the Nortel DMS-250, one of the most prevalent products in the North American Class 4 market, is used as a real-world example. The other

[2]Chapuis, Robert, and Amos Joel. "In the United States, AT&T's Digital Switch Entry No. 4 ESS, First Generation Time Division Digital Switch." *Electronics, Computers, and Telephone Systems.* New York: North Holland Publishing, 1990, p. 337–338.

leading product in this market is the 4ESS from Lucent Technologies. For local offices or Class 5, the most prevalent product is the 5ESS from Lucent. DMS-250 hardware, for example, is redundant for reliability and decreased downtime during upgrades. It has a reliability rating of 99.999 percent (the five 9s), which meets the industry metric for reliability. The modular design of the hardware enables the system to scale from 480 to over 100,000 DS0s (individual phone lines). The density, or number of phone lines the switch can handle, is one metric of scalability. The DMS-250 is rated at 800,000 BHCAs. Tracking BHCAs on a switch is a measure of call-processing capability and is another metric for scalability.

Key hardware components of the DMS-250 system include the DMS core, switch matrix, and trunk interface. The DMS core is the *central processing unit* (CPU) and memory of the system, handling high-level call processing, system control functions, system maintenance, and the installation of new switch software.

The DMS-250 switching matrix switches calls to their destinations. Its nonblocking architecture enables the switch to communicate with peripherals through fiber optic connections. The trunk interfaces are peripheral modules that form a bridge between the DMS-250 switching matrix and the trunks it serves. They handle voice and data traffic to and from customers and other switching systems. DMS-250 trunk interfaces terminate DS-1, *Integrated Services Digital Network* (ISDN) *Primary Rate Interface* (PRI), X.75/X.75 packet networking, and analog trunks. They also accommodate test and service circuits used in office and facility maintenance. It is important to note that the Class 4 switching matrix is a part of the centralized architecture of the Class 4. Unlike the media gateways in a softswitch solution, it must be collocated with the other components of the Class 4.

DMS-250 billing requires the maintenance of real-time, transaction-based billing records for many thousands of customers and scores of variants in service pricing. The DMS-250 system automatically provides detailed data, formats the data into call detail records, and constructs bills.[3]

Private Branch Exchange (PBX)

As the name would imply, a *private branch exchange* (PBX) is a switch owned and maintained by a business with many (20 or more) users. A key

[3]Nortel Networks. "Product Service Information-DMS300/250 System Advantage." www.nortel.com, 2001.

system is used by smaller offices. PBXs and key systems today are computer based and enable soft changes to be made through an administration terminal or PC. Unless the business has a need for technical telecommunications personnel on staff for other reasons, the business will normally contract with their vendor for routine adds, moves, and changes of telephone equipment.

PBX systems are often equipped with key assemblies and systems, including voice mail, call accounting, a local maintenance terminal, and a dial-in modem. The voice mail system is controlled by the PBX and only receives calls when the PBX software determines a message can be left or retrieved. The call accounting system receives system message details on all call activities that occur within the PBX. The local terminal provides onsite access to the PBX for maintenance activities. The dial-in capability also provides access to the PBX for maintenance activities.[4]

Centrex

After PBXs caught on in the industry, local exchange carriers began to lose some of their more lucrative business margins. The response to the PBX was Centrex. Centrex is a service offered by a local telephone service provider (primarily to businesses) that enables the customer to have features that are typically associated with a PBX. These features include three- or four-digit dialing, intercom features, distinctive line ringing for inside and outside lines, voice mail, call-waiting indication, and others. Centrex services flourished and still have a place for many large, dispersed entities such as large universities and major medical centers.

One of the major selling points for Centrex is the lack of capital expenditure up front. That, coupled with the reliability associated with Centrex due to its location in the telephone company central office, has kept Centrex as the primary telephone system in many of the businesses referenced previously. PBXs, however, have cut into what was once a lucrative market for the telephone companies and are now the rule rather than the exception for business telephone service. This has come about because of inventive ways of funding the initial capital outlay and the significantly lower operating cost of a PBX versus a comparable Centrex offering.

[4]Harte, Lawrence. *Telecom Made Simple*. Fuquay-Varina, NC: APDG Publishing, 2002.

Multiplexing

The earliest approach to getting multiple conversations over one circuit was *frequency division multiplexing* (FDM). FDM was made possible by the vacuum tube where the range of frequencies was divided into parcels that were distributed among subscribers. In the first FDM architectures, the overall system bandwidth was 96 kHz. This 96 kHz could be divided among a number of subscribers into, for example, 5 kHz per subscriber, meaning almost 20 subscribers could use this circuit.

FDM is an analog technology and suffers from a number of shortcomings. It is susceptible to picking up noise along the transmission path. This FDM signal loses its power over the length of the transmission path. FDM requires amplifiers to strengthen the signal over that path. However, the amplifiers cannot separate the noise from the signal and the end result is an amplified noisy signal.

The improvement over FDM was *time division multiplexing* (TDM). TDM was made possible by the transistor that arrived in the market in the 1950s and 1960s. As the name would imply, TDM divides the *time* rather than the frequency of a signal over a given circuit. Although FDM was typified by "some of the frequency all of the time," TDM is "all of the frequency some of the time." TDM is a digital transmission scheme that uses a small number of discrete signal states. Digital carrier systems have only three valid signal values: one positive, one negative, and zero. Everything else is registered as noise. A repeater, known as a regenerator, can receive a weak and noisy digital signal, remove the noise, reconstruct the original signal, and amplify it before transmitting the signal onto the next segment of the transmission facility. Digitization brings with it the advantages of better maintenance and troubleshooting capability, resulting in better reliability. Also, a digital system enables improved configuration flexibility.

TDM has made the multiplexer, also known as the channel bank, possible. In the United States, the multiplexer or "mux" enables 24 channels per single four-wire facility. This is called a T-1, DS1, or T-Carrier. Outside North America and Japan, it is 32 channels per facility and known as E1. These systems came on the market in the early 1960s as a means to transport multiple channels of voice over expensive transmission facilities.

Voice Digitization via Pulse Code Modulation

One of the first processes in the transmission of a telephone call is the conversion of an analog signal into a digital one. This process is called *pulse*

code modulation (PCM). This is a four-step process consisting of *pulse amplitude modulation* (PAM) sampling, companding, quantization, and encoding.

Pulse Amplitude Modulation (PAM) The first stage in PCM is known as PAM. In order for an analog signal to be represented as a digitally encoded bitstream, the analog signal must be sampled at a rate that is equal to twice the bandwidth of the channel over which the signal is to be transmitted. As each analog voice channel is allocated 4 kHz of bandwidth, each voice signal is sampled at twice that rate, or 8,000 samples per second. In a T-Carrier, the standard in North America and Japan, each channel is sampled every one eight-thousandth of a second in rotation, resulting in the generation of 8,000 pulse amplitude samples from each channel every second. If the sampling rate is too high, too much information is transmitted and bandwidth is wasted. If the sampling rate is too low, aliasing may result. Aliasing is the interpretation of the sample points as a false waveform due to the lack of samples.

Companding The second process of PCM is companding. Companding is the process of compressing the values of the PAM samples to fit the nonlinear quantizing scale that results in bandwidth savings of more than 30 percent. It is called companding as the sample is compressed for transmission and expanded for reception.[5]

Quantization The third stage in PCM is quantization. In quantization, values are assigned to each sample within a constrained range. In using a limited number of bits to represent each sample, the signal is quantized. The difference between the actual level of the input analog signal and the digitized representation is known as quantization noise. Noise is a detraction to voice quality and it is necessary to minimize noise. The way to do this is to use more bits, thus providing better granularity. In this case, an inevitable trade-off takes place bewteen bandwidth and quality. More bandwidth usually improves signal quality, but bandwidth costs money. Service providers, whether using TDM or *Voice over IP* (VoIP) for voice transmission will always have to choose between quality and bandwidth. A process known as nonuniform quantization involves the usage of smaller

[5]Shepard, Steven. *SONET/SDH Demystified.* New York: McGraw-Hill, 2001. p. 15–21.

quantization steps at smaller signal levels and larger quantization steps for larger signal levels. This gives the signal greater granularity or quality at low signal levels and less granularity (quality) at high signal levels. The result is to spread the signal-to-noise ratio more evenly across the range of different signals and to enable fewer bits to be used compared to uniform quantization. This process results in less bandwidth being consumed than for uniform quantization.[6]

Encoding The fourth and final process in PCM is encoding the signal. This is performed by a *codec* (coder/decoder). Three types of codecs exist: waveform codecs, source codecs (also known as vocoders), and hybrid codecs. Waveform codecs sample and code an incoming analog signal without regard to how the signal was generated. Quantized values of the samples are then transmitted to the destination where the original signal is reconstructed, at least to a certain approximation of the original. Waveform codecs are known for simplicity with high-quality output. The disadvantage of waveform codecs is that they consume considerably more bandwidth than the other codecs. When waveform codecs are used at low bandwidth, speech quality degrades markedly.

Source codecs match an incoming signal to a mathematical model of how speech is produced. They use the linear predictive filter model of the vocal tract, with a voiced/unvoiced flag to represent the excitation that is applied to the filter. The filter represents the vocal tract and the voice/unvoiced flag represents whether a voiced or unvoiced input is received from the vocal chords. The information transmitted is a set of model parameters as opposed to the signal itself. The receiver, using the same modeling technique in reverse, reconstructs the values received into an analog signal.

Source codecs also operate at low bit rates and reproduce a synthetically sounding voice. Using higher bit rates does not result in improved voice quality. Vocoders (source codecs) are most widely used in private and military applications.

Hybrid codecs are deployed in an attempt to derive the benefits from both technologies. They perform some degree of waveform matching while mimicking the architecture of human speech. Hybrid codecs provide better voice quality at low bandwidth than waveform codecs. Table 2-1 provides an outline of the different ITU codec standards and Table 2-2 lists the parameters of the voice codecs.

[6]Collins, Daniel. *Carrier Grade Voice Over IP.* New York: McGraw-Hill, 2001. p. 95–96.

Table 2-1
Descriptions of voice codecs (ITU)

ITU Standard	Description
P.800	A subjective rating system to determine the *Mean Opinion Score* (MOS) or the quality of telephone connections
G.114	A maximum one-way delay end to end for a VoIP call (150 ms)
G.165	Echo cancellers
G.168	Digital network echo cancellers
G.711	PCM of voice frequencies
G.722	7 kHz audio coding within 64 Kbps
G.723.1	A dual-rate speech coder for multimedia communications transmitting at 5.3 and 6.3 Kbps
G.729	Coding for speech at 8 Kbps using *conjugate-structure algebraic code-excited linear-prediction* (CS-ACELP)
G.729A	Annex A reduced complexity 8 Kbps CS-ACELP speech codec
H.323	A packet-based multimedia communications system
P.861	Specifies a model to map actual audio signals to their representations inside the human head
Q.931	Digital subscriber signaling system number 1 ISDN user-network interface layer 3 specification for basic call control

Table 2-2
Parameters of voice codecs

Standard	Data rate (Kbps)	Delay (ms)	MOS	Codec
G.711	64	0.125	4.8	Waveform
G.721, G.723, G.726	16,24,32,40	0.125	4.2	
G.728	16	2.5	4.2	
G.729	8	10	4.2	
G.723.1	5.3, 6.3	30	3.5, 3.98	

Popular Speech Codecs Codecs are best known for the sophisticated compression algorithms they introduce into a conversation. Bandwidth costs service providers money. The challenge for many service providers is to squeeze as much traffic as possible into one "pipe," that is one channel. Most codecs allow multiple conversations to be carried on one 64 kbps channel. There is an inevitable trade off in compression for voice quality in the

conversation. The challenge for service providers is to balance the economics of compression with savings in bandwidth costs.

G.711 G.711 is the best-known coding technique in use today. It is a waveform codec and is the coding technique used in circuit-switched telephone networks all over the world. G.711 has a sampling rate of 8,000 Hz. If uniform quantization were to be used, the signal levels commonly found in speech would be such that at least 12 bits per sample would be needed, giving it a bit rate of 96 Kbps. Nonuniform quantization is used with eight bits used to represent each sample. This quantization leads to the well-known 64 Kbps DS0 rate. G.711 is often referred to as PCM. G.711 has two variants: A-law and mu-law. Mu-law is used in North America and Japan where T-Carrier systems prevail. A-law is used everywhere else in the world. The difference between the two is the way nonuniform quantization is performed. Both are symmetrical at approximately zero. Both A-law and mu-law offer good voice quality with a MOS of 4.3, with 5 being the best and 1 being the worst. Despite being the predominant codec in the industry, G.711 suffers one significant drawback; it consumes 64 Kbps in bandwidth. Carriers seek to deliver voice quality using little bandwidth, thus saving on operating costs.

G.728 LD-CELP *Code-Excited Linear Predictor* (LD-CELP) codecs implement a filter and contain a codebook of acoustic vectors. Each vector contains a set of elements in which the elements represent various characteristics of the excitation signal. CELP coders transmit to the receiving end a set of information determining filter coefficients, gain, and a pointer to the chosen excitation vector. The receiving end contains the same code book and filter capabilities so that it reconstructs the original signal. G.728 is a backward-adaptive coder as it uses previous speech samples to determine the applicable filter coefficients. G.728 operates on five samples at one time. That is, 5 samples at 8,000 Hz are needed to determine a codebook vector and filter coefficients based upon previous and current samples. Given a coder operating on five samples at a time, a delay of less than 1 millisecond is the result. Low delay equals better voice quality.

The G.728 codebook contains 1,024 vectors, which requires a 10-bit index value for transmission. It also uses 5 samples at a time taken at a rate of 8,000 per second. For each of those 5 samples, G.728 results in a transmitted bit rate of 16 Kbps. Hence, G.728 has a transmitted bit rate of 16 Kbps. Another advantage here is that this coder introduces a delay of 0.625 milliseconds with an MOS of 3.9. The difference from G.711's MOS of 4.3 is imperceptible to the human ear. The bandwidth savings between G.728's 16 Kbps per conversation and G.711's 64 Kbps per conversation make G.728 very attractive to carriers given the savings in bandwidth.

G.723.1 ACELP G.723.1 ACELP can operate at either 6.3 Kbps or 5.3 Kbps with the 6.3 Kbps providing higher voice quality. Bit rates are contained in the coder and decoder, and the transition between the two can be made during a conversation. The coder takes a bank-limited input speech signal that is sampled a 8,000 Hz and undergoes uniform PCM quantization, resulting in a 16-bit PCM signal. The encoder then operates on blocks or frames of 240 samples at a time. Each frame corresponds to 30 milliseconds of speech, which means that the coder causes a delay of 30 milliseconds. With a look-ahead delay of 7.5 milliseconds, the total algorithmic delay is 37.5 milliseconds. G.723.1 gives an MOS of 3.8, which is highly advantageous in regards to the bandwidth used. The delay of 37.5 milliseconds one way does present an impediment to good quality, but the round-trip delay over varying aspects of a network determines the final delay and not necessarily the codec used.

G.729 G.729 is a speech coder that operates at 8 Kbps. This coder uses input frames of 10 milliseconds, corresponding to 80 samples at a sampling rate of 8,000 Hz. This coder includes a 5-millisecond look-ahead, resulting in an algorithmic delay of 15 milliseconds (considerably better than G.723.1). G.729 uses an 80-bit frame. The transmitted bit rate is 8 Kbps. Given that it turns in an MOS of 4.0, G.729 is perhaps the best trade-off in bandwidth for voice quality. The previous paragraphs provide an overview of the multiple means of maximizing the efficiency of transport via the PSTN. We find today that TDM is almost synonymous with circuit switching. Telecommunications engineers use the term TDM to describe a circuit-switched solution. A 64 Kbps G.711 codec is the standard in use on the PSTN. The codecs described in the previous pages apply to VoIP as well. VoIP engineers seeking to squeeze more conversations over valuable bandwidth have found these codecs very valuable in compressing VoIP conversations over an IP circuit.[7]

Signaling

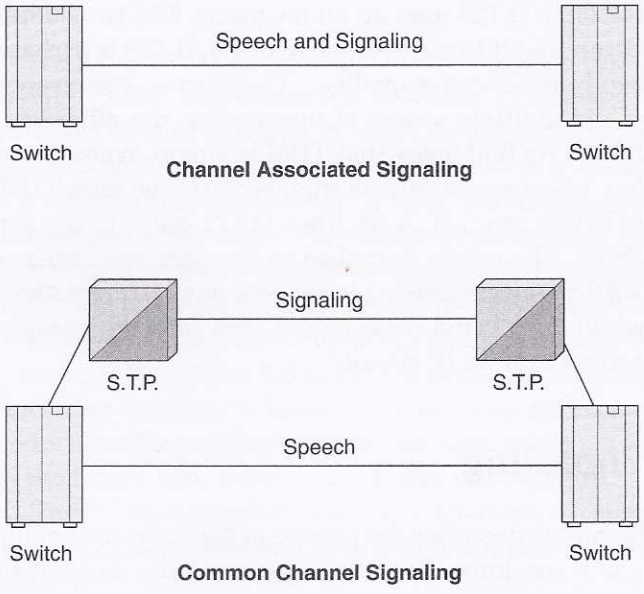
Signaling describes the process of how calls are set up and torn down. Generally speaking, there are three main functions of signaling: supervision, alerting, and addressing. Supervision refers to monitoring the status of a line or circuit to determine if there is traffic on the line. Alerting deals with the ringing of a phone indicating the arrival of an incoming call. Addressing is the routing of a call over a network. As telephone networks matured,

[7]Ibid.

individual nations developed their proprietary signaling systems. Ultimately, there become a signaling protocol for every national phone service in the world. Frankly, it is a miracle that international calls are ever completed given the complexity of interfacing national signaling protocols.

Signaling System 7 (SS7) For much of the history of circuit-switched networks, signaling followed the same path as the conversation. This is called *Channel-Associated Signaling* (CAS) and is still in wide use today. R1 *Multifrequency* (MF) used in North American markets and *R2 Multi-Frequency Compelled* (RFC) used elsewhere in the world are the best examples of this. Another name for this is in-channel signaling. The newer technology for signaling is called *Common Channel Signaling* (CCS), also known as out-of-band signaling. CCS uses a separate transmission path for call signaling and not the bearer path for the call. This separation enables the signaling to be handled in a different manner to the call. This enables signaling to be managed by a network independent of the transport network. Figure 2-4 details the difference between CAS and CCS.

Figure 2-4
CAS and CCS



[8]Stallings, William. *ISDN and Broadband ISDN with Frame Relay and ATM.* New York: Prentice Hall, 1995. p.292.

Signaling System 7 (SS7) is the standard for CCS with many national variants throughout the world (such as Mexico's NOM-112). It routes control messages through the network to perform call management (setup, maintenance, and termination) and network management functions. Although the network being controlled is circuit switched, the control signaling is implemented using packet-switching technology. In effect, a packet-switched network is overlaid on a circuit-switched network in order to operate and control the circuit-switched network. SS7 defines the functions that are performed in the packet-switched network but does not dictate any particular hardware implementation.[8]

The SS7 network and protocol are used for the following:

- Basic call setup, management, and tear down
- Wireless services such as *personal communications services* (PCS), wireless roaming, and mobile subscriber authentication
- *Local number portability* (LNP)
- Toll-free (800/888) and toll (900) wireline services
- Enhanced call features such as call forwarding, calling party name/number display, and three-way calling
- Efficient and secure worldwide telecommunications

Signaling Links SS7 messages are exchanged between network elements over 56 or 64 Kbps bidirectional channels called signaling links. Signaling occurs out of band on dedicated channels rather than in-band on voice channels. Compared to in-band signaling, out-of-band signaling provides faster call setup times (compared to in-band signaling using MF signaling tones), more efficient use of voice circuits, support for *Intelligent Network* (IN) services that require signaling to network elements without voice trunks (such as database systems), and improved control over fraudulent network usage.

Signaling Points Each signaling point in the SS7 network is uniquely identified by a numeric point code. Point codes are carried in signaling messages exchanged between signaling points to identify the source and destination of each message. Each signaling point uses a routing table to select the appropriate signaling path for each message. Three kinds of signaling points are used in the SS7 network: *service switching points* (SSP), *signal transfer points* (STP), and *service control points* (SCP), as shown in Figure 2-5.

SSPs are switches that originate, terminate, or tandem calls. An SSP sends signaling messages to other SSPs to set up, manage, and release voice

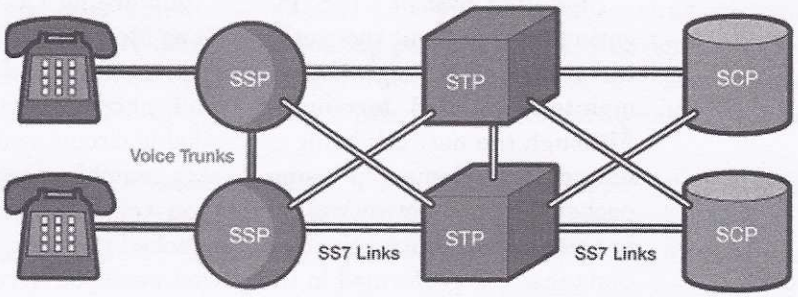


Figure 2-5
SS7 signaling points (Source: Performance Technologies)

circuits required to complete a call. An SSP may also send a query message to a centralized database (an SCP) to determine how to route a call (such as a toll-free 1-800/888 call in North America). An SCP sends a response to the originating SSP containing the routing number(s) associated with the dialed number. An alternate routing number may be used by the SSP if the primary number is busy or the call is unanswered within a specified time. Actual call features vary from network to network and from service to service.

Network traffic between signaling points may be routed via a packet switch called an STP. An STP routes each incoming message to an outgoing signaling link based on routing information contained in the SS7 message. Because it acts as a network hub, an STP provides improved utilization of the SS7 network by eliminating the need for direct links between signaling points. An STP may perform global title translation, a procedure by which the destination signaling point is determined from digits present in the signaling message (such as the dialed 800 number, the calling card number, or mobile subscriber identification number). An STP can also act as a firewall to screen SS7 messages exchanged with other networks.

Because the SS7 network is critical to call processing, SCPs and STPs are usually deployed in mated-pair configurations in separate physical locations to ensure network-wide service in the event of an isolated failure. Links between signaling points are also provisioned in pairs. Traffic is shared across all links in the linkset. If one of the links fails, the signaling traffic is rerouted over another link in the linkset. The SS7 protocol provides both error correction and retransmission capabilities to enable continued service in the event of signaling point or link failures.

SS7 Signaling Link Types Signaling links are logically organized by link type (A through F) according to their use in the SS7 signaling network (see Figure 2-6 and Table 2-3).

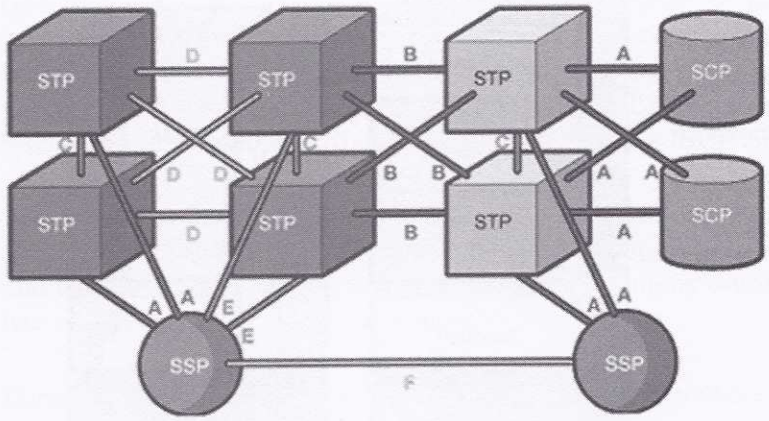


Figure 2-6
SS7 signaling link types (Source: Performance Technologies)

Table 2-3
Descriptions of SS7 links

A link	An A (access) link connects a signaling end point (an SCP or SSP) to an STP. Only messages originating from or destined to the signaling end point are transmitted on an A link.
B link	B (bridge) links connect an STP to another STP. Typically, a quad of B links interconnect peer (or primary) STPs (the STPs from one network to the STPs of another). The distinction between a B link and a D link is rather arbitrary. For this reason, such links may be referred to as B/D links.
C link	C (cross) links connect STPs performing identical functions into a mated pair. They are used only when an STP has no other route available to a destination signaling point due to link failure(s). Note that SCPs may also be deployed in pairs to improve reliability. Unlike STPs, however, signaling links do not interconnect mated SCPs.
D link	D (diagonal) links connect a secondary (local or regional) STP pair to a primary (internetwork gateway) STP pair in a quad-link configuration. Secondary STPs within the same network are connected via a quad of D links. The distinction between a B link and a D link is rather arbitrary. For this reason, such links may be referred to as B/D links.
E link	An E (extended) link connects an SSP to an alternate STP. E links provide an alternate signaling path if an SSP's home STP cannot be reached via an A link. E links are not usually provisioned unless the benefit of a marginally higher degree of reliability justifies the added expense.
F link	An F (fully associated) link connects two signaling end points (SSPs and SCPs). F links are not usually used in networks with STPs. In networks without STPs, F links directly connect signaling points.

Source: Performance Technologies

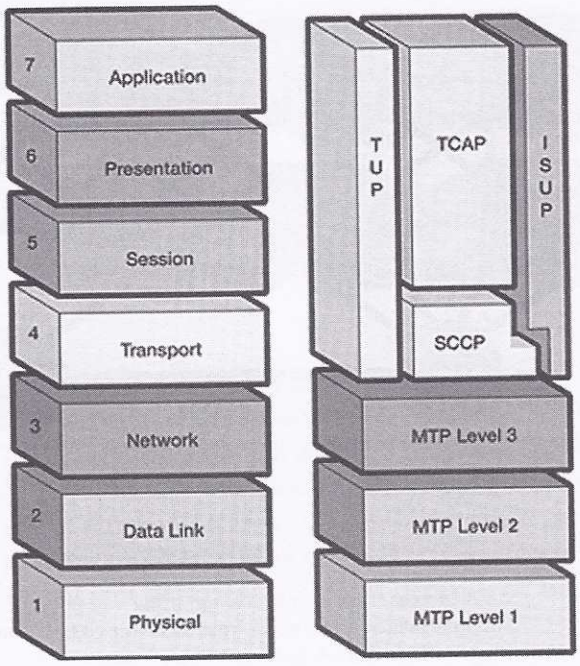


Figure 2-7
The OSI Reference Model and the SS7 protocol stack (Source: Performance Technologies)

SS7 Protocol Stack The hardware and software functions of the SS7 protocol are divided into functional abstractions called levels. These levels map loosely to the *Open Systems Interconnect* (OSI) seven-layer model defined by the *International Standards Organization* (ISO), as shown in Figure 2-7.

Message Transfer Part The *Message Transfer Part* (MTP) is divided into three levels. The lowest level, MTP level 1, is equivalent to the OSI physical layer. MTP level 1 defines the physical, electrical, and functional characteristics of the digital signaling link. Physical interfaces defined include E-1 (2,048 Kbps; 32 64-Kbps channels), DS-1 (1,544 Kbps; 24 64-Kbps channels), V.35 (64 Kbps), DS-0 (64 Kbps), and DS-0A (56 Kbps). MTP level 2 ensures accurate end-to-end transmission of a message across a signaling link. Level 2 implements flow control, message sequence validation, and error checking. When an error occurs on a signaling link, the message (or set of messages) is retransmitted. MTP level 2 is equivalent to the OSI data link layer.

MTP level 3 provides message routing between signaling points in the SS7 network. MTP level 3 reroutes traffic away from failed links and signaling points, and it controls traffic when congestion occurs. MTP level 3 is equivalent to the OSI network layer.

ISDN User Part (ISUP) The *ISDN User Part* (ISUP) defines the protocol used to set up, manage, and release trunk circuits that carry voice and data between terminating line exchanges (between a calling party and a called party). ISUP is used for both ISDN and non-ISDN calls. However, calls that originate and terminate at the same switch do not use ISUP signaling.

Telephone User Part (TUP) In some parts of the world (such as China and Brazil), the *Telephone User Part* (TUP) is used to support basic call setup and teardown. TUP handles analog circuits only. In many countries, ISUP has replaced TUP for call management.

Signaling Connection Control Part (SCCP) SCCP provides connectionless and connection-oriented network services and *global title translation* (GTT) capabilities above MTP level 3. A global title is an address (a dialed 800 number, calling card number, or mobile subscriber identification number) that is translated by SCCP into a destination point code and subsystem number. A subsystem number uniquely identifies an application at the destination signaling point. SCCP is used as the transport layer for TCAP-based services.

Transaction Capabilities Applications Part (TCAP) TCAP supports the exchange of noncircuit-related data between applications across the SS7 network using the SCCP connectionless service. Queries and responses sent between SSPs and SCPs are carried in TCAP messages. For example, an SSP sends a TCAP query to determine the routing number associated with a dialed 800/888 number and to check the *personal identification number* (PIN) of a calling card user. In mobile networks (IS-41 and GSM), TCAP carries *Mobile Application Part* (MAP) messages sent between mobile switches and databases to support user authentication, equipment identification, and roaming.

The Advanced Intelligent Network (AIN)

How are features delivered? In one concept, features are made possible by the *Advanced Intelligent Network* (AIN) and SS7. The AIN is a telephone network architecture that separates service logic from switching equipment, enabling new services to be added without having to redesign switches to support new services. It encourages competition among service providers as it makes it easier for a provider to add services, and it offers customers more service choices. Developed by Bell Communications Research, AIN is recognized as an industry standard in North America.

The AIN was a concept promoted by large telephone companies throughout the 1980s to promote their architecture for the 1990s and beyond. Two consistent themes characterize the AIN. One is that the network can control the routing of calls within it from moment to moment based on some criteria other than that of finding a path through the network for the call based on the dialed number. The other is that the originator or receiver of the call can inject intelligence into the network and affect the flow of the call. That intelligence is provided through the use of databases in a network.

The foundation of the AIN architecture is SS7 (see Figure 2-8). SS7 enables a wide range of services to be provided to the end-user. An SCP is a network entity that contains additional logic and that can be used to offer advanced services. To use the service logic of the SCP, a switch needs to contain functionality that will enable it to act upon instructions from the SCP. In such a case, the switch is known as an SSP. If a particular service needs to be invoked, the SSP sends a message to the SCP asking for instruction. The SCP, based upon data and service logic that is available, will tell the SSP which actions need to be taken.[9]

How does AIN work? A telephone caller dials a number that is received by a switch at the telephone company central office. The switch, also known as the signaling point, forwards the call over an SS7 network to an SCP where the service logic is located. The SCP identifies the service requested from part of the number that was dialed and returns information about how to handle the call to the signaling point. Examples of services that the SCP might provide include area number calling services, disaster recovery services, do not disturb services, and 800 toll-free and 5-digit extension dialing services.

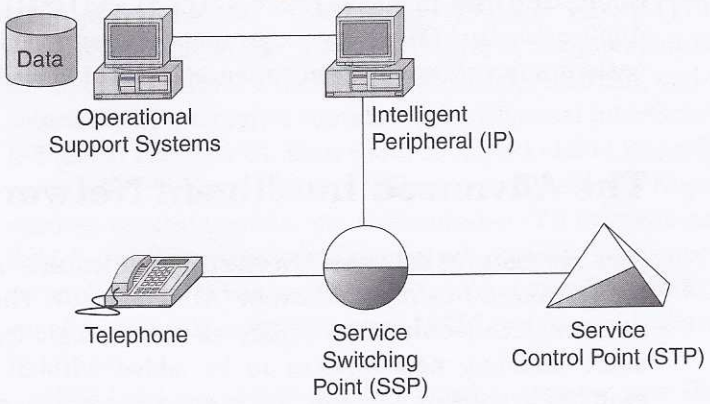


Figure 2-8
AIN release 1 architecture (Source: Telcordia)

[9]Collins, Michael. *Carrier Grade Voice Over IP.* New York: McGraw-Hill, 2001. p. 311.

In some cases, the call can be handled more quickly by an *intelligent peripheral* attached to the SSP over a high-speed connection. For example, a customized voice announcement can be delivered in response to the dialed number or a voice call can be analyzed and recognized. In addition, an adjunct facility can be added directly to the SSP for a high-speed connection to additional, undefined services.[10]

SCPs have two complementary tasks. First, they host the application functionality on which service logic is installed after services are created. Secondly, the SCP controls functionalities developed by SCP vendors. The SCP contains programmable, service-independent capabilities (or service logic) that are under the control of service providers. As a separate offering, the SCP can contain service-specific data that can be customized by either service providers or their customers (at the service provider's discretion). In addition to its programmable functionality, the SCP provides SS7 interface to switching systems.

A third element in the AIN architecture is the intelligent peripheral. Intelligent peripherals provide resources such as voice announcements, voice recognition, and DTMF digit collection. Intelligent peripherals support flexible interaction between the end user and the network.

The two main benefits of AIN are its capabilities to improve existing services and to develop new services as sources of revenue. To meet these goals, service providers must introduce new services rapidly, provide service customization, establish vendor independence, and create open interfaces. AIN technology uses an embedded base of stored program-controlled switching systems and the SS7 network. At the same time, AIN technology enables the separation of service-specific functions and data from other network resources. This feature reduces the dependency on switching system vendors for software developments and delivery schedules. In theory, service providers have more freedom to create and customize services.[11]

Features

Custom Local Area Signaling Service (CLASS) features are basic services available in each *local access and transport area* (LATA). The features and

[10]Search Networking. "Advanced Intelligent Networks," p.1, http://searchnetworking.techtarget.com. (This URL is no longer valid.)

[11]Telcordia Technologies. "Intelligent Networks (IN)." A white paper hosted by the International Engineering Consortium at www.iec.org.

the services they enable are a function of Class 5 switches and SS7 networks. The Class 4 switch offers no features of its own. It transmits the features of Class 5. With almost three decades of development, the Class 4 switch has a well-established history of interoperability with the features offered by the Class 5 and SS7 networks. Features often enable service provider systems to generate high margins that, of course, equate to stronger revenue streams.

Examples of features offered through the DMS-250 system can be grouped into two major categories: basic and enhanced services. The basic services include 1+, 800/900 service, travel cards, account codes, PIN numbers, operator access, speed dialing, hotline service, *automatic number identification* (ANI) screening, *virtual private networks* (VPNs), calling cards, and call detail recording. Enhanced services include information database services (NXX number services, authorization codes, calling card authorization, and debit/prepaid card services), and routing and screening (includes Carrier Identification Code [CIC] routing, time of day screening, ANI screening, and class of service screening). Enhanced features also include enterprise networks, data and video services (dedicated access lines, ISDN PRI services, dialable wideband services, and switched 56 Kpbs), and multiple dialing plans (full 10-digit routing, 7-digit VPN routing, 15-digit international dialing, speed dialing, and hotline dialing). Most of these features have been standards on the DMS-250 and other Class 4 switches for many years.

This long list of features is evidence of the importance of features in the legacy market in which they were developed. Service providers are reluctant to give up these features and the higher margins they generate. In the converging market, features are equally important to reliability because service providers don't want to offer fewer features to their customers and they will want to continue to offer high-margin features.

Performance Metrics for Class 4 and 5 Switches

To date, the basis for choosing a Class 4 or 5 switch architecture over that of softswitch has been reliability, scalability, good QoS, and well-known features and applications. The question now becomes, what happens when competing technologies meet or exceed the standards set around the legacy of the Class 4 or 5 switch?

Reliability Not all businesses need to provide or rely on round-the-clock availability. For those that do, Table 2-4 from a 1998 Gartner Group study[12] illustrates how costly downtime can be within and across industries.

The telecommunications industry is a little different. If a Class 4 switch with 100,000 DS0s charging $0.05 per minute were to be down 1 hour, the service provider would lose $300,000 in revenue. Downtime is lost revenue. Five 9s of reliability is the standard for the legacy market. Service providers know their customers expect the same levels of reliability in any new market as they did in the legacy market. The focus of debate on this issue in the industry revolves around the question of how many nines of reliability a product can deliver. The PSTN or legacy voice network claims five 9s. What is meant by five 9s?

One to Five 9s Availability is often expressed numerically as a percentage of uninterrupted productive time containing from one to five 9s. For instance, 99 percent availability, or two nines, equates to a certain amount of availability and downtime, as does 99.9 percent (three nines), and so on. Table 2-5 offers calculations for each of the five 9s based on 24-hour, year-round operation.

How Does a Switch Achieve Five 9s? Five 9s are not the result of divine guidance given to Bellcore in the 1970s, but rather a process of engineering resulting in a high level of reliability. Reliability is enhanced when each component is replicated in a system. This is called redundancy. If one unit

Table 2-4
Costs of down time

Industry	Application	Avg. cost per hour of downtime
Financial	Brokerage operations	$6,500,000
Financial	Credit card sales	$2,600,000
Media	Pay per view	$1,150,000
Retail	Home shopping (TV)	$113,000
Retail	Catalog sales	$90,000

[12]Nelson, Gene. "Architecting and Deploying High Availability Solutions: Business Drivers and Key Considerations." Compaq white paper. October 1998. Available online at ftp://ftp.compaq.com/pub/supportinformation/papers/ecg0641198.pdf.

Table 2-5

Availability and downtime: How the five 9s are calculated

Availability	Downtime
90% (one 9)	36.5 days per year
99% (two 9s)	3.65 days per year
99.9% (three 9s)	8.76 hours per year
99.99% (four 9s)	52.55 minutes per year
99.999% (five 9s)	5.25 minutes per year

fails, its replicated unit takes over. Redundancy is usually expressed in terms of a ratio of 1:1 where one replicated unit exists for every primary unit or N11 redundancy where there are N(N>1) replicated units per primary unit. Another mechanism to enhance reliability is to ensure no *single point of failure* (SPOF) exists on the system. That is, every mechanism has a backup in the event of the failure of one unit. Hot standby refers to having a replicated unit take over the functions of its primary unit for either planned or unplanned outages. Continuously available (reliable) systems rely exclusively on active replications to achieve transparency in masking both planned and unplanned outages.[13]

Network Equipment Building Standards (NEBS) In addition to the five 9s, the other buzzword for reliability in the Class 4 market is *Network Equipment Building Standards* (NEBS). NEBS address the physical reliability of a switch. NEBS parameters are contained in Telcordia specification SR 3580, which contains the requirements for performance, quality, safety, and environmental metrics applicable to network equipment installed in a carrier's central office. Most North American carriers require equipment in their central offices or switching locations to be NEBS compliant. Tests include electrical safety, immunity from electromagnetic emissions, lightning and power faulting, and bonding and grounding evaluations. Between five 9s and NEBs, the Class 4 and 5 vendors have developed, through decades of experience, a reliable product that delivers superb uptime, and rapid recovery capabilities. As a result, service providers are often reluctant to experiment with new technologies.

[13]"The Five 9's Pilgrimage: Toward the Next Generation of High Availability Systems." A white paper from Clustra at www.clustra.com.

Scalability For financial reasons, a Class 4 or 5 switch must offer flexibility in scalability. Ideally, a service provider starts out with a chassis and a minimum capability in terms of DS0s (one DS0 is one phone line) and then adds more capacity as demand increases. This is considered a scalable solution and is preferable to a solution that requires either another chassis or a whole new system (known as a forklift upgrade) when demand grows beyond the initial installation. Nortel's DMS-250 Class 4 switch, for example, scales up to approximately 100,000 DS0s. The other metric for scalability is the call-processing power of the switch. The DMS-250, for example, can process 800,000 BHCAs.[14]

Another financial reason for scalability is to achieve a low cost per DS0 in purchases and operations. By buying a large switch with many DS0s, a service provider can negotiate a lower price per DS0 and improve the odds of being profitable in that market. For these financial reasons, scalability is important to service providers in both the legacy and converging markets. In terms of BHCAs, a Class 4, such as DMS-250, offers call-processing power at 800,000 BHCAs. The first softswitches offered no more than 250,000 BHCAs.

Quality of Service (QoS) The voice quality of the PSTN is the standard for telephone service. The Class 4 switch was the first deployment of TDM utilizing a 64 Kbps circuit (G.711 codec), which remains the standard to this day. Service on the PSTN is known for the absence of echo, crosstalk, latency, dropped or blocked calls, noise, or any other degradations of voice quality. Mainstream service providers in North America are reluctant to deploy equipment that offers voice quality at a lesser standard than the Class 4 or 5 switch.

One advantage service providers have had in delivering good QoS is that their legacy networks were designed specifically to deliver excellent voice quality and dependability in call setup and teardown. Historically, service providers have owned and operated their own proprietary networks over which they have had total control. Given end-to-end control, this has ensured good QoS for their subscribers. Good voice quality has long been a selling point for long-distance service providers.

Good QoS has been important in the legacy market. Service providers fear the loss of market share if they introduce a product in a converging market that does not deliver the same QoS as subscribers experienced in the legacy market. QoS is vitally important in legacy and converging markets.

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[14]Nortel Networks. "Product Service Information-DMS300/250 System Advantage." www.nortel.com, 2001.

Transport

The PSTN was built over the course of a century at a great expense. Developers have been obsessed over the years with getting the maximum number of conversations transported at the least cost in infrastructure possible. Imagine an early telephone circuit running from New York to Los Angeles. The copper wire, repeaters, and other mechanisms involved in transporting a conversation this distance were immense for its time. Hence, the early telephone engineers and scientists had to find ways to get the maximum number of conversations transported over this network. Through much research, different means were developed to wring the maximum efficiency from the copper wire infrastructure. Many of those discoveries translated into technologies that worked equally well when fiber optic cable came on the market. The primary form of transport in the PSTN has been TDM (described earlier in this chapter). In the 1990s, long-distance service providers (*interexchange carriers* or IXCs) and local service providers (*local exchange carriers* or LECs) have migrated those transport networks to *Asynchronous Transfer Mode* (ATM). ATM is the means for transport from switch to switch.

Asynchronous Transfer Mode (ATM)

IXCs use high-speed switching systems to interconnect transmission lines. The key high-speed switching system used in IXC networks is ATM. ATM is a fast packet-switching technology that transports information through the use of small, fixed-length packets of data (53-byte cells).

The ATM system uses high-speed transmission facilities (155 Mbps/OC-3 and above). OC-3 is the entry-level speed for commercial ATM. Higher speeds (such as OC-192) are used in backbone networks of IXCs and other specialized service providers. ATM service was developed to enable one communication technology (high-speed packet data) to provide for voice, data, and video service in a single offering. When an ATM circuit is established, a patch through multiple switches is set up and remains in place until the connection is completed.

The ATM switch rapidly transfers and routes packets to the predesignated destinations. To transfer packets to their destinations, each ATM switch maintains a database called a routing table. The routing table instructs the ATM switch as to which channel to transfer the incoming packet to and what priority should be given to the packet. The routing table

is updated each time a connection is set up and disconnected. This enables the ATM switch to forward packets to the next ATM switch or destination point without spending much processing time.

The ATM switch also may prioritize or discard packets that it receives based on network availability (congestion). The ATM switch determines the prioritization and discard options by the type of channels and packets within the channels that are being switched by the ATM switch.

Three signal sources go through an ATM network to different destinations. The audio signal source (signal 1) is a 64 Kbps voice circuit. The data from the voice circuit is divided into short packets and sent to the ATM switch 1. ATM switch 1 looks in its routing table and determines the packet is destined for ATM switch 4, and ATM switch 4 adapts (slows down the transmission speed) and routes it to its destination voice circuit. The routing from ATM switch 1 to ATM switch 4 is accomplished by assigning the ATM packet a *virtual circuit identifier* (VCI) that an ATM switch can understand (the packet routing address). This VCI code remains for the duration of the communication.

The second signal source is a 384 Kbps Internet session. ATM switch 1 determines the destination of these packets is ATM switch 4 through ATM switch 3. The third signal source is a 1 Mbps digital video signal from a digital video camera. ATM switch 1 determines this signal is destined for ATM switch 4 for a digital television. In this case, the communication path is through ATM switches 1, 2, and 4.

Optical Transmission Systems

At the physical layer, carriers use microwave or fiber optic cable to transport ATM packets containing voice and data from switch to switch. IXC backbone carrier facilities primarily use microwave and fiber transmission lines. Microwave systems offer a medium capacity of up to several hundred Mbps communications with a range of 20 to 30 miles between towers. Fiber optic communication systems offer a data transmission capacity of over one million Mbps (one million in a million bits per second).

Microwave transmission systems transfer signal energy through an unobstructed medium (no blocking buildings or hills) between two or more points. In 1951, microwave radio transmission systems became the backbone of the telecommunications infrastructure. Microwave systems require a transducer to convert signal energy of one form into electromagnetic energy for transmission. The transducer must also focus the energy (using an antenna dish) so it may launch the energy in the desired direction. Some

of the electromagnetic energy that is transmitted by microwave systems is absorbed by the water particles in the air.

Although the extensive deployment of fiber optic cable has removed some of the need for microwave radio systems, microwave radio is still used in places that are hard to reach or are not cost effectively served by fiber cable, such as in developing countries. Fiber optic transmission is the transfer of information (usually in digital form) through the use of light pulses. Fiber optic transmission can be performed through glass fiber or through air. Fiber optic transmission lines are capable of extending up to 1,200 kilometers without amplifiers. Each fiber optic strand can carry up to 10 Gbps of optical channels and a fiber can have many optical channels (called DWDM). Each fiber cable can have many strands of fiber.

Fiber cable is relatively light and low cost, and it can be easily installed in a variety of ways. It does not experience distortion from electrical interference and this enables it to be installed on high-voltage power lines or in other places that have high levels of electromagnetic interference. Optical transmission systems use strands of glass or plastic fiber to transfer optical energy between points. For most optical transmission systems, the transmitting end-node uses a *light amplification through stimulated emission of radiation* (laser) device to convert digital information into pulsed light signals (amplitude modulation). The light signals travel down the fiber strand by bouncing (reflecting) off the sides of the fiber (called the cladding) until they reach the end of the fiber. The end of the fiber is connected to a photodetector that converts these light pulses back into their electrical signal form.

Synchronous optical transmission systems use a specific frame structure and the data transmission through the transmission line is synchronized to a precise clock. This eliminates the signaling overhead requirement for framing or timing alignment messages. The basic frame size used in optical transmission systems is 125 usec frames.

Optical transmission systems are characterized by their carrier level (OCX) where the basic carrier level 1 is 51.84 Mbps. Lower-level OC structures are combined to produce higher-speed communication lines. Different structures of OC are used in the world. The North American optical transmission standard is called *Synchronous Optical Network* (SONET) and the European (world standard) is *Synchronous Digital Hierarchy* (SDH).

Signals are applied to and are extracted from optical transmission systems using an *optical add/drop multiplexer* (OADM). The OADM is a network element that provides access to all or some subset *synchronous transport signal* (STS) line signals contained within an *optical carrier level N* (OC-N). The process used to direct a data signal or packet to a pay-

load of an optical signal is called mapping. The mapping table is contained in the OADM. A copy of the OADM mapping is kept at other locations in the event of equipment failure. This allows the OADM to be quickly reprogrammed.

SDH is an international digital transmission format used in optical (fiber) standardized networks that is similar (but not identical) to SONET. SDH uses standardized synchronous transmissions according to ITU standards G.707, G.708, and G.709. These standards define data transfer rates, defined optical interfaces, and signal structure formats.

Some of the key differences between SONET and SDH include differences in overhead (control) bits and minimum transfer rates. The first level available in the SONET system is OC1 and is 51.84 Mbps. The first level in the SDH system starts at STM-1 and has a data transmission rate of 155.52 Mbps. SONET also multiplexes *synchronous transport signal level 1* (STS-1) to form multiple levels of STS. The SDH system divides the channels into multiple DS0s (64 Kbps channels). This is why the overhead signaling structures are different.

Table 2-6 shows the optical standards for both SONET and SDH. This table shows that the first common optical level between SONET and SDH

Table 2-6

Optical transmission systems

OC level	Signal level	Sonet STS level	SDH STM level	DS0 (64 Kbps) channel
OC-1	51.84 Mbps	STS-1		672
OC-2	103.68 Mbps	STS-2		1,344
OC-3	155.52 Mbps	STS-3	STM-1	2,016
OC-4	207.36 Mbps	STS-4	STM-3	2,688
OC-9	466.56 Mbps	STS-9	STM-3	6,048
OC-12	622.08 Mbps	STS-12	STM-4	8,063
OC-18	933.12 Mbps	STS-18	STM-6	12,096
OC-24	1.24416 Gbps	STS-24	STM-8	16,128
OC-36	1.86624 Gbps	STS-36	STM-12	24,192
OC-48	2.48832 Gbps	STS-48	STM-16	32,256
OC-96	4.976 Gbps	STS-96	STM-32	64,512
OC-192	9.953 Gbps	STS-192	STM-64	129,024
OC-256	13.219 Gbps	STS-256		
OC-768	52.877 Gbps	STS-786		

is OC3 or STS-1. STS-x and STM-x are the standards that specify the electrical signal characteristics that are input to the respective optical encoding/multiplexing processes.

Conclusion

This chapter has described the major components of the PSTN. By categorizing the diverse components of the PSTN into three simple elements, access, switching, and transport, a framework is provided for understanding how comparable elements of a softswitch solution replace those of the PSTN, enabling bottlenecks to be bypassed in the PSTN when delivering voice services to subscribers. Many concepts deployed in the PSTN have been translated into softswitched networks, including signaling, voice codecs, and transport. When this technology can be duplicated by startup technology providers and implemented by competitive service providers, competition to the local loop becomes possible.

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S.652

One Hundred Fourth Congress
of the
United States of America
AT THE SECOND SESSION
Begun and held at the City of Washington on Wednesday,
the third day of January, one thousand nine hundred and ninety-six

An Act

To promote competition and reduce regulation in order to secure lower prices and higher quality services for American telecommunications consumers and encourage the rapid deployment of new telecommunications technologies.

[Italic->] Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, [<-Italic]

SECTION 1. SHORT TITLE; REFERENCES.

(a) SHORT TITLE- This Act may be cited as the `Telecommunications Act of 1996'.

(b) REFERENCES- Except as otherwise expressly provided, whenever in this Act an amendment or repeal is expressed in terms of an amendment to, or repeal of, a section or other provision, the reference shall be considered to be made to a section or other provision of the Communications Act of 1934 (47 U.S.C. 151 et seq.).

SEC. 2. TABLE OF CONTENTS.

The table of contents for this Act is as follows:

SEC. 3. DEFINITIONS.

(a) ADDITIONAL DEFINITIONS- Section 3 (47 U.S.C. 153) is amended--

(1) in subsection (r)--

(A) by inserting `(A)' after `means'; and

(B) by inserting before the period at the end the following: `, or (B) comparable service provided through a system of switches, transmission equipment, or other facilities (or combination thereof) by which a subscriber can originate and terminate a telecommunications service'; and

(2) by adding at the end thereof the following:

`(33) AFFILIATE- The term `affiliate' means a person that (directly or indirectly) owns or controls, is owned or controlled by, or is under common ownership or control with, another person. For purposes of this paragraph, the term `own' means to own an equity interest (or the equivalent thereof) of more than 10 percent.

`(34) AT&T CONSENT DECREE- The term `AT&T Consent Decree' means the order entered August 24, 1982, in the antitrust action styled United States v. Western Electric, Civil Action No. 82-0192, in the United States District Court for the District of Columbia, and includes any judgment or order with respect to such action entered on or after August 24, 1982.

`(35) BELL OPERATING COMPANY- The term `Bell operating company'--

`(A) means any of the following companies: Bell Telephone Company of Nevada, Illinois Bell Telephone Company, Indiana Bell Telephone Company, Incorporated, Michigan Bell Telephone Company, New England Telephone and Telegraph Company, New Jersey Bell Telephone Company, New York Telephone Company, U S West Communications Company, South Central Bell Telephone Company, Southern Bell Telephone and Telegraph Company, Southwestern Bell Telephone Company, The Bell Telephone Company of Pennsylvania, The Chesapeake and

Potomac Telephone Company, The Chesapeake and Potomac Telephone Company of Maryland, The Chesapeake and Potomac Telephone Company of Virginia, The Chesapeake and Potomac Telephone Company of West Virginia, The Diamond State Telephone Company, The Ohio Bell Telephone Company, The Pacific Telephone and Telegraph Company, or Wisconsin Telephone Company; and

`(B) includes any successor or assign of any such company that provides wireline telephone exchange service; but

`(C) does not include an affiliate of any such company, other than an affiliate described in subparagraph (A) or (B).

`(36) CABLE SERVICE- The term `cable service' has the meaning given such term in section 602.

`(37) CABLE SYSTEM- The term `cable system' has the meaning given such term in section 602.

`(38) CUSTOMER PREMISES EQUIPMENT- The term `customer premises equipment' means equipment employed on the premises of a person (other than a carrier) to originate, route, or terminate telecommunications.

`(39) DIALING PARITY- The term `dialing parity' means that a person that is not an affiliate of a local exchange carrier is able to provide telecommunications services in such a manner that customers have the ability to route automatically, without the use of any access code, their telecommunications to the telecommunications services provider of the customer's designation from among 2 or more telecommunications services providers (including such local exchange carrier).

`(40) EXCHANGE ACCESS- The term `exchange access' means the offering of access to telephone exchange services or facilities for the purpose of the origination or termination of telephone toll services.

`(41) INFORMATION SERVICE- The term `information service' means the offering of a capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information via telecommunications, and includes electronic publishing, but does not include any use of any such capability for the management, control, or operation of a telecommunications system or the management of a telecommunications service.

`(42) INTERLATA SERVICE- The term `interLATA service' means telecommunications between a point located in a local access and transport area and a point located outside such area.

`(43) LOCAL ACCESS AND TRANSPORT AREA- The term `local access and transport area' or `LATA' means a contiguous geographic area--

`(A) established before the date of enactment of the Telecommunications Act of 1996 by a Bell operating company such that no exchange area includes points within more than 1 metropolitan statistical area, consolidated metropolitan statistical area, or State, except as expressly permitted under the AT&T Consent Decree; or

`(B) established or modified by a Bell operating company after such date of enactment and approved by the Commission.

`(44) LOCAL EXCHANGE CARRIER- The term `local exchange carrier' means any person that is engaged in the provision of telephone exchange service or exchange access. Such term does not include a person insofar as such person is engaged in the provision of a commercial mobile service under section 332(c), except to the extent that the Commission finds that such service should be included in the definition of such term.

`(45) NETWORK ELEMENT- The term `network element' means a facility or equipment used in the provision of a telecommunications service. Such term also includes features, functions, and capabilities that are provided by means of such facility or equipment, including subscriber numbers, databases, signaling systems, and information sufficient for billing and collection or used in the transmission, routing, or other provision of a telecommunications service.

`(46) NUMBER PORTABILITY- The term `number portability' means the ability of users of telecommunications services to retain, at the same location, existing telecommunications numbers without impairment of quality, reliability, or convenience when switching from one telecommunications carrier to another.

`(47) RURAL TELEPHONE COMPANY- The term `rural telephone company' means a local exchange carrier operating entity to the extent that such entity--

`(A) provides common carrier service to any local exchange carrier study area that does not include either--

`(i) any incorporated place of 10,000 inhabitants or more, or any part thereof, based on the most recently available population statistics of the Bureau of the Census; or

`(ii) any territory, incorporated or unincorporated, included in an urbanized area, as defined by the Bureau of the Census as of August 10, 1993;

`(B) provides telephone exchange service, including exchange access, to fewer than 50,000 access lines;

`(C) provides telephone exchange service to any local exchange carrier study area with fewer than 100,000 access lines; or

`(D) has less than 15 percent of its access lines in communities of more than 50,000 on the date of enactment of the Telecommunications Act of 1996.

`(48) TELECOMMUNICATIONS- The term `telecommunications' means the transmission, between or among points specified by the user, of information of the user's choosing, without change in the form or content of the information as sent and received.

`(49) TELECOMMUNICATIONS CARRIER- The term `telecommunications carrier' means any provider of telecommunications services, except that such term does not include aggregators of telecommunications services (as defined in section 226). A telecommunications carrier shall be treated as a common carrier under this Act only to the extent that it is engaged in providing telecommunications services, except that the Commission shall determine whether the provision of fixed and mobile satellite service shall be treated as common carriage.

`(50) TELECOMMUNICATIONS EQUIPMENT- The term `telecommunications equipment' means equipment, other than customer premises equipment, used by a carrier to provide telecommunications services, and includes software integral to such equipment (including upgrades).

`(51) TELECOMMUNICATIONS SERVICE- The term `telecommunications service' means the offering of telecommunications for a fee directly to the public, or to such classes of users as to be effectively available directly to the public, regardless of the facilities used.'.

(b) COMMON TERMINOLOGY- Except as otherwise provided in this Act, the terms used in this Act have the meanings provided in section 3 of the Communications Act of 1934 (47 U.S.C. 153), as amended by this section.

(c) STYLISTIC CONSISTENCY- Section 3 (47 U.S.C. 153) is amended--

(1) in subsections (e) and (n), by redesignating clauses (1), (2), and (3), as clauses (A), (B), and (C), respectively;

(2) in subsection (w), by redesignating paragraphs (1) through (5) as subparagraphs (A) through (E), respectively;

(3) in subsections (y) and (z), by redesignating paragraphs (1) and (2) as subparagraphs (A) and (B), respectively;

(4) by redesignating subsections (a) through (ff) as paragraphs (1) through (32);

(5) by indenting such paragraphs 2 em spaces;

(6) by inserting after the designation of each such paragraph--

(A) a heading, in a form consistent with the form of the heading of this subsection, consisting of the term defined by such paragraph, or the first term so defined if such

paragraph defines more than one term; and

(B) the words `The term';

(7) by changing the first letter of each defined term in such paragraphs from a capital to a lower case letter (except for `United States', `State', `State commission', and `Great Lakes Agreement'); and

(8) by reordering such paragraphs and the additional paragraphs added by subsection (a) in alphabetical order based on the headings of such paragraphs and renumbering such paragraphs as so reordered.

(d) CONFORMING AMENDMENTS- The Act is amended--

(1) in section 225(a)(1), by striking `section 3(h)' and inserting `section 3';

(2) in section 332(d), by striking `section 3(n)' each place it appears and inserting `section 3'; and

(3) in sections 621(d)(3), 636(d), and 637(a)(2), by striking `section 3(v)' and inserting `section 3'.

TITLE I--TELECOMMUNICATION SERVICES

SUBTITLE A--TELECOMMUNICATIONS SERVICES

SEC. 101. ESTABLISHMENT OF PART II OF TITLE II.

(a) AMENDMENT- Title II is amended by inserting after section 229 (47 U.S.C. 229) the following new part:

`PART II--DEVELOPMENT OF COMPETITIVE MARKETS

`SEC. 251. INTERCONNECTION.

`(a) GENERAL DUTY OF TELECOMMUNICATIONS CARRIERS- Each telecommunications carrier has the duty--

`(1) to interconnect directly or indirectly with the facilities and equipment of other telecommunications carriers; and

`(2) not to install network features, functions, or capabilities that do not comply with the guidelines and standards established pursuant to section 255 or 256.

`(b) OBLIGATIONS OF ALL LOCAL EXCHANGE CARRIERS- Each local exchange carrier has the following duties:

`(1) RESALE- The duty not to prohibit, and not to impose unreasonable or discriminatory conditions or limitations on, the resale of its telecommunications services.

`(2) NUMBER PORTABILITY- The duty to provide, to the extent technically feasible, number portability in accordance with requirements prescribed by the Commission.

`(3) DIALING PARITY- The duty to provide dialing parity to competing providers of telephone exchange service and telephone toll service, and the duty to permit all such providers to have nondiscriminatory access to telephone numbers, operator services, directory assistance, and directory listing, with no

unreasonable dialing delays.

`(4) ACCESS TO RIGHTS-OF-WAY- The duty to afford access to the poles, ducts, conduits, and rights-of-way of such carrier to competing providers of telecommunications services on rates, terms, and conditions that are consistent with section 224.

`(5) RECIPROCAL COMPENSATION- The duty to establish reciprocal compensation arrangements for the transport and termination of telecommunications.

`(c) ADDITIONAL OBLIGATIONS OF INCUMBENT LOCAL EXCHANGE CARRIERS-

In addition to the duties contained in subsection (b), each incumbent local exchange carrier has the following duties:

`(1) DUTY TO NEGOTIATE- The duty to negotiate in good faith in accordance with section 252 the particular terms and conditions of agreements to fulfill the duties described in paragraphs (1) through (5) of subsection (b) and this subsection. The requesting telecommunications carrier also has the duty to negotiate in good faith the terms and conditions of such agreements.

`(2) INTERCONNECTION- The duty to provide, for the facilities and equipment of any requesting telecommunications carrier, interconnection with the local exchange carrier's network--

`(A) for the transmission and routing of telephone exchange service and exchange access;

`(B) at any technically feasible point within the carrier's network;

`(C) that is at least equal in quality to that provided by the local exchange carrier to itself or to any subsidiary, affiliate, or any other party to which the carrier provides interconnection; and

`(D) on rates, terms, and conditions that are just, reasonable, and nondiscriminatory, in accordance with the terms and conditions of the agreement and the requirements of this section and section 252.

`(3) UNBUNDLED ACCESS- The duty to provide, to any requesting telecommunications carrier for the provision of a telecommunications service, nondiscriminatory access to network elements on an unbundled basis at any technically feasible point on rates, terms, and conditions that are just, reasonable, and nondiscriminatory in accordance with the terms and conditions of the agreement and the requirements of this section and section 252. An incumbent local exchange carrier shall provide such unbundled network elements in a manner that allows requesting carriers to combine such elements in order to provide such telecommunications service.

`(4) RESALE- The duty--

`(A) to offer for resale at wholesale rates any telecommunications service that the carrier provides at retail to subscribers who are not telecommunications carriers; and

`(B) not to prohibit, and not to impose unreasonable or discriminatory conditions or limitations on, the resale of such telecommunications service, except that a State commission may, consistent with regulations prescribed by the Commission under this section, prohibit a reseller that obtains at wholesale rates a telecommunications service that is available at retail only to a category of subscribers from offering such service to a different category of subscribers.

`(5) NOTICE OF CHANGES- The duty to provide reasonable public notice of changes in the information necessary for the transmission and routing of services using that local exchange carrier's facilities or networks, as well as of any other changes that would affect the interoperability of those facilities and networks.

`(6) COLLOCATION- The duty to provide, on rates, terms, and conditions that are just, reasonable, and nondiscriminatory, for physical collocation of equipment necessary for interconnection or access to unbundled network elements at the premises of the local exchange carrier, except that the carrier may provide for virtual collocation if the local exchange carrier demonstrates to the State commission that physical collocation is not practical for technical reasons or because of space limitations.

`(d) IMPLEMENTATION-

`(1) IN GENERAL- Within 6 months after the date of enactment of the Telecommunications Act of 1996, the Commission shall complete all actions necessary to establish regulations to implement the requirements of this section.

`(2) ACCESS STANDARDS- In determining what network elements should be made available for purposes of subsection (c)(3), the Commission shall consider, at a minimum, whether--

`(A) access to such network elements as are proprietary in nature is necessary; and

`(B) the failure to provide access to such network elements would impair the ability of the telecommunications carrier seeking access to provide the services that it seeks to offer.

`(3) PRESERVATION OF STATE ACCESS REGULATIONS- In prescribing and enforcing regulations to implement the requirements of this

section, the Commission shall not preclude the enforcement of any regulation, order, or policy of a State commission that--

`(A) establishes access and interconnection obligations of local exchange carriers;

`(B) is consistent with the requirements of this section; and

`(C) does not substantially prevent implementation of the requirements of this section and the purposes of this part.

`(e) NUMBERING ADMINISTRATION-

`(1) COMMISSION AUTHORITY AND JURISDICTION- The Commission shall create or designate one or more impartial entities to administer telecommunications numbering and to make such numbers available on an equitable basis. The Commission shall have exclusive jurisdiction over those portions of the North American Numbering Plan that pertain to the United States. Nothing in this paragraph shall preclude the Commission from delegating to State commissions or other entities all or any portion of such jurisdiction.

`(2) COSTS- The cost of establishing telecommunications numbering administration arrangements and number portability shall be borne by all telecommunications carriers on a competitively neutral basis as determined by the Commission.

`(f) EXEMPTIONS, SUSPENSIONS, AND MODIFICATIONS-

`(1) EXEMPTION FOR CERTAIN RURAL TELEPHONE COMPANIES-

`(A) EXEMPTION- Subsection (c) of this section shall not apply to a rural telephone company until (i) such company has received a bona fide request for interconnection, services, or network elements, and (ii) the State commission determines (under subparagraph (B)) that such request is not unduly economically burdensome, is technically feasible, and is consistent with section 254 (other than subsections (b)(7) and (c)(1)(D) thereof).

`(B) STATE TERMINATION OF EXEMPTION AND IMPLEMENTATION SCHEDULE- The party making a bona fide request of a rural telephone company for interconnection, services, or network elements shall submit a notice of its request to the State commission. The State commission shall conduct an inquiry for the purpose of determining whether to terminate the exemption under subparagraph (A). Within 120 days after the State commission receives notice of the request, the State commission shall terminate the exemption if the request is not unduly economically burdensome, is technically feasible, and is consistent with section 254 (other than subsections (b)(7) and (c)(1)(D) thereof). Upon termination of the exemption, a State commission shall establish an

implementation schedule for compliance with the request that is consistent in time and manner with Commission regulations.

`(C) LIMITATION ON EXEMPTION- The exemption provided by this paragraph shall not apply with respect to a request under subsection (c) from a cable operator providing video programming, and seeking to provide any telecommunications service, in the area in which the rural telephone company provides video programming. The limitation contained in this subparagraph shall not apply to a rural telephone company that is providing video programming on the date of enactment of the Telecommunications Act of 1996.

`(2) SUSPENSIONS AND MODIFICATIONS FOR RURAL CARRIERS- A local exchange carrier with fewer than 2 percent of the Nation's subscriber lines installed in the aggregate nationwide may petition a State commission for a suspension or modification of the application of a requirement or requirements of subsection (b) or (c) to telephone exchange service facilities specified in such petition. The State commission shall grant such petition to the extent that, and for such duration as, the State commission determines that such suspension or modification--

`(A) is necessary--

`(i) to avoid a significant adverse economic impact on users of telecommunications services generally;

`(ii) to avoid imposing a requirement that is unduly economically burdensome; or

`(iii) to avoid imposing a requirement that is technically infeasible; and

`(B) is consistent with the public interest, convenience, and necessity.

The State commission shall act upon any petition filed under this paragraph within 180 days after receiving such petition. Pending such action, the State commission may suspend enforcement of the requirement or requirements to which the petition applies with respect to the petitioning carrier or carriers.

`(g) CONTINUED ENFORCEMENT OF EXCHANGE ACCESS AND INTERCONNECTION REQUIREMENTS- On and after the date of enactment of the Telecommunications Act of 1996, each local exchange carrier, to the extent that it provides wireline services, shall provide exchange access, information access, and exchange services for such access to interexchange carriers and information service providers in accordance with the same equal access and nondiscriminatory

interconnection restrictions and obligations (including receipt of compensation) that apply to such carrier on the date immediately preceding the date of enactment of the Telecommunications Act of 1996 under any court order, consent decree, or regulation, order, or policy of the Commission, until such restrictions and obligations are explicitly superseded by regulations prescribed by the Commission after such date of enactment. During the period beginning on such date of enactment and until such restrictions and obligations are so superseded, such restrictions and obligations shall be enforceable in the same manner as regulations of the Commission.

`(h) DEFINITION OF INCUMBENT LOCAL EXCHANGE CARRIER-

`(1) DEFINITION- For purposes of this section, the term `incumbent local exchange carrier' means, with respect to an area, the local exchange carrier that--

`(A) on the date of enactment of the Telecommunications Act of 1996, provided telephone exchange service in such area; and

`(B)(i) on such date of enactment, was deemed to be a member of the exchange carrier association pursuant to section 69.601(b) of the Commission's regulations (47 C.F.R. 69.601(b)); or

`(ii) is a person or entity that, on or after such date of enactment, became a successor or assign of a member described in clause (i).

`(2) TREATMENT OF COMPARABLE CARRIERS AS INCUMBENTS- The Commission may, by rule, provide for the treatment of a local exchange carrier (or class or category thereof) as an incumbent local exchange carrier for purposes of this section if--

`(A) such carrier occupies a position in the market for telephone exchange service within an area that is comparable to the position occupied by a carrier described in paragraph (1);

`(B) such carrier has substantially replaced an incumbent local exchange carrier described in paragraph (1); and

`(C) such treatment is consistent with the public interest, convenience, and necessity and the purposes of this section.

`(i) SAVINGS PROVISION- Nothing in this section shall be construed to limit or otherwise affect the Commission's authority under section 201.

`SEC. 252. PROCEDURES FOR NEGOTIATION, ARBITRATION, AND APPROVAL OF AGREEMENTS.

`(a) AGREEMENTS ARRIVED AT THROUGH NEGOTIATION-

`(1) VOLUNTARY NEGOTIATIONS- Upon receiving a request for interconnection, services, or network elements pursuant to section 251, an incumbent local exchange carrier may negotiate and enter into a binding agreement with the requesting telecommunications carrier or carriers without regard to the standards set forth in subsections (b) and (c) of section 251. The agreement shall include a detailed schedule of itemized charges for interconnection and each service or network element included in the agreement. The agreement, including any interconnection agreement negotiated before the date of enactment of the Telecommunications Act of 1996, shall be submitted to the State commission under subsection (e) of this section.

`(2) MEDIATION- Any party negotiating an agreement under this section may, at any point in the negotiation, ask a State commission to participate in the negotiation and to mediate any differences arising in the course of the negotiation.

`(b) AGREEMENTS ARRIVED AT THROUGH COMPULSORY ARBITRATION-

`(1) ARBITRATION- During the period from the 135th to the 160th day (inclusive) after the date on which an incumbent local exchange carrier receives a request for negotiation under this section, the carrier or any other party to the negotiation may petition a State commission to arbitrate any open issues.

`(2) DUTY OF PETITIONER-

`(A) A party that petitions a State commission under paragraph (1) shall, at the same time as it submits the petition, provide the State commission all relevant documentation concerning--

`(i) the unresolved issues;

`(ii) the position of each of the parties with respect to those issues; and

`(iii) any other issue discussed and resolved by the parties.

`(B) A party petitioning a State commission under paragraph (1) shall provide a copy of the petition and any documentation to the other party or parties not later than the day on which the State commission receives the petition.

`(3) OPPORTUNITY TO RESPOND- A non-petitioning party to a negotiation under this section may respond to the other party's petition and provide such additional information as it wishes within 25 days after the State commission receives the petition.

`(4) ACTION BY STATE COMMISSION-

`(A) The State commission shall limit its consideration of any petition under paragraph (1) (and any response thereto) to the issues set forth in the petition and in the

response, if any, filed under paragraph (3).

`(B) The State commission may require the petitioning party and the responding party to provide such information as may be necessary for the State commission to reach a decision on the unresolved issues. If any party refuses or fails unreasonably to respond on a timely basis to any reasonable request from the State commission, then the State commission may proceed on the basis of the best information available to it from whatever source derived.

`(C) The State commission shall resolve each issue set forth in the petition and the response, if any, by imposing appropriate conditions as required to implement subsection (c) upon the parties to the agreement, and shall conclude the resolution of any unresolved issues not later than 9 months after the date on which the local exchange carrier received the request under this section.

`(5) REFUSAL TO NEGOTIATE- The refusal of any other party to the negotiation to participate further in the negotiations, to cooperate with the State commission in carrying out its function as an arbitrator, or to continue to negotiate in good faith in the presence, or with the assistance, of the State commission shall be considered a failure to negotiate in good faith.

`(c) STANDARDS FOR ARBITRATION- In resolving by arbitration under subsection (b) any open issues and imposing conditions upon the parties to the agreement, a State commission shall--

`(1) ensure that such resolution and conditions meet the requirements of section 251, including the regulations prescribed by the Commission pursuant to section 251;

`(2) establish any rates for interconnection, services, or network elements according to subsection (d); and

`(3) provide a schedule for implementation of the terms and conditions by the parties to the agreement.

`(d) PRICING STANDARDS-

`(1) INTERCONNECTION AND NETWORK ELEMENT CHARGES- Determinations by a State commission of the just and reasonable rate for the interconnection of facilities and equipment for purposes of subsection (c)(2) of section 251, and the just and reasonable rate for network elements for purposes of subsection (c)(3) of such section--

`(A) shall be--

`(i) based on the cost (determined without reference to a rate-of-return or other rate-based proceeding) of providing the interconnection or network element (whichever is applicable), and

`(ii) nondiscriminatory, and

`(B) may include a reasonable profit.

`(2) CHARGES FOR TRANSPORT AND TERMINATION OF TRAFFIC-

`(A) IN GENERAL- For the purposes of compliance by an incumbent local exchange carrier with section 251(b)(5), a State commission shall not consider the terms and conditions for reciprocal compensation to be just and reasonable unless--

`(i) such terms and conditions provide for the mutual and reciprocal recovery by each carrier of costs associated with the transport and termination on each carrier's network facilities of calls that originate on the network facilities of the other carrier; and

`(ii) such terms and conditions determine such costs on the basis of a reasonable approximation of the additional costs of terminating such calls.

`(B) RULES OF CONSTRUCTION- This paragraph shall not be construed--

`(i) to preclude arrangements that afford the mutual recovery of costs through the offsetting of reciprocal obligations, including arrangements that waive mutual recovery (such as bill-and-keep arrangements); or

`(ii) to authorize the Commission or any State commission to engage in any rate regulation proceeding to establish with particularity the additional costs of transporting or terminating calls, or to require carriers to maintain records with respect to the additional costs of such calls.

`(3) WHOLESALE PRICES FOR TELECOMMUNICATIONS SERVICES- For the purposes of section 251(c)(4), a State commission shall determine wholesale rates on the basis of retail rates charged to subscribers for the telecommunications service requested, excluding the portion thereof attributable to any marketing, billing, collection, and other costs that will be avoided by the local exchange carrier.

`(e) APPROVAL BY STATE COMMISSION-

`(1) APPROVAL REQUIRED- Any interconnection agreement adopted by negotiation or arbitration shall be submitted for approval to the State commission. A State commission to which an agreement is submitted shall approve or reject the agreement, with written findings as to any deficiencies.

`(2) GROUNDS FOR REJECTION- The State commission may only reject--

`(A) an agreement (or any portion thereof) adopted by negotiation under subsection (a) if it finds that--

`(i) the agreement (or portion thereof) discriminates against a telecommunications carrier not a party to the agreement; or

`(ii) the implementation of such agreement or portion is not consistent with the public interest, convenience, and necessity; or

`(B) an agreement (or any portion thereof) adopted by arbitration under subsection (b) if it finds that the agreement does not meet the requirements of section 251, including the regulations prescribed by the Commission pursuant to section 251, or the standards set forth in subsection (d) of this section.

`(3) PRESERVATION OF AUTHORITY- Notwithstanding paragraph (2), but subject to section 253, nothing in this section shall prohibit a State commission from establishing or enforcing other requirements of State law in its review of an agreement, including requiring compliance with intrastate telecommunications service quality standards or requirements.

`(4) SCHEDULE FOR DECISION- If the State commission does not act to approve or reject the agreement within 90 days after submission by the parties of an agreement adopted by negotiation under subsection (a), or within 30 days after submission by the parties of an agreement adopted by arbitration under subsection (b), the agreement shall be deemed approved. No State court shall have jurisdiction to review the action of a State commission in approving or rejecting an agreement under this section.

`(5) COMMISSION TO ACT IF STATE WILL NOT ACT- If a State commission fails to act to carry out its responsibility under this section in any proceeding or other matter under this section, then the Commission shall issue an order preempting the State commission's jurisdiction of that proceeding or matter within 90 days after being notified (or taking notice) of such failure, and shall assume the responsibility of the State commission under this section with respect to the proceeding or matter and act for the State commission.

`(6) REVIEW OF STATE COMMISSION ACTIONS- In a case in which a State fails to act as described in paragraph (5), the proceeding by the Commission under such paragraph and any judicial review of the Commission's actions shall be the exclusive remedies for a State commission's failure to act. In any case in which a State commission makes a determination under this section, any party aggrieved by such determination may bring an action in an appropriate Federal district court to determine whether the agreement or statement meets the

requirements of section 251 and this section.

`(f) STATEMENTS OF GENERALLY AVAILABLE TERMS-

`(1) IN GENERAL- A Bell operating company may prepare and file with a State commission a statement of the terms and conditions that such company generally offers within that State to comply with the requirements of section 251 and the regulations thereunder and the standards applicable under this section.

`(2) STATE COMMISSION REVIEW- A State commission may not approve such statement unless such statement complies with subsection (d) of this section and section 251 and the regulations thereunder. Except as provided in section 253, nothing in this section shall prohibit a State commission from establishing or enforcing other requirements of State law in its review of such statement, including requiring compliance with intrastate telecommunications service quality standards or requirements.

`(3) SCHEDULE FOR REVIEW- The State commission to which a statement is submitted shall, not later than 60 days after the date of such submission--

`(A) complete the review of such statement under paragraph (2) (including any reconsideration thereof), unless the submitting carrier agrees to an extension of the period for such review; or

`(B) permit such statement to take effect.

`(4) AUTHORITY TO CONTINUE REVIEW- Paragraph (3) shall not preclude the State commission from continuing to review a statement that has been permitted to take effect under subparagraph (B) of such paragraph or from approving or disapproving such statement under paragraph (2).

`(5) DUTY TO NEGOTIATE NOT AFFECTED- The submission or approval of a statement under this subsection shall not relieve a Bell operating company of its duty to negotiate the terms and conditions of an agreement under section 251.

`(g) CONSOLIDATION OF STATE PROCEEDINGS- Where not inconsistent with the requirements of this Act, a State commission may, to the extent practical, consolidate proceedings under sections 214(e), 251(f), 253, and this section in order to reduce administrative burdens on telecommunications carriers, other parties to the proceedings, and the State commission in carrying out its responsibilities under this Act.

`(h) FILING REQUIRED- A State commission shall make a copy of each agreement approved under subsection (e) and each statement approved under subsection (f) available for public inspection and copying within 10 days after the agreement or statement is

approved. The State commission may charge a reasonable and nondiscriminatory fee to the parties to the agreement or to the party filing the statement to cover the costs of approving and filing such agreement or statement.

`(i) AVAILABILITY TO OTHER TELECOMMUNICATIONS CARRIERS- A local exchange carrier shall make available any interconnection, service, or network element provided under an agreement approved under this section to which it is a party to any other requesting telecommunications carrier upon the same terms and conditions as those provided in the agreement.

`(j) DEFINITION OF INCUMBENT LOCAL EXCHANGE CARRIER- For purposes of this section, the term `incumbent local exchange carrier' has the meaning provided in section 251(h).

`SEC. 253. REMOVAL OF BARRIERS TO ENTRY.

`(a) IN GENERAL- No State or local statute or regulation, or other State or local legal requirement, may prohibit or have the effect of prohibiting the ability of any entity to provide any interstate or intrastate telecommunications service.

`(b) STATE REGULATORY AUTHORITY- Nothing in this section shall affect the ability of a State to impose, on a competitively neutral basis and consistent with section 254, requirements necessary to preserve and advance universal service, protect the public safety and welfare, ensure the continued quality of telecommunications services, and safeguard the rights of consumers.

`(c) STATE AND LOCAL GOVERNMENT AUTHORITY- Nothing in this section affects the authority of a State or local government to manage the public rights-of-way or to require fair and reasonable compensation from telecommunications providers, on a competitively neutral and nondiscriminatory basis, for use of public rights-of-way on a nondiscriminatory basis, if the compensation required is publicly disclosed by such government.

`(d) PREEMPTION- If, after notice and an opportunity for public comment, the Commission determines that a State or local government has permitted or imposed any statute, regulation, or legal requirement that violates subsection (a) or (b), the Commission shall preempt the enforcement of such statute, regulation, or legal requirement to the extent necessary to correct such violation or inconsistency.

`(e) COMMERCIAL MOBILE SERVICE PROVIDERS- Nothing in this section shall affect the application of section 332(c)(3) to commercial mobile service providers.

`(f) RURAL MARKETS- It shall not be a violation of this section for a State to require a telecommunications carrier that seeks to provide telephone exchange service or exchange access in a service area served by a rural telephone company to meet the requirements

in section 214(e)(1) for designation as an eligible telecommunications carrier for that area before being permitted to provide such service. This subsection shall not apply--

`(1) to a service area served by a rural telephone company that has obtained an exemption, suspension, or modification of section 251(c)(4) that effectively prevents a competitor from meeting the requirements of section 214(e)(1); and

`(2) to a provider of commercial mobile services.

`SEC. 254. UNIVERSAL SERVICE.

`(a) PROCEDURES TO REVIEW UNIVERSAL SERVICE REQUIREMENTS-

`(1) FEDERAL-STATE JOINT BOARD ON UNIVERSAL SERVICE- Within one month after the date of enactment of the Telecommunications Act of 1996, the Commission shall institute and refer to a Federal-State Joint Board under section 410(c) a proceeding to recommend changes to any of its regulations in order to implement sections 214(e) and this section, including the definition of the services that are supported by Federal universal service support mechanisms and a specific timetable for completion of such recommendations. In addition to the members of the Joint Board required under section 410(c), one member of such Joint Board shall be a State-appointed utility consumer advocate nominated by a national organization of State utility consumer advocates. The Joint Board shall, after notice and opportunity for public comment, make its recommendations to the Commission 9 months after the date of enactment of the Telecommunications Act of 1996.

`(2) COMMISSION ACTION- The Commission shall initiate a single proceeding to implement the recommendations from the Joint Board required by paragraph (1) and shall complete such proceeding within 15 months after the date of enactment of the Telecommunications Act of 1996. The rules established by such proceeding shall include a definition of the services that are supported by Federal universal service support mechanisms and a specific timetable for implementation. Thereafter, the Commission shall complete any proceeding to implement subsequent recommendations from any Joint Board on universal service within one year after receiving such recommendations.

`(b) UNIVERSAL SERVICE PRINCIPLES- The Joint Board and the Commission shall base policies for the preservation and advancement of universal service on the following principles:

`(1) QUALITY AND RATES- Quality services should be available at just, reasonable, and affordable rates.

`(2) ACCESS TO ADVANCED SERVICES- Access to advanced telecommunications and information services should be provided in all regions of the Nation.

`(3) ACCESS IN RURAL AND HIGH COST AREAS- Consumers in all regions of the Nation, including low-income consumers and those in rural, insular, and high cost areas, should have access to telecommunications and information services, including interexchange services and advanced telecommunications and information services, that are reasonably comparable to those services provided in urban areas and that are available at rates that are reasonably comparable to rates charged for similar services in urban areas.

`(4) EQUITABLE AND NONDISCRIMINATORY CONTRIBUTIONS- All providers of telecommunications services should make an equitable and nondiscriminatory contribution to the preservation and advancement of universal service.

`(5) SPECIFIC AND PREDICTABLE SUPPORT MECHANISMS- There should be specific, predictable and sufficient Federal and State mechanisms to preserve and advance universal service.

`(6) ACCESS TO ADVANCED TELECOMMUNICATIONS SERVICES FOR SCHOOLS, HEALTH CARE, AND LIBRARIES- Elementary and secondary schools and classrooms, health care providers, and libraries should have access to advanced telecommunications services as described in subsection (h).

`(7) ADDITIONAL PRINCIPLES- Such other principles as the Joint Board and the Commission determine are necessary and appropriate for the protection of the public interest, convenience, and necessity and are consistent with this Act.

`(c) DEFINITION-

`(1) IN GENERAL- Universal service is an evolving level of telecommunications services that the Commission shall establish periodically under this section, taking into account advances in telecommunications and information technologies and services. The Joint Board in recommending, and the Commission in establishing, the definition of the services that are supported by Federal universal service support mechanisms shall consider the extent to which such telecommunications services--

`(A) are essential to education, public health, or public safety;

`(B) have, through the operation of market choices by customers, been subscribed to by a substantial majority of residential customers;

`(C) are being deployed in public telecommunications networks by telecommunications carriers; and

`(D) are consistent with the public interest, convenience, and necessity.

`(2) ALTERATIONS AND MODIFICATIONS- The Joint Board may, from time to time, recommend to the Commission modifications in the

definition of the services that are supported by Federal universal service support mechanisms.

`(3) SPECIAL SERVICES- In addition to the services included in the definition of universal service under paragraph (1), the Commission may designate additional services for such support mechanisms for schools, libraries, and health care providers for the purposes of subsection (h).

`(d) TELECOMMUNICATIONS CARRIER CONTRIBUTION- Every telecommunications carrier that provides interstate telecommunications services shall contribute, on an equitable and nondiscriminatory basis, to the specific, predictable, and sufficient mechanisms established by the Commission to preserve and advance universal service. The Commission may exempt a carrier or class of carriers from this requirement if the carrier's telecommunications activities are limited to such an extent that the level of such carrier's contribution to the preservation and advancement of universal service would be de minimis. Any other provider of interstate telecommunications may be required to contribute to the preservation and advancement of universal service if the public interest so requires.

`(e) UNIVERSAL SERVICE SUPPORT- After the date on which Commission regulations implementing this section take effect, only an eligible telecommunications carrier designated under section 214(e) shall be eligible to receive specific Federal universal service support. A carrier that receives such support shall use that support only for the provision, maintenance, and upgrading of facilities and services for which the support is intended. Any such support should be explicit and sufficient to achieve the purposes of this section.

`(f) STATE AUTHORITY- A State may adopt regulations not inconsistent with the Commission's rules to preserve and advance universal service. Every telecommunications carrier that provides intrastate telecommunications services shall contribute, on an equitable and nondiscriminatory basis, in a manner determined by the State to the preservation and advancement of universal service in that State. A State may adopt regulations to provide for additional definitions and standards to preserve and advance universal service within that State only to the extent that such regulations adopt additional specific, predictable, and sufficient mechanisms to support such definitions or standards that do not rely on or burden Federal universal service support mechanisms.

`(g) INTEREXCHANGE AND INTERSTATE SERVICES- Within 6 months after the date of enactment of the Telecommunications Act of 1996, the Commission shall adopt rules to require that the rates charged by providers of interexchange telecommunications services to

subscribers in rural and high cost areas shall be no higher than the rates charged by each such provider to its subscribers in urban areas. Such rules shall also require that a provider of interstate interexchange telecommunications services shall provide such services to its subscribers in each State at rates no higher than the rates charged to its subscribers in any other State.

`(h) TELECOMMUNICATIONS SERVICES FOR CERTAIN PROVIDERS-

`(1) IN GENERAL-

`(A) HEALTH CARE PROVIDERS FOR RURAL AREAS- A telecommunications carrier shall, upon receiving a bona fide request, provide telecommunications services which are necessary for the provision of health care services in a State, including instruction relating to such services, to any public or nonprofit health care provider that serves persons who reside in rural areas in that State at rates that are reasonably comparable to rates charged for similar services in urban areas in that State. A telecommunications carrier providing service under this paragraph shall be entitled to have an amount equal to the difference, if any, between the rates for services provided to health care providers for rural areas in a State and the rates for similar services provided to other customers in comparable rural areas in that State treated as a service obligation as a part of its obligation to participate in the mechanisms to preserve and advance universal service.

`(B) EDUCATIONAL PROVIDERS AND LIBRARIES- All telecommunications carriers serving a geographic area shall, upon a bona fide request for any of its services that are within the definition of universal service under subsection (c)(3), provide such services to elementary schools, secondary schools, and libraries for educational purposes at rates less than the amounts charged for similar services to other parties. The discount shall be an amount that the Commission, with respect to interstate services, and the States, with respect to intrastate services, determine is appropriate and necessary to ensure affordable access to and use of such services by such entities. A telecommunications carrier providing service under this paragraph shall--

`(i) have an amount equal to the amount of the discount treated as an offset to its obligation to contribute to the mechanisms to preserve and advance universal service, or

`(ii) notwithstanding the provisions of subsection (e) of this section, receive reimbursement utilizing

the support mechanisms to preserve and advance universal service.

`(2) ADVANCED SERVICES- The Commission shall establish competitively neutral rules--

`(A) to enhance, to the extent technically feasible and economically reasonable, access to advanced telecommunications and information services for all public and nonprofit elementary and secondary school classrooms, health care providers, and libraries; and

`(B) to define the circumstances under which a telecommunications carrier may be required to connect its network to such public institutional telecommunications users.

`(3) TERMS AND CONDITIONS- Telecommunications services and network capacity provided to a public institutional telecommunications user under this subsection may not be sold, resold, or otherwise transferred by such user in consideration for money or any other thing of value.

`(4) ELIGIBILITY OF USERS- No entity listed in this subsection shall be entitled to preferential rates or treatment as required by this subsection, if such entity operates as a for-profit business, is a school described in paragraph (5)(A) with an endowment of more than $50,000,000, or is a library not eligible for participation in State-based plans for funds under title III of the Library Services and Construction Act (20 U.S.C. 335c et seq.).

`(5) DEFINITIONS- For purposes of this subsection:

`(A) ELEMENTARY AND SECONDARY SCHOOLS- The term `elementary and secondary schools' means elementary schools and secondary schools, as defined in paragraphs (14) and (25), respectively, of section 14101 of the Elementary and Secondary Education Act of 1965 (20 U.S.C. 8801).

`(B) HEALTH CARE PROVIDER- The term `health care provider' means--

`(i) post-secondary educational institutions offering health care instruction, teaching hospitals, and medical schools;

`(ii) community health centers or health centers providing health care to migrants;

`(iii) local health departments or agencies;

`(iv) community mental health centers;

`(v) not-for-profit hospitals;

`(vi) rural health clinics; and

`(vii) consortia of health care providers consisting of one or more entities described in clauses (i)

through (vi).

`(C) PUBLIC INSTITUTIONAL TELECOMMUNICATIONS USER- The term `public institutional telecommunications user' means an elementary or secondary school, a library, or a health care provider as those terms are defined in this paragraph.

`(i) CONSUMER PROTECTION- The Commission and the States should ensure that universal service is available at rates that are just, reasonable, and affordable.

`(j) LIFELINE ASSISTANCE- Nothing in this section shall affect the collection, distribution, or administration of the Lifeline Assistance Program provided for by the Commission under regulations set forth in section 69.117 of title 47, Code of Federal Regulations, and other related sections of such title.

`(k) SUBSIDY OF COMPETITIVE SERVICES PROHIBITED- A telecommunications carrier may not use services that are not competitive to subsidize services that are subject to competition. The Commission, with respect to interstate services, and the States, with respect to intrastate services, shall establish any necessary cost allocation rules, accounting safeguards, and guidelines to ensure that services included in the definition of universal service bear no more than a reasonable share of the joint and common costs of facilities used to provide those services.

`SEC. 255. ACCESS BY PERSONS WITH DISABILITIES.

`(a) DEFINITIONS- As used in this section--

`(1) DISABILITY- The term `disability' has the meaning given to it by section 3(2)(A) of the Americans with Disabilities Act of 1990 (42 U.S.C. 12102(2)(A)).

`(2) READILY ACHIEVABLE- The term `readily achievable' has the meaning given to it by section 301(9) of that Act (42 U.S.C. 12181(9)).

`(b) MANUFACTURING- A manufacturer of telecommunications equipment or customer premises equipment shall ensure that the equipment is designed, developed, and fabricated to be accessible to and usable by individuals with disabilities, if readily achievable.

`(c) TELECOMMUNICATIONS SERVICES- A provider of telecommunications service shall ensure that the service is accessible to and usable by individuals with disabilities, if readily achievable.

`(d) COMPATIBILITY- Whenever the requirements of subsections (b) and (c) are not readily achievable, such a manufacturer or provider shall ensure that the equipment or service is compatible with existing peripheral devices or specialized customer premises equipment commonly used by individuals with disabilities to achieve access, if readily achievable.

`(e) GUIDELINES- Within 18 months after the date of enactment of the Telecommunications Act of 1996, the Architectural and Transportation Barriers Compliance Board shall develop guidelines for accessibility of telecommunications equipment and customer premises equipment in conjunction with the Commission. The Board shall review and update the guidelines periodically.

`(f) NO ADDITIONAL PRIVATE RIGHTS AUTHORIZED- Nothing in this section shall be construed to authorize any private right of action to enforce any requirement of this section or any regulation thereunder. The Commission shall have exclusive jurisdiction with respect to any complaint under this section.

`SEC. 256. COORDINATION FOR INTERCONNECTIVITY.

`(a) PURPOSE- It is the purpose of this section--

`(1) to promote nondiscriminatory accessibility by the broadest number of users and vendors of communications products and services to public telecommunications networks used to provide telecommunications service through--

`(A) coordinated public telecommunications network planning and design by telecommunications carriers and other providers of telecommunications service; and

`(B) public telecommunications network interconnectivity, and interconnectivity of devices with such networks used to provide telecommunications service; and

`(2) to ensure the ability of users and information providers to seamlessly and transparently transmit and receive information between and across telecommunications networks.

`(b) COMMISSION FUNCTIONS- In carrying out the purposes of this section, the Commission--

`(1) shall establish procedures for Commission oversight of coordinated network planning by telecommunications carriers and other providers of telecommunications service for the effective and efficient interconnection of public telecommunications networks used to provide telecommunications service; and

`(2) may participate, in a manner consistent with its authority and practice prior to the date of enactment of this section, in the development by appropriate industry standards-setting organizations of public telecommunications network interconnectivity standards that promote access to--

`(A) public telecommunications networks used to provide telecommunications service;

`(B) network capabilities and services by individuals with disabilities; and

`(C) information services by subscribers of rural telephone companies.

`(c) COMMISSION'S AUTHORITY- Nothing in this section shall be

construed as expanding or limiting any authority that the Commission may have under law in effect before the date of enactment of the Telecommunications Act of 1996.

`(d) DEFINITION- As used in this section, the term `public telecommunications network interconnectivity' means the ability of two or more public telecommunications networks used to provide telecommunications service to communicate and exchange information without degeneration, and to interact in concert with one another.

`SEC. 257. MARKET ENTRY BARRIERS PROCEEDING.

`(a) ELIMINATION OF BARRIERS- Within 15 months after the date of enactment of the Telecommunications Act of 1996, the Commission shall complete a proceeding for the purpose of identifying and eliminating, by regulations pursuant to its authority under this Act (other than this section), market entry barriers for entrepreneurs and other small businesses in the provision and ownership of telecommunications services and information services, or in the provision of parts or services to providers of telecommunications services and information services.

`(b) NATIONAL POLICY- In carrying out subsection (a), the Commission shall seek to promote the policies and purposes of this Act favoring diversity of media voices, vigorous economic competition, technological advancement, and promotion of the public interest, convenience, and necessity.

`(c) PERIODIC REVIEW- Every 3 years following the completion of the proceeding required by subsection (a), the Commission shall review and report to Congress on--

`(1) any regulations prescribed to eliminate barriers within its jurisdiction that are identified under subsection (a) and that can be prescribed consistent with the public interest, convenience, and necessity; and

`(2) the statutory barriers identified under subsection (a) that the Commission recommends be eliminated, consistent with the public interest, convenience, and necessity.

`SEC. 258. ILLEGAL CHANGES IN SUBSCRIBER CARRIER SELECTIONS.

`(a) PROHIBITION- No telecommunications carrier shall submit or execute a change in a subscriber's selection of a provider of telephone exchange service or telephone toll service except in accordance with such verification procedures as the Commission shall prescribe. Nothing in this section shall preclude any State commission from enforcing such procedures with respect to intrastate services.

`(b) LIABILITY FOR CHARGES- Any telecommunications carrier that violates the verification procedures described in subsection (a) and that collects charges for telephone exchange service or telephone toll service from a subscriber shall be liable to the

carrier previously selected by the subscriber in an amount equal to all charges paid by such subscriber after such violation, in accordance with such procedures as the Commission may prescribe. The remedies provided by this subsection are in addition to any other remedies available by law.

`SEC. 259. INFRASTRUCTURE SHARING.

`(a) REGULATIONS REQUIRED- The Commission shall prescribe, within one year after the date of enactment of the Telecommunications Act of 1996, regulations that require incumbent local exchange carriers (as defined in section 251(h)) to make available to any qualifying carrier such public switched network infrastructure, technology, information, and telecommunications facilities and functions as may be requested by such qualifying carrier for the purpose of enabling such qualifying carrier to provide telecommunications services, or to provide access to information services, in the service area in which such qualifying carrier has requested and obtained designation as an eligible telecommunications carrier under section 214(e).

`(b) TERMS AND CONDITIONS OF REGULATIONS- The regulations prescribed by the Commission pursuant to this section shall--

`(1) not require a local exchange carrier to which this section applies to take any action that is economically unreasonable or that is contrary to the public interest;

`(2) permit, but shall not require, the joint ownership or operation of public switched network infrastructure and services by or among such local exchange carrier and a qualifying carrier;

`(3) ensure that such local exchange carrier will not be treated by the Commission or any State as a common carrier for hire or as offering common carrier services with respect to any infrastructure, technology, information, facilities, or functions made available to a qualifying carrier in accordance with regulations issued pursuant to this section;

`(4) ensure that such local exchange carrier makes such infrastructure, technology, information, facilities, or functions available to a qualifying carrier on just and reasonable terms and conditions that permit such qualifying carrier to fully benefit from the economies of scale and scope of such local exchange carrier, as determined in accordance with guidelines prescribed by the Commission in regulations issued pursuant to this section;

`(5) establish conditions that promote cooperation between local exchange carriers to which this section applies and qualifying carriers;

`(6) not require a local exchange carrier to which this

section applies to engage in any infrastructure sharing agreement for any services or access which are to be provided or offered to consumers by the qualifying carrier in such local exchange carrier's telephone exchange area; and

`(7) require that such local exchange carrier file with the Commission or State for public inspection, any tariffs, contracts, or other arrangements showing the rates, terms, and conditions under which such carrier is making available public switched network infrastructure and functions under this section.

`(c) INFORMATION CONCERNING DEPLOYMENT OF NEW SERVICES AND EQUIPMENT- A local exchange carrier to which this section applies that has entered into an infrastructure sharing agreement under this section shall provide to each party to such agreement timely information on the planned deployment of telecommunications services and equipment, including any software or upgrades of software integral to the use or operation of such telecommunications equipment.

`(d) DEFINITION- For purposes of this section, the term `qualifying carrier' means a telecommunications carrier that--

`(1) lacks economies of scale or scope, as determined in accordance with regulations prescribed by the Commission pursuant to this section; and

`(2) offers telephone exchange service, exchange access, and any other service that is included in universal service, to all consumers without preference throughout the service area for which such carrier has been designated as an eligible telecommunications carrier under section 214(e).

`SEC. 260. PROVISION OF TELEMESSAGING SERVICE.

`(a) NONDISCRIMINATION SAFEGUARDS- Any local exchange carrier subject to the requirements of section 251(c) that provides telemessaging service--

`(1) shall not subsidize its telemessaging service directly or indirectly from its telephone exchange service or its exchange access; and

`(2) shall not prefer or discriminate in favor of its telemessaging service operations in its provision of telecommunications services.

`(b) EXPEDITED CONSIDERATION OF COMPLAINTS- The Commission shall establish procedures for the receipt and review of complaints concerning violations of subsection (a) or the regulations thereunder that result in material financial harm to a provider of telemessaging service. Such procedures shall ensure that the Commission will make a final determination with respect to any such complaint within 120 days after receipt of the complaint. If the complaint contains an appropriate showing that the alleged

violation occurred, the Commission shall, within 60 days after receipt of the complaint, order the local exchange carrier and any affiliates to cease engaging in such violation pending such final determination.

`(c) DEFINITION- As used in this section, the term `telemessaging service' means voice mail and voice storage and retrieval services, any live operator services used to record, transcribe, or relay messages (other than telecommunications relay services), and any ancillary services offered in combination with these services.

`SEC. 261. EFFECT ON OTHER REQUIREMENTS.

`(a) COMMISSION REGULATIONS- Nothing in this part shall be construed to prohibit the Commission from enforcing regulations prescribed prior to the date of enactment of the Telecommunications Act of 1996 in fulfilling the requirements of this part, to the extent that such regulations are not inconsistent with the provisions of this part.

`(b) EXISTING STATE REGULATIONS- Nothing in this part shall be construed to prohibit any State commission from enforcing regulations prescribed prior to the date of enactment of the Telecommunications Act of 1996, or from prescribing regulations after such date of enactment, in fulfilling the requirements of this part, if such regulations are not inconsistent with the provisions of this part.

`(c) ADDITIONAL STATE REQUIREMENTS- Nothing in this part precludes a State from imposing requirements on a telecommunications carrier for intrastate services that are necessary to further competition in the provision of telephone exchange service or exchange access, as long as the State's requirements are not inconsistent with this part or the Commission's regulations to implement this part.'.

(b) DESIGNATION OF PART I- Title II of the Act is further amended by inserting before the heading of section 201 the following new heading:

`PART I--COMMON CARRIER REGULATION'.

(c) STYLISTIC CONSISTENCY- The Act is amended so that--

(1) the designation and heading of each title of the Act shall be in the form and typeface of the designation and heading of this title of this Act; and

(2) the designation and heading of each part of each title of the Act shall be in the form and typeface of the designation and heading of part I of title II of the Act, as amended by subsection (a).

SEC. 102. ELIGIBLE TELECOMMUNICATIONS CARRIERS.

(a) IN GENERAL- Section 214 (47 U.S.C. 214) is amended by adding at the end thereof the following new subsection:

`(e) PROVISION OF UNIVERSAL SERVICE-

`(1) ELIGIBLE TELECOMMUNICATIONS CARRIERS- A common carrier designated as an eligible telecommunications carrier under paragraph (2) or (3) shall be eligible to receive universal service support in accordance with section 254 and shall, throughout the service area for which the designation is received--

`(A) offer the services that are supported by Federal universal service support mechanisms under section 254(c), either using its own facilities or a combination of its own facilities and resale of another carrier's services (including the services offered by another eligible telecommunications carrier); and

`(B) advertise the availability of such services and the charges therefor using media of general distribution.

`(2) DESIGNATION OF ELIGIBLE TELECOMMUNICATIONS CARRIERS- A State commission shall upon its own motion or upon request designate a common carrier that meets the requirements of paragraph (1) as an eligible telecommunications carrier for a service area designated by the State commission. Upon request and consistent with the public interest, convenience, and necessity, the State commission may, in the case of an area served by a rural telephone company, and shall, in the case of all other areas, designate more than one common carrier as an eligible telecommunications carrier for a service area designated by the State commission, so long as each additional requesting carrier meets the requirements of paragraph (1). Before designating an additional eligible telecommunications carrier for an area served by a rural telephone company, the State commission shall find that the designation is in the public interest.

`(3) DESIGNATION OF ELIGIBLE TELECOMMUNICATIONS CARRIERS FOR UNSERVED AREAS- If no common carrier will provide the services that are supported by Federal universal service support mechanisms under section 254(c) to an unserved community or any portion thereof that requests such service, the Commission, with respect to interstate services, or a State commission, with respect to intrastate services, shall determine which common carrier or carriers are best able to provide such service to the requesting unserved community or portion thereof and shall order such carrier or carriers to provide such service for that unserved community or portion thereof. Any carrier or carriers ordered to provide such service under this paragraph shall meet the requirements of paragraph (1) and shall be designated as an eligible telecommunications carrier

for that community or portion thereof.

`(4) RELINQUISHMENT OF UNIVERSAL SERVICE- A State commission shall permit an eligible telecommunications carrier to relinquish its designation as such a carrier in any area served by more than one eligible telecommunications carrier. An eligible telecommunications carrier that seeks to relinquish its eligible telecommunications carrier designation for an area served by more than one eligible telecommunications carrier shall give advance notice to the State commission of such relinquishment. Prior to permitting a telecommunications carrier designated as an eligible telecommunications carrier to cease providing universal service in an area served by more than one eligible telecommunications carrier, the State commission shall require the remaining eligible telecommunications carrier or carriers to ensure that all customers served by the relinquishing carrier will continue to be served, and shall require sufficient notice to permit the purchase or construction of adequate facilities by any remaining eligible telecommunications carrier. The State commission shall establish a time, not to exceed one year after the State commission approves such relinquishment under this paragraph, within which such purchase or construction shall be completed.

`(5) SERVICE AREA DEFINED- The term `service area' means a geographic area established by a State commission for the purpose of determining universal service obligations and support mechanisms. In the case of an area served by a rural telephone company, `service area' means such company's `study area' unless and until the Commission and the States, after taking into account recommendations of a Federal-State Joint Board instituted under section 410(c), establish a different definition of service area for such company.'.

SEC. 103. EXEMPT TELECOMMUNICATIONS COMPANIES.

The Public Utility Holding Company Act of 1935 (15 U.S.C. 79 and following) is amended by redesignating sections 34 and 35 as sections 35 and 36, respectively, and by inserting the following new section after section 33:

`SEC. 34. EXEMPT TELECOMMUNICATIONS COMPANIES.

`(a) DEFINITIONS- For purposes of this section--

`(1) EXEMPT TELECOMMUNICATIONS COMPANY- The term `exempt telecommunications company' means any person determined by the Federal Communications Commission to be engaged directly or indirectly, wherever located, through one or more affiliates (as defined in section 2(a)(11)(B)), and exclusively in the business of providing---

`(A) telecommunications services;
`(B) information services;
`(C) other services or products subject to the jurisdiction of the Federal Communications Commission; or
`(D) products or services that are related or incidental to the provision of a product or service described in subparagraph (A), (B), or (C).

No person shall be deemed to be an exempt telecommunications company under this section unless such person has applied to the Federal Communications Commission for a determination under this paragraph. A person applying in good faith for such a determination shall be deemed an exempt telecommunications company under this section, with all of the exemptions provided by this section, until the Federal Communications Commission makes such determination. The Federal Communications Commission shall make such determination within 60 days of its receipt of any such application filed after the enactment of this section and shall notify the Commission whenever a determination is made under this paragraph that any person is an exempt telecommunications company. Not later than 12 months after the date of enactment of this section, the Federal Communications Commission shall promulgate rules implementing the provisions of this paragraph which shall be applicable to applications filed under this paragraph after the effective date of such rules.

`(2) OTHER TERMS- For purposes of this section, the terms `telecommunications services' and `information services' shall have the same meanings as provided in the Communications Act of 1934.

`(b) STATE CONSENT FOR SALE OF EXISTING RATE-BASED FACILITIES- If a rate or charge for the sale of electric energy or natural gas (other than any portion of a rate or charge which represents recovery of the cost of a wholesale rate or charge) for, or in connection with, assets of a public utility company that is an associate company or affiliate of a registered holding company was in effect under the laws of any State as of December 19, 1995, the public utility company owning such assets may not sell such assets to an exempt telecommunications company that is an associate company or affiliate unless State commissions having jurisdiction over such public utility company approve such sale. Nothing in this subsection shall preempt the otherwise applicable authority of any State to approve or disapprove the sale of such assets. The approval of the Commission under this Act shall not be required for the sale of assets as provided in this subsection.

`(c) OWNERSHIP OF ETCS BY EXEMPT HOLDING COMPANIES-

Notwithstanding any provision of this Act, a holding company that is exempt under section 3 of this Act shall be permitted, without condition or limitation under this Act, to acquire and maintain an interest in the business of one or more exempt telecommunications companies.

`(d) OWNERSHIP OF ETCS BY REGISTERED HOLDING COMPANIES- Notwithstanding any provision of this Act, a registered holding company shall be permitted (without the need to apply for, or receive, approval from the Commission, and otherwise without condition under this Act) to acquire and hold the securities, or an interest in the business, of one or more exempt telecommunications companies.

`(e) FINANCING AND OTHER RELATIONSHIPS BETWEEN ETCS AND REGISTERED HOLDING COMPANIES- The relationship between an exempt telecommunications company and a registered holding company, its affiliates and associate companies, shall remain subject to the jurisdiction of the Commission under this Act: [Italic->] Provided, [<-Italic] That--

`(1) section 11 of this Act shall not prohibit the ownership of an interest in the business of one or more exempt telecommunications companies by a registered holding company (regardless of activities engaged in or where facilities owned or operated by such exempt telecommunications companies are located), and such ownership by a registered holding company shall be deemed consistent with the operation of an integrated public utility system;

`(2) the ownership of an interest in the business of one or more exempt telecommunications companies by a registered holding company (regardless of activities engaged in or where facilities owned or operated by such exempt telecommunications companies are located) shall be considered as reasonably incidental, or economically necessary or appropriate, to the operations of an integrated public utility system;

`(3) the Commission shall have no jurisdiction under this Act over, and there shall be no restriction or approval required under this Act with respect to (A) the issue or sale of a security by a registered holding company for purposes of financing the acquisition of an exempt telecommunications company, or (B) the guarantee of a security of an exempt telecommunications company by a registered holding company; and

`(4) except for costs that should be fairly and equitably allocated among companies that are associate companies of a registered holding company, the Commission shall have no jurisdiction under this Act over the sales, service, and construction contracts between an exempt telecommunications

company and a registered holding company, its affiliates and associate companies.

`(f) REPORTING OBLIGATIONS CONCERNING INVESTMENTS AND ACTIVITIES OF REGISTERED PUBLIC-UTILITY HOLDING COMPANY SYSTEMS-

`(1) OBLIGATIONS TO REPORT INFORMATION- Any registered holding company or subsidiary thereof that acquires or holds the securities, or an interest in the business, of an exempt telecommunications company shall file with the Commission such information as the Commission, by rule, may prescribe concerning--

`(A) investments and activities by the registered holding company, or any subsidiary thereof, with respect to exempt telecommunications companies, and

`(B) any activities of an exempt telecommunications company within the holding company system,

that are reasonably likely to have a material impact on the financial or operational condition of the holding company system.

`(2) AUTHORITY TO REQUIRE ADDITIONAL INFORMATION- If, based on reports provided to the Commission pursuant to paragraph (1) of this subsection or other available information, the Commission reasonably concludes that it has concerns regarding the financial or operational condition of any registered holding company or any subsidiary thereof (including an exempt telecommunications company), the Commission may require such registered holding company to make additional reports and provide additional information.

`(3) AUTHORITY TO LIMIT DISCLOSURE OF INFORMATION- Notwithstanding any other provision of law, the Commission shall not be compelled to disclose any information required to be reported under this subsection. Nothing in this subsection shall authorize the Commission to withhold the information from Congress, or prevent the Commission from complying with a request for information from any other Federal or State department or agency requesting the information for purposes within the scope of its jurisdiction. For purposes of section 552 of title 5, United States Code, this subsection shall be considered a statute described in subsection (b)(3)(B) of such section 552.

`(g) ASSUMPTION OF LIABILITIES- Any public utility company that is an associate company, or an affiliate, of a registered holding company and that is subject to the jurisdiction of a State commission with respect to its retail electric or gas rates shall not issue any security for the purpose of financing the acquisition, ownership, or operation of an exempt

telecommunications company. Any public utility company that is an associate company, or an affiliate, of a registered holding company and that is subject to the jurisdiction of a State commission with respect to its retail electric or gas rates shall not assume any obligation or liability as guarantor, endorser, surety, or otherwise by the public utility company in respect of any security of an exempt telecommunications company.

`(h) PLEDGING OR MORTGAGING OF ASSETS- Any public utility company that is an associate company, or affiliate, of a registered holding company and that is subject to the jurisdiction of a State commission with respect to its retail electric or gas rates shall not pledge, mortgage, or otherwise use as collateral any assets of the public utility company or assets of any subsidiary company thereof for the benefit of an exempt telecommunications company.

`(i) PROTECTION AGAINST ABUSIVE AFFILIATE TRANSACTIONS- A public utility company may enter into a contract to purchase services or products described in subsection (a)(1) from an exempt telecommunications company that is an affiliate or associate company of the public utility company only if--

`(1) every State commission having jurisdiction over the retail rates of such public utility company approves such contract; or

`(2) such public utility company is not subject to State commission retail rate regulation and the purchased services or products--

`(A) would not be resold to any affiliate or associate company; or

`(B) would be resold to an affiliate or associate company and every State commission having jurisdiction over the retail rates of such affiliate or associate company makes the determination required by subparagraph (A).

The requirements of this subsection shall not apply in any case in which the State or the State commission concerned publishes a notice that the State or State commission waives its authority under this subsection.

`(j) NONPREEMPTION OF RATE AUTHORITY- Nothing in this Act shall preclude the Federal Energy Regulatory Commission or a State commission from exercising its jurisdiction under otherwise applicable law to determine whether a public utility company may recover in rates the costs of products or services purchased from or sold to an associate company or affiliate that is an exempt telecommunications company, regardless of whether such costs are incurred through the direct or indirect purchase or sale of products or services from such associate company or affiliate.

`(k) RECIPROCAL ARRANGEMENTS PROHIBITED- Reciprocal arrangements

among companies that are not affiliates or associate companies of each other that are entered into in order to avoid the provisions of this section are prohibited.

`(l) BOOKS AND RECORDS- (1) Upon written order of a State commission, a State commission may examine the books, accounts, memoranda, contracts, and records of--

`(A) a public utility company subject to its regulatory authority under State law;

`(B) any exempt telecommunications company selling products or services to such public utility company or to an associate company of such public utility company; and

`(C) any associate company or affiliate of an exempt telecommunications company which sells products or services to a public utility company referred to in subparagraph (A),

wherever located, if such examination is required for the effective discharge of the State commission's regulatory responsibilities affecting the provision of electric or gas service in connection with the activities of such exempt telecommunications company.

`(2) Where a State commission issues an order pursuant to paragraph (1), the State commission shall not publicly disclose trade secrets or sensitive commercial information.

`(3) Any United States district court located in the State in which the State commission referred to in paragraph (1) is located shall have jurisdiction to enforce compliance with this subsection.

`(4) Nothing in this section shall--

`(A) preempt applicable State law concerning the provision of records and other information; or

`(B) in any way limit rights to obtain records and other information under Federal law, contracts, or otherwise.

`(m) INDEPENDENT AUDIT AUTHORITY FOR STATE COMMISSIONS-

`(1) STATE MAY ORDER AUDIT- Any State commission with jurisdiction over a public utility company that--

`(A) is an associate company of a registered holding company; and

`(B) transacts business, directly or indirectly, with a subsidiary company, an affiliate or an associate company that is an exempt telecommunications company,

may order an independent audit to be performed, no more frequently than on an annual basis, of all matters deemed relevant by the selected auditor that reasonably relate to retail rates: [Italic->] Provided [<-Italic] , That such matters relate, directly or indirectly, to transactions or transfers between the public utility company subject to its jurisdiction and such exempt telecommunications company.

`(2) SELECTION OF FIRM TO CONDUCT AUDIT- (A) If a State

commission orders an audit in accordance with paragraph (1), the public utility company and the State commission shall jointly select, within 60 days, a firm to perform the audit. The firm selected to perform the audit shall possess demonstrated qualifications relating to--

`(i) competency, including adequate technical training and professional proficiency in each discipline necessary to carry out the audit; and

`(ii) independence and objectivity, including that the firm be free from personal or external impairments to independence, and should assume an independent position with the State commission and auditee, making certain that the audit is based upon an impartial consideration of all pertinent facts and responsible opinions.

`(B) The public utility company and the exempt telecommunications company shall cooperate fully with all reasonable requests necessary to perform the audit and the public utility company shall bear all costs of having the audit performed.

`(3) AVAILABILITY OF AUDITOR'S REPORT- The auditor's report shall be provided to the State commission not later than 6 months after the selection of the auditor, and provided to the public utility company not later than 60 days thereafter.

`(n) APPLICABILITY OF TELECOMMUNICATIONS REGULATION- Nothing in this section shall affect the authority of the Federal Communications Commission under the Communications Act of 1934, or the authority of State commissions under State laws concerning the provision of telecommunications services, to regulate the activities of an exempt telecommunications company.'.

SEC. 104. NONDISCRIMINATION PRINCIPLE.

Section 1 (47 U.S.C. 151) is amended by inserting after `to all the people of the United States' the following: `, without discrimination on the basis of race, color, religion, national origin, or sex,'.

SUBTITLE B--SPECIAL PROVISIONS CONCERNING BELL OPERATING COMPANIES

SEC. 151. BELL OPERATING COMPANY PROVISIONS.

(a) ESTABLISHMENT OF PART III OF TITLE II- Title II is amended by adding at the end of part II (as added by section 101) the following new part:

`PART III--SPECIAL PROVISIONS CONCERNING BELL OPERATING COMPANIES

`SEC. 271. BELL OPERATING COMPANY ENTRY INTO INTERLATA SERVICES.

`(a) GENERAL LIMITATION- Neither a Bell operating company, nor any affiliate of a Bell operating company, may provide interLATA

services except as provided in this section.

`(b) INTERLATA SERVICES TO WHICH THIS SECTION APPLIES-

`(1) IN-REGION SERVICES- A Bell operating company, or any affiliate of that Bell operating company, may provide interLATA services originating in any of its in-region States (as defined in subsection (i)) if the Commission approves the application of such company for such State under subsection (d)(3).

`(2) OUT-OF-REGION SERVICES- A Bell operating company, or any affiliate of that Bell operating company, may provide interLATA services originating outside its in-region States after the date of enactment of the Telecommunications Act of 1996, subject to subsection (j).

`(3) INCIDENTAL INTERLATA SERVICES- A Bell operating company, or any affiliate of a Bell operating company, may provide incidental interLATA services (as defined in subsection (g)) originating in any State after the date of enactment of the Telecommunications Act of 1996.

`(4) TERMINATION- Nothing in this section prohibits a Bell operating company or any of its affiliates from providing termination for interLATA services, subject to subsection (j).

`(c) REQUIREMENTS FOR PROVIDING CERTAIN IN-REGION INTERLATA SERVICES-

`(1) AGREEMENT OR STATEMENT- A Bell operating company meets the requirements of this paragraph if it meets the requirements of subparagraph (A) or subparagraph (B) of this paragraph for each State for which the authorization is sought.

`(A) PRESENCE OF A FACILITIES-BASED COMPETITOR- A Bell operating company meets the requirements of this subparagraph if it has entered into one or more binding agreements that have been approved under section 252 specifying the terms and conditions under which the Bell operating company is providing access and interconnection to its network facilities for the network facilities of one or more unaffiliated competing providers of telephone exchange service (as defined in section 3(47)(A), but excluding exchange access) to residential and business subscribers. For the purpose of this subparagraph, such telephone exchange service may be offered by such competing providers either exclusively over their own telephone exchange service facilities or predominantly over their own telephone exchange service facilities in combination with the resale of the telecommunications services of another carrier. For the purpose of this subparagraph, services provided pursuant to subpart K of part 22 of the Commission's regulations (47 C.F.R. 22.901 et seq.) shall

not be considered to be telephone exchange services.

`(B) FAILURE TO REQUEST ACCESS- A Bell operating company meets the requirements of this subparagraph if, after 10 months after the date of enactment of the Telecommunications Act of 1996, no such provider has requested the access and interconnection described in subparagraph (A) before the date which is 3 months before the date the company makes its application under subsection (d)(1), and a statement of the terms and conditions that the company generally offers to provide such access and interconnection has been approved or permitted to take effect by the State commission under section 252(f). For purposes of this subparagraph, a Bell operating company shall be considered not to have received any request for access and interconnection if the State commission of such State certifies that the only provider or providers making such a request have (i) failed to negotiate in good faith as required by section 252, or (ii) violated the terms of an agreement approved under section 252 by the provider's failure to comply, within a reasonable period of time, with the implementation schedule contained in such agreement.

`(2) SPECIFIC INTERCONNECTION REQUIREMENTS-

`(A) AGREEMENT REQUIRED- A Bell operating company meets the requirements of this paragraph if, within the State for which the authorization is sought--

`(i)(I) such company is providing access and interconnection pursuant to one or more agreements described in paragraph (1)(A), or

`(II) such company is generally offering access and interconnection pursuant to a statement described in paragraph (1)(B), and

`(ii) such access and interconnection meets the requirements of subparagraph (B) of this paragraph.

`(B) COMPETITIVE CHECKLIST- Access or interconnection provided or generally offered by a Bell operating company to other telecommunications carriers meets the requirements of this subparagraph if such access and interconnection includes each of the following:

`(i) Interconnection in accordance with the requirements of sections 251(c)(2) and 252(d)(1).

`(ii) Nondiscriminatory access to network elements in accordance with the requirements of sections 251(c)(3) and 252(d)(1).

`(iii) Nondiscriminatory access to the poles, ducts, conduits, and rights-of-way owned or controlled by the

Bell operating company at just and reasonable rates in accordance with the requirements of section 224.

`(iv) Local loop transmission from the central office to the customer's premises, unbundled from local switching or other services.

`(v) Local transport from the trunk side of a wireline local exchange carrier switch unbundled from switching or other services.

`(vi) Local switching unbundled from transport, local loop transmission, or other services.

`(vii) Nondiscriminatory access to--

`(I) 911 and E911 services;

`(II) directory assistance services to allow the other carrier's customers to obtain telephone numbers; and

`(III) operator call completion services.

`(viii) White pages directory listings for customers of the other carrier's telephone exchange service.

`(ix) Until the date by which telecommunications numbering administration guidelines, plan, or rules are established, nondiscriminatory access to telephone numbers for assignment to the other carrier's telephone exchange service customers. After that date, compliance with such guidelines, plan, or rules.

`(x) Nondiscriminatory access to databases and associated signaling necessary for call routing and completion.

`(xi) Until the date by which the Commission issues regulations pursuant to section 251 to require number portability, interim telecommunications number portability through remote call forwarding, direct inward dialing trunks, or other comparable arrangements, with as little impairment of functioning, quality, reliability, and convenience as possible. After that date, full compliance with such regulations.

`(xii) Nondiscriminatory access to such services or information as are necessary to allow the requesting carrier to implement local dialing parity in accordance with the requirements of section 251(b)(3).

`(xiii) Reciprocal compensation arrangements in accordance with the requirements of section 252(d)(2).

`(xiv) Telecommunications services are available for resale in accordance with the requirements of sections 251(c)(4) and 252(d)(3).

`(d) ADMINISTRATIVE PROVISIONS-

`(1) APPLICATION TO COMMISSION- On and after the date of

enactment of the Telecommunications Act of 1996, a Bell operating company or its affiliate may apply to the Commission for authorization to provide interLATA services originating in any in-region State. The application shall identify each State for which the authorization is sought.

`(2) CONSULTATION-

`(A) CONSULTATION WITH THE ATTORNEY GENERAL- The Commission shall notify the Attorney General promptly of any application under paragraph (1). Before making any determination under this subsection, the Commission shall consult with the Attorney General, and if the Attorney General submits any comments in writing, such comments shall be included in the record of the Commission's decision. In consulting with and submitting comments to the Commission under this paragraph, the Attorney General shall provide to the Commission an evaluation of the application using any standard the Attorney General considers appropriate. The Commission shall give substantial weight to the Attorney General's evaluation, but such evaluation shall not have any preclusive effect on any Commission decision under paragraph (3).

`(B) CONSULTATION WITH STATE COMMISSIONS- Before making any determination under this subsection, the Commission shall consult with the State commission of any State that is the subject of the application in order to verify the compliance of the Bell operating company with the requirements of subsection (c).

`(3) DETERMINATION- Not later than 90 days after receiving an application under paragraph (1), the Commission shall issue a written determination approving or denying the authorization requested in the application for each State. The Commission shall not approve the authorization requested in an application submitted under paragraph (1) unless it finds that--

`(A) the petitioning Bell operating company has met the requirements of subsection (c)(1) and--

`(i) with respect to access and interconnection provided pursuant to subsection (c)(1)(A), has fully implemented the competitive checklist in subsection (c)(2)(B); or

`(ii) with respect to access and interconnection generally offered pursuant to a statement under subsection (c)(1)(B), such statement offers all of the items included in the competitive checklist in subsection (c)(2)(B);

`(B) the requested authorization will be carried out in

accordance with the requirements of section 272; and
`(C) the requested authorization is consistent with the public interest, convenience, and necessity.
The Commission shall state the basis for its approval or denial of the application.
`(4) LIMITATION ON COMMISSION- The Commission may not, by rule or otherwise, limit or extend the terms used in the competitive checklist set forth in subsection (c)(2)(B).
`(5) PUBLICATION- Not later than 10 days after issuing a determination under paragraph (3), the Commission shall publish in the Federal Register a brief description of the determination.
`(6) ENFORCEMENT OF CONDITIONS-
`(A) COMMISSION AUTHORITY- If at any time after the approval of an application under paragraph (3), the Commission determines that a Bell operating company has ceased to meet any of the conditions required for such approval, the Commission may, after notice and opportunity for a hearing--
`(i) issue an order to such company to correct the deficiency;
`(ii) impose a penalty on such company pursuant to title V; or
`(iii) suspend or revoke such approval.
`(B) RECEIPT AND REVIEW OF COMPLAINTS- The Commission shall establish procedures for the review of complaints concerning failures by Bell operating companies to meet conditions required for approval under paragraph (3). Unless the parties otherwise agree, the Commission shall act on such complaint within 90 days.
`(e) LIMITATIONS-
`(1) JOINT MARKETING OF LOCAL AND LONG DISTANCE SERVICES- Until a Bell operating company is authorized pursuant to subsection (d) to provide interLATA services in an in-region State, or until 36 months have passed since the date of enactment of the Telecommunications Act of 1996, whichever is earlier, a telecommunications carrier that serves greater than 5 percent of the Nation's presubscribed access lines may not jointly market in such State telephone exchange service obtained from such company pursuant to section 251(c)(4) with interLATA services offered by that telecommunications carrier.
`(2) INTRALATA TOLL DIALING PARITY-
`(A) PROVISION REQUIRED- A Bell operating company granted authority to provide interLATA services under subsection (d) shall provide intraLATA toll dialing parity throughout that State coincident with its exercise of that authority.

`(B) LIMITATION- Except for single-LATA States and States that have issued an order by December 19, 1995, requiring a Bell operating company to implement intraLATA toll dialing parity, a State may not require a Bell operating company to implement intraLATA toll dialing parity in that State before a Bell operating company has been granted authority under this section to provide interLATA services originating in that State or before 3 years after the date of enactment of the Telecommunications Act of 1996, whichever is earlier. Nothing in this subparagraph precludes a State from issuing an order requiring intraLATA toll dialing parity in that State prior to either such date so long as such order does not take effect until after the earlier of either such dates.

`(f) EXCEPTION FOR PREVIOUSLY AUTHORIZED ACTIVITIES- Neither subsection (a) nor section 273 shall prohibit a Bell operating company or affiliate from engaging, at any time after the date of enactment of the Telecommunications Act of 1996, in any activity to the extent authorized by, and subject to the terms and conditions contained in, an order entered by the United States District Court for the District of Columbia pursuant to section VII or VIII(C) of the AT&T Consent Decree if such order was entered on or before such date of enactment, to the extent such order is not reversed or vacated on appeal. Nothing in this subsection shall be construed to limit, or to impose terms or conditions on, an activity in which a Bell operating company is otherwise authorized to engage under any other provision of this section.

`(g) DEFINITION OF INCIDENTAL INTERLATA SERVICES- For purposes of this section, the term `incidental interLATA services' means the interLATA provision by a Bell operating company or its affiliate--

`(1)(A) of audio programming, video programming, or other programming services to subscribers to such services of such company or affiliate;

`(B) of the capability for interaction by such subscribers to select or respond to such audio programming, video programming, or other programming services;

`(C) to distributors of audio programming or video programming that such company or affiliate owns or controls, or is licensed by the copyright owner of such programming (or by an assignee of such owner) to distribute; or

`(D) of alarm monitoring services;

`(2) of two-way interactive video services or Internet services over dedicated facilities to or for elementary and secondary schools as defined in section 254(h)(5);

`(3) of commercial mobile services in accordance with section

332(c) of this Act and with the regulations prescribed by the Commission pursuant to paragraph (8) of such section;

`(4) of a service that permits a customer that is located in one LATA to retrieve stored information from, or file information for storage in, information storage facilities of such company that are located in another LATA;

`(5) of signaling information used in connection with the provision of telephone exchange services or exchange access by a local exchange carrier; or

`(6) of network control signaling information to, and receipt of such signaling information from, common carriers offering interLATA services at any location within the area in which such Bell operating company provides telephone exchange services or exchange access.

`(h) LIMITATIONS- The provisions of subsection (g) are intended to be narrowly construed. The interLATA services provided under subparagraph (A), (B), or (C) of subsection (g)(1) are limited to those interLATA transmissions incidental to the provision by a Bell operating company or its affiliate of video, audio, and other programming services that the company or its affiliate is engaged in providing to the public. The Commission shall ensure that the provision of services authorized under subsection (g) by a Bell operating company or its affiliate will not adversely affect telephone exchange service ratepayers or competition in any telecommunications market.

`(i) ADDITIONAL DEFINITIONS- As used in this section--

`(1) IN-REGION STATE- The term `in-region State' means a State in which a Bell operating company or any of its affiliates was authorized to provide wireline telephone exchange service pursuant to the reorganization plan approved under the AT&T Consent Decree, as in effect on the day before the date of enactment of the Telecommunications Act of 1996.

`(2) AUDIO PROGRAMMING SERVICES- The term `audio programming services' means programming provided by, or generally considered to be comparable to programming provided by, a radio broadcast station.

`(3) VIDEO PROGRAMMING SERVICES; OTHER PROGRAMMING SERVICES- The terms `video programming service' and `other programming services' have the same meanings as such terms have under section 602 of this Act.

`(j) CERTAIN SERVICE APPLICATIONS TREATED AS IN-REGION SERVICE APPLICATIONS- For purposes of this section, a Bell operating company application to provide 800 service, private line service, or their equivalents that--

`(1) terminate in an in-region State of that Bell operating

company, and

`(2) allow the called party to determine the interLATA carrier,

shall be considered an in-region service subject to the requirements of subsection (b)(1).

`SEC. 272. SEPARATE AFFILIATE; SAFEGUARDS.

`(a) SEPARATE AFFILIATE REQUIRED FOR COMPETITIVE ACTIVITIES-

`(1) IN GENERAL- A Bell operating company (including any affiliate) which is a local exchange carrier that is subject to the requirements of section 251(c) may not provide any service described in paragraph (2) unless it provides that service through one or more affiliates that--

`(A) are separate from any operating company entity that is subject to the requirements of section 251(c); and

`(B) meet the requirements of subsection (b).

`(2) SERVICES FOR WHICH A SEPARATE AFFILIATE IS REQUIRED- The services for which a separate affiliate is required by paragraph (1) are:

`(A) Manufacturing activities (as defined in section 273(h)).

`(B) Origination of interLATA telecommunications services, other than--

`(i) incidental interLATA services described in paragraphs (1), (2), (3), (5), and (6) of section 271(g);

`(ii) out-of-region services described in section 271(b)(2); or

`(iii) previously authorized activities described in section 271(f).

`(C) InterLATA information services, other than electronic publishing (as defined in section 274(h)) and alarm monitoring services (as defined in section 275(e)).

`(b) STRUCTURAL AND TRANSACTIONAL REQUIREMENTS- The separate affiliate required by this section--

`(1) shall operate independently from the Bell operating company;

`(2) shall maintain books, records, and accounts in the manner prescribed by the Commission which shall be separate from the books, records, and accounts maintained by the Bell operating company of which it is an affiliate;

`(3) shall have separate officers, directors, and employees from the Bell operating company of which it is an affiliate;

`(4) may not obtain credit under any arrangement that would permit a creditor, upon default, to have recourse to the assets of the Bell operating company; and

`(5) shall conduct all transactions with the Bell operating company of which it is an affiliate on an arm's length basis

with any such transactions reduced to writing and available for public inspection.

`(c) NONDISCRIMINATION SAFEGUARDS- In its dealings with its affiliate described in subsection (a), a Bell operating company--

`(1) may not discriminate between that company or affiliate and any other entity in the provision or procurement of goods, services, facilities, and information, or in the establishment of standards; and

`(2) shall account for all transactions with an affiliate described in subsection (a) in accordance with accounting principles designated or approved by the Commission.

`(d) BIENNIAL AUDIT-

`(1) GENERAL REQUIREMENT- A company required to operate a separate affiliate under this section shall obtain and pay for a joint Federal/State audit every 2 years conducted by an independent auditor to determine whether such company has complied with this section and the regulations promulgated under this section, and particularly whether such company has complied with the separate accounting requirements under subsection (b).

`(2) RESULTS SUBMITTED TO COMMISSION; STATE COMMISSIONS- The auditor described in paragraph (1) shall submit the results of the audit to the Commission and to the State commission of each State in which the company audited provides service, which shall make such results available for public inspection. Any party may submit comments on the final audit report.

`(3) ACCESS TO DOCUMENTS- For purposes of conducting audits and reviews under this subsection--

`(A) the independent auditor, the Commission, and the State commission shall have access to the financial accounts and records of each company and of its affiliates necessary to verify transactions conducted with that company that are relevant to the specific activities permitted under this section and that are necessary for the regulation of rates;

`(B) the Commission and the State commission shall have access to the working papers and supporting materials of any auditor who performs an audit under this section; and

`(C) the State commission shall implement appropriate procedures to ensure the protection of any proprietary information submitted to it under this section.

`(e) FULFILLMENT OF CERTAIN REQUESTS- A Bell operating company and an affiliate that is subject to the requirements of section 251(c)--

`(1) shall fulfill any requests from an unaffiliated entity

for telephone exchange service and exchange access within a period no longer than the period in which it provides such telephone exchange service and exchange access to itself or to its affiliates;

`(2) shall not provide any facilities, services, or information concerning its provision of exchange access to the affiliate described in subsection (a) unless such facilities, services, or information are made available to other providers of interLATA services in that market on the same terms and conditions;

`(3) shall charge the affiliate described in subsection (a), or impute to itself (if using the access for its provision of its own services), an amount for access to its telephone exchange service and exchange access that is no less than the amount charged to any unaffiliated interexchange carriers for such service; and

`(4) may provide any interLATA or intraLATA facilities or services to its interLATA affiliate if such services or facilities are made available to all carriers at the same rates and on the same terms and conditions, and so long as the costs are appropriately allocated.

`(f) SUNSET-

`(1) MANUFACTURING AND LONG DISTANCE- The provisions of this section (other than subsection (e)) shall cease to apply with respect to the manufacturing activities or the interLATA telecommunications services of a Bell operating company 3 years after the date such Bell operating company or any Bell operating company affiliate is authorized to provide interLATA telecommunications services under section 271(d), unless the Commission extends such 3-year period by rule or order.

`(2) INTERLATA INFORMATION SERVICES- The provisions of this section (other than subsection (e)) shall cease to apply with respect to the interLATA information services of a Bell operating company 4 years after the date of enactment of the Telecommunications Act of 1996, unless the Commission extends such 4-year period by rule or order.

`(3) PRESERVATION OF EXISTING AUTHORITY- Nothing in this subsection shall be construed to limit the authority of the Commission under any other section of this Act to prescribe safeguards consistent with the public interest, convenience, and necessity.

`(g) JOINT MARKETING-

`(1) AFFILIATE SALES OF TELEPHONE EXCHANGE SERVICES- A Bell operating company affiliate required by this section may not market or sell telephone exchange services provided by the Bell

operating company unless that company permits other entities offering the same or similar service to market and sell its telephone exchange services.

`(2) BELL OPERATING COMPANY SALES OF AFFILIATE SERVICES- A Bell operating company may not market or sell interLATA service provided by an affiliate required by this section within any of its in-region States until such company is authorized to provide interLATA services in such State under section 271(d).

`(3) RULE OF CONSTRUCTION- The joint marketing and sale of services permitted under this subsection shall not be considered to violate the nondiscrimination provisions of subsection (c).

`(h) TRANSITION- With respect to any activity in which a Bell operating company is engaged on the date of enactment of the Telecommunications Act of 1996, such company shall have one year from such date of enactment to comply with the requirements of this section.

`SEC. 273. MANUFACTURING BY BELL OPERATING COMPANIES.

`(a) AUTHORIZATION- A Bell operating company may manufacture and provide telecommunications equipment, and manufacture customer premises equipment, if the Commission authorizes that Bell operating company or any Bell operating company affiliate to provide interLATA services under section 271(d), subject to the requirements of this section and the regulations prescribed thereunder, except that neither a Bell operating company nor any of its affiliates may engage in such manufacturing in conjunction with a Bell operating company not so affiliated or any of its affiliates.

`(b) COLLABORATION; RESEARCH AND ROYALTY AGREEMENTS-

`(1) COLLABORATION- Subsection (a) shall not prohibit a Bell operating company from engaging in close collaboration with any manufacturer of customer premises equipment or telecommunications equipment during the design and development of hardware, software, or combinations thereof related to such equipment.

`(2) CERTAIN RESEARCH ARRANGEMENTS; ROYALTY AGREEMENTS- Subsection (a) shall not prohibit a Bell operating company from--

`(A) engaging in research activities related to manufacturing, and

`(B) entering into royalty agreements with manufacturers of telecommunications equipment.

`(c) INFORMATION REQUIREMENTS-

`(1) INFORMATION ON PROTOCOLS AND TECHNICAL REQUIREMENTS- Each Bell operating company shall, in accordance with regulations prescribed by the Commission, maintain and file with the Commission full and complete information with respect

to the protocols and technical requirements for connection with and use of its telephone exchange service facilities. Each such company shall report promptly to the Commission any material changes or planned changes to such protocols and requirements, and the schedule for implementation of such changes or planned changes.

`(2) DISCLOSURE OF INFORMATION- A Bell operating company shall not disclose any information required to be filed under paragraph (1) unless that information has been filed promptly, as required by regulation by the Commission.

`(3) ACCESS BY COMPETITORS TO INFORMATION- The Commission may prescribe such additional regulations under this subsection as may be necessary to ensure that manufacturers have access to the information with respect to the protocols and technical requirements for connection with and use of telephone exchange service facilities that a Bell operating company makes available to any manufacturing affiliate or any unaffiliated manufacturer.

`(4) PLANNING INFORMATION- Each Bell operating company shall provide, to interconnecting carriers providing telephone exchange service, timely information on the planned deployment of telecommunications equipment.

`(d) MANUFACTURING LIMITATIONS FOR STANDARD-SETTING ORGANIZATIONS-

`(1) APPLICATION TO BELL COMMUNICATIONS RESEARCH OR MANUFACTURERS- Bell Communications Research, Inc., or any successor entity or affiliate--

`(A) shall not be considered a Bell operating company or a successor or assign of a Bell operating company at such time as it is no longer an affiliate of any Bell operating company; and

`(B) notwithstanding paragraph (3), shall not engage in manufacturing telecommunications equipment or customer premises equipment as long as it is an affiliate of more than 1 otherwise unaffiliated Bell operating company or successor or assign of any such company.

Nothing in this subsection prohibits Bell Communications Research, Inc., or any successor entity, from engaging in any activity in which it is lawfully engaged on the date of enactment of the Telecommunications Act of 1996. Nothing provided in this subsection shall render Bell Communications Research, Inc., or any successor entity, a common carrier under title II of this Act. Nothing in this subsection restricts any manufacturer from engaging in any activity in which it is lawfully engaged on the date of enactment of the

Telecommunications Act of 1996.

`(2) PROPRIETARY INFORMATION- Any entity which establishes standards for telecommunications equipment or customer premises equipment, or generic network requirements for such equipment, or certifies telecommunications equipment or customer premises equipment, shall be prohibited from releasing or otherwise using any proprietary information, designated as such by its owner, in its possession as a result of such activity, for any purpose other than purposes authorized in writing by the owner of such information, even after such entity ceases to be so engaged.

`(3) MANUFACTURING SAFEGUARDS- (A) Except as prohibited in paragraph (1), and subject to paragraph (6), any entity which certifies telecommunications equipment or customer premises equipment manufactured by an unaffiliated entity shall only manufacture a particular class of telecommunications equipment or customer premises equipment for which it is undertaking or has undertaken, during the previous 18 months, certification activity for such class of equipment through a separate affiliate.

`(B) Such separate affiliate shall--

`(i) maintain books, records, and accounts separate from those of the entity that certifies such equipment, consistent with generally acceptable accounting principles;

`(ii) not engage in any joint manufacturing activities with such entity; and

`(iii) have segregated facilities and separate employees with such entity.

`(C) Such entity that certifies such equipment shall--

`(i) not discriminate in favor of its manufacturing affiliate in the establishment of standards, generic requirements, or product certification;

`(ii) not disclose to the manufacturing affiliate any proprietary information that has been received at any time from an unaffiliated manufacturer, unless authorized in writing by the owner of the information; and

`(iii) not permit any employee engaged in product certification for telecommunications equipment or customer premises equipment to engage jointly in sales or marketing of any such equipment with the affiliated manufacturer.

`(4) STANDARD-SETTING ENTITIES- Any entity that is not an accredited standards development organization and that establishes industry-wide standards for telecommunications equipment or customer premises equipment, or industry-wide generic network requirements for such equipment, or that

certifies telecommunications equipment or customer premises equipment manufactured by an unaffiliated entity, shall--

`(A) establish and publish any industry-wide standard for, industry-wide generic requirement for, or any substantial modification of an existing industry-wide standard or industry-wide generic requirement for, telecommunications equipment or customer premises equipment only in compliance with the following procedure--

`(i) such entity shall issue a public notice of its consideration of a proposed industry-wide standard or industry-wide generic requirement;

`(ii) such entity shall issue a public invitation to interested industry parties to fund and participate in such efforts on a reasonable and nondiscriminatory basis, administered in such a manner as not to unreasonably exclude any interested industry party;

`(iii) such entity shall publish a text for comment by such parties as have agreed to participate in the process pursuant to clause (ii), provide such parties a full opportunity to submit comments, and respond to comments from such parties;

`(iv) such entity shall publish a final text of the industry-wide standard or industry-wide generic requirement, including the comments in their entirety, of any funding party which requests to have its comments so published; and

`(v) such entity shall attempt, prior to publishing a text for comment, to agree with the funding parties as a group on a mutually satisfactory dispute resolution process which such parties shall utilize as their sole recourse in the event of a dispute on technical issues as to which there is disagreement between any funding party and the entity conducting such activities, except that if no dispute resolution process is agreed to by all the parties, a funding party may utilize the dispute resolution procedures established pursuant to paragraph (5) of this subsection;

`(B) engage in product certification for telecommunications equipment or customer premises equipment manufactured by unaffiliated entities only if--

`(i) such activity is performed pursuant to published criteria;

`(ii) such activity is performed pursuant to auditable criteria; and

`(iii) such activity is performed pursuant to

available industry-accepted testing methods and standards, where applicable, unless otherwise agreed upon by the parties funding and performing such activity;

`(C) not undertake any actions to monopolize or attempt to monopolize the market for such services; and

`(D) not preferentially treat its own telecommunications equipment or customer premises equipment, or that of its affiliate, over that of any other entity in establishing and publishing industry-wide standards or industry-wide generic requirements for, and in certification of, telecommunications equipment and customer premises equipment.

`(5) ALTERNATE DISPUTE RESOLUTION- Within 90 days after the date of enactment of the Telecommunications Act of 1996, the Commission shall prescribe a dispute resolution process to be utilized in the event that a dispute resolution process is not agreed upon by all the parties when establishing and publishing any industry-wide standard or industry-wide generic requirement for telecommunications equipment or customer premises equipment, pursuant to paragraph (4)(A)(v). The Commission shall not establish itself as a party to the dispute resolution process. Such dispute resolution process shall permit any funding party to resolve a dispute with the entity conducting the activity that significantly affects such funding party's interests, in an open, nondiscriminatory, and unbiased fashion, within 30 days after the filing of such dispute. Such disputes may be filed within 15 days after the date the funding party receives a response to its comments from the entity conducting the activity. The Commission shall establish penalties to be assessed for delays caused by referral of frivolous disputes to the dispute resolution process.

`(6) SUNSET- The requirements of paragraphs (3) and (4) shall terminate for the particular relevant activity when the Commission determines that there are alternative sources of industry-wide standards, industry-wide generic requirements, or product certification for a particular class of telecommunications equipment or customer premises equipment available in the United States. Alternative sources shall be deemed to exist when such sources provide commercially viable alternatives that are providing such services to customers. The Commission shall act on any application for such a determination within 90 days after receipt of such application, and shall receive public comment on such application.

`(7) ADMINISTRATION AND ENFORCEMENT AUTHORITY- For the purposes of administering this subsection and the regulations prescribed thereunder, the Commission shall have the same

remedial authority as the Commission has in administering and enforcing the provisions of this title with respect to any common carrier subject to this Act.

`(8) DEFINITIONS- For purposes of this subsection:

`(A) The term `affiliate' shall have the same meaning as in section 3 of this Act, except that, for purposes of paragraph (1)(B)--

`(i) an aggregate voting equity interest in Bell Communications Research, Inc., of at least 5 percent of its total voting equity, owned directly or indirectly by more than 1 otherwise unaffiliated Bell operating company, shall constitute an affiliate relationship; and

`(ii) a voting equity interest in Bell Communications Research, Inc., by any otherwise unaffiliated Bell operating company of less than 1 percent of Bell Communications Research's total voting equity shall not be considered to be an equity interest under this paragraph.

`(B) The term `generic requirement' means a description of acceptable product attributes for use by local exchange carriers in establishing product specifications for the purchase of telecommunications equipment, customer premises equipment, and software integral thereto.

`(C) The term `industry-wide' means activities funded by or performed on behalf of local exchange carriers for use in providing wireline telephone exchange service whose combined total of deployed access lines in the United States constitutes at least 30 percent of all access lines deployed by telecommunications carriers in the United States as of the date of enactment of the Telecommunications Act of 1996.

`(D) The term `certification' means any technical process whereby a party determines whether a product, for use by more than one local exchange carrier, conforms with the specified requirements pertaining to such product.

`(E) The term `accredited standards development organization' means an entity composed of industry members which has been accredited by an institution vested with the responsibility for standards accreditation by the industry.

`(e) BELL OPERATING COMPANY EQUIPMENT PROCUREMENT AND SALES-

`(1) NONDISCRIMINATION STANDARDS FOR MANUFACTURING- In the procurement or awarding of supply contracts for telecommunications equipment, a Bell operating company, or any entity acting on its behalf, for the duration of the requirement for a separate subsidiary including manufacturing

under this Act--

`(A) shall consider such equipment, produced or supplied by unrelated persons; and

`(B) may not discriminate in favor of equipment produced or supplied by an affiliate or related person.

`(2) PROCUREMENT STANDARDS- Each Bell operating company or any entity acting on its behalf shall make procurement decisions and award all supply contracts for equipment, services, and software on the basis of an objective assessment of price, quality, delivery, and other commercial factors.

`(3) NETWORK PLANNING AND DESIGN- A Bell operating company shall, to the extent consistent with the antitrust laws, engage in joint network planning and design with local exchange carriers operating in the same area of interest. No participant in such planning shall be allowed to delay the introduction of new technology or the deployment of facilities to provide telecommunications services, and agreement with such other carriers shall not be required as a prerequisite for such introduction or deployment.

`(4) SALES RESTRICTIONS- Neither a Bell operating company engaged in manufacturing nor a manufacturing affiliate of such a company shall restrict sales to any local exchange carrier of telecommunications equipment, including software integral to the operation of such equipment and related upgrades.

`(5) PROTECTION OF PROPRIETARY INFORMATION- A Bell operating company and any entity it owns or otherwise controls shall protect the proprietary information submitted for procurement decisions from release not specifically authorized by the owner of such information.

`(f) ADMINISTRATION AND ENFORCEMENT AUTHORITY- For the purposes of administering and enforcing the provisions of this section and the regulations prescribed thereunder, the Commission shall have the same authority, power, and functions with respect to any Bell operating company or any affiliate thereof as the Commission has in administering and enforcing the provisions of this title with respect to any common carrier subject to this Act.

`(g) ADDITIONAL RULES AND REGULATIONS- The Commission may prescribe such additional rules and regulations as the Commission determines are necessary to carry out the provisions of this section, and otherwise to prevent discrimination and cross-subsidization in a Bell operating company's dealings with its affiliate and with third parties.

`(h) DEFINITION- As used in this section, the term `manufacturing' has the same meaning as such term has under the AT&T Consent Decree.

`SEC. 274. ELECTRONIC PUBLISHING BY BELL OPERATING COMPANIES.

`(a) LIMITATIONS- No Bell operating company or any affiliate may engage in the provision of electronic publishing that is disseminated by means of such Bell operating company's or any of its affiliates' basic telephone service, except that nothing in this section shall prohibit a separated affiliate or electronic publishing joint venture operated in accordance with this section from engaging in the provision of electronic publishing.

`(b) SEPARATED AFFILIATE OR ELECTRONIC PUBLISHING JOINT VENTURE REQUIREMENTS- A separated affiliate or electronic publishing joint venture shall be operated independently from the Bell operating company. Such separated affiliate or joint venture and the Bell operating company with which it is affiliated shall--

`(1) maintain separate books, records, and accounts and prepare separate financial statements;

`(2) not incur debt in a manner that would permit a creditor of the separated affiliate or joint venture upon default to have recourse to the assets of the Bell operating company;

`(3) carry out transactions (A) in a manner consistent with such independence, (B) pursuant to written contracts or tariffs that are filed with the Commission and made publicly available, and (C) in a manner that is auditable in accordance with generally accepted auditing standards;

`(4) value any assets that are transferred directly or indirectly from the Bell operating company to a separated affiliate or joint venture, and record any transactions by which such assets are transferred, in accordance with such regulations as may be prescribed by the Commission or a State commission to prevent improper cross subsidies;

`(5) between a separated affiliate and a Bell operating company--

`(A) have no officers, directors, and employees in common after the effective date of this section; and

`(B) own no property in common;

`(6) not use for the marketing of any product or service of the separated affiliate or joint venture, the name, trademarks, or service marks of an existing Bell operating company except for names, trademarks, or service marks that are owned by the entity that owns or controls the Bell operating company;

`(7) not permit the Bell operating company--

`(A) to perform hiring or training of personnel on behalf of a separated affiliate;

`(B) to perform the purchasing, installation, or maintenance of equipment on behalf of a separated affiliate, except for telephone service that it provides

under tariff or contract subject to the provisions of this section; or

`(C) to perform research and development on behalf of a separated affiliate;

`(8) each have performed annually a compliance review--

`(A) that is conducted by an independent entity for the purpose of determining compliance during the preceding calendar year with any provision of this section; and

`(B) the results of which are maintained by the separated affiliate or joint venture and the Bell operating company for a period of 5 years subject to review by any lawful authority; and

`(9) within 90 days of receiving a review described in paragraph (8), file a report of any exceptions and corrective action with the Commission and allow any person to inspect and copy such report subject to reasonable safeguards to protect any proprietary information contained in such report from being used for purposes other than to enforce or pursue remedies under this section.

`(c) JOINT MARKETING-

`(1) IN GENERAL- Except as provided in paragraph (2)--

`(A) a Bell operating company shall not carry out any promotion, marketing, sales, or advertising for or in conjunction with a separated affiliate; and

`(B) a Bell operating company shall not carry out any promotion, marketing, sales, or advertising for or in conjunction with an affiliate that is related to the provision of electronic publishing.

`(2) PERMISSIBLE JOINT ACTIVITIES-

`(A) JOINT TELEMARKETING- A Bell operating company may provide inbound telemarketing or referral services related to the provision of electronic publishing for a separated affiliate, electronic publishing joint venture, affiliate, or unaffiliated electronic publisher: [Italic->] P rovided, [<-Italic] That if such services are provided to a separated affiliate, electronic publishing joint venture, or affiliate, such services shall be made available to all electronic publishers on request, on nondiscriminatory terms.

`(B) TEAMING ARRANGEMENTS- A Bell operating company may engage in nondiscriminatory teaming or business arrangements to engage in electronic publishing with any separated affiliate or with any other electronic publisher if (i) the Bell operating company only provides facilities, services, and basic telephone service information as authorized by this section, and (ii) the Bell operating

company does not own such teaming or business arrangement.

`(C) ELECTRONIC PUBLISHING JOINT VENTURES- A Bell operating company or affiliate may participate on a nonexclusive basis in electronic publishing joint ventures with entities that are not a Bell operating company, affiliate, or separated affiliate to provide electronic publishing services, if the Bell operating company or affiliate has not more than a 50 percent direct or indirect equity interest (or the equivalent thereof) or the right to more than 50 percent of the gross revenues under a revenue sharing or royalty agreement in any electronic publishing joint venture. Officers and employees of a Bell operating company or affiliate participating in an electronic publishing joint venture may not have more than 50 percent of the voting control over the electronic publishing joint venture. In the case of joint ventures with small, local electronic publishers, the Commission for good cause shown may authorize the Bell operating company or affiliate to have a larger equity interest, revenue share, or voting control but not to exceed 80 percent. A Bell operating company participating in an electronic publishing joint venture may provide promotion, marketing, sales, or advertising personnel and services to such joint venture.

`(d) BELL OPERATING COMPANY REQUIREMENT- A Bell operating company under common ownership or control with a separated affiliate or electronic publishing joint venture shall provide network access and interconnections for basic telephone service to electronic publishers at just and reasonable rates that are tariffed (so long as rates for such services are subject to regulation) and that are not higher on a per-unit basis than those charged for such services to any other electronic publisher or any separated affiliate engaged in electronic publishing.

`(e) PRIVATE RIGHT OF ACTION-

`(1) DAMAGES- Any person claiming that any act or practice of any Bell operating company, affiliate, or separated affiliate constitutes a violation of this section may file a complaint with the Commission or bring suit as provided in section 207 of this Act, and such Bell operating company, affiliate, or separated affiliate shall be liable as provided in section 206 of this Act; except that damages may not be awarded for a violation that is discovered by a compliance review as required by subsection (b)(7) of this section and corrected within 90 days.

`(2) CEASE AND DESIST ORDERS- In addition to the provisions of paragraph (1), any person claiming that any act or practice

of any Bell operating company, affiliate, or separated affiliate constitutes a violation of this section may make application to the Commission for an order to cease and desist such violation or may make application in any district court of the United States of competent jurisdiction for an order enjoining such acts or practices or for an order compelling compliance with such requirement.

`(f) SEPARATED AFFILIATE REPORTING REQUIREMENT- Any separated affiliate under this section shall file with the Commission annual reports in a form substantially equivalent to the Form 10-K required by regulations of the Securities and Exchange Commission.

`(g) EFFECTIVE DATES-

`(1) TRANSITION- Any electronic publishing service being offered to the public by a Bell operating company or affiliate on the date of enactment of the Telecommunications Act of 1996 shall have one year from such date of enactment to comply with the requirements of this section.

`(2) SUNSET- The provisions of this section shall not apply to conduct occurring after 4 years after the date of enactment of the Telecommunications Act of 1996.

`(h) DEFINITION OF ELECTRONIC PUBLISHING-

`(1) IN GENERAL- The term `electronic publishing' means the dissemination, provision, publication, or sale to an unaffiliated entity or person, of any one or more of the following: news (including sports); entertainment (other than interactive games); business, financial, legal, consumer, or credit materials; editorials, columns, or features; advertising; photos or images; archival or research material; legal notices or public records; scientific, educational, instructional, technical, professional, trade, or other literary materials; or other like or similar information.

`(2) EXCEPTIONS- The term `electronic publishing' shall not include the following services:

`(A) Information access, as that term is defined by the AT&T Consent Decree.

`(B) The transmission of information as a common carrier.

`(C) The transmission of information as part of a gateway to an information service that does not involve the generation or alteration of the content of information, including data transmission, address translation, protocol conversion, billing management, introductory information content, and navigational systems that enable users to access electronic publishing services, which do not affect the presentation of such electronic publishing services to users.

`(D) Voice storage and retrieval services, including voice messaging and electronic mail services.

`(E) Data processing or transaction processing services that do not involve the generation or alteration of the content of information.

`(F) Electronic billing or advertising of a Bell operating company's regulated telecommunications services.

`(G) Language translation or data format conversion.

`(H) The provision of information necessary for the management, control, or operation of a telephone company telecommunications system.

`(I) The provision of directory assistance that provides names, addresses, and telephone numbers and does not include advertising.

`(J) Caller identification services.

`(K) Repair and provisioning databases and credit card and billing validation for telephone company operations.

`(L) 911-E and other emergency assistance databases.

`(M) Any other network service of a type that is like or similar to these network services and that does not involve the generation or alteration of the content of information.

`(N) Any upgrades to these network services that do not involve the generation or alteration of the content of information.

`(O) Video programming or full motion video entertainment on demand.

`(i) ADDITIONAL DEFINITIONS- As used in this section--

`(1) The term `affiliate' means any entity that, directly or indirectly, owns or controls, is owned or controlled by, or is under common ownership or control with, a Bell operating company. Such term shall not include a separated affiliate.

`(2) The term `basic telephone service' means any wireline telephone exchange service, or wireline telephone exchange service facility, provided by a Bell operating company in a telephone exchange area, except that such term does not include--

`(A) a competitive wireline telephone exchange service provided in a telephone exchange area where another entity provides a wireline telephone exchange service that was provided on January 1, 1984, or

`(B) a commercial mobile service.

`(3) The term `basic telephone service information' means network and customer information of a Bell operating company and other information acquired by a Bell operating company as a result of its engaging in the provision of basic telephone service.

`(4) The term `control' has the meaning that it has in 17 C.F.R. 240.12b-2, the regulations promulgated by the Securities and Exchange Commission pursuant to the Securities Exchange Act of 1934 (15 U.S.C. 78a et seq.) or any successor provision to such section.

`(5) The term `electronic publishing joint venture' means a joint venture owned by a Bell operating company or affiliate that engages in the provision of electronic publishing which is disseminated by means of such Bell operating company's or any of its affiliates' basic telephone service.

`(6) The term `entity' means any organization, and includes corporations, partnerships, sole proprietorships, associations, and joint ventures.

`(7) The term `inbound telemarketing' means the marketing of property, goods, or services by telephone to a customer or potential customer who initiated the call.

`(8) The term `own' with respect to an entity means to have a direct or indirect equity interest (or the equivalent thereof) of more than 10 percent of an entity, or the right to more than 10 percent of the gross revenues of an entity under a revenue sharing or royalty agreement.

`(9) The term `separated affiliate' means a corporation under common ownership or control with a Bell operating company that does not own or control a Bell operating company and is not owned or controlled by a Bell operating company and that engages in the provision of electronic publishing which is disseminated by means of such Bell operating company's or any of its affiliates' basic telephone service.

`(10) The term `Bell operating company' has the meaning provided in section 3, except that such term includes any entity or corporation that is owned or controlled by such a company (as so defined) but does not include an electronic publishing joint venture owned by such an entity or corporation.

`SEC. 275. ALARM MONITORING SERVICES.

`(a) DELAYED ENTRY INTO ALARM MONITORING-

`(1) PROHIBITION- No Bell operating company or affiliate thereof shall engage in the provision of alarm monitoring services before the date which is 5 years after the date of enactment of the Telecommunications Act of 1996.

`(2) EXISTING ACTIVITIES- Paragraph (1) does not prohibit or limit the provision, directly or through an affiliate, of alarm monitoring services by a Bell operating company that was engaged in providing alarm monitoring services as of November 30, 1995, directly or through an affiliate. Such Bell operating company or affiliate may not acquire any equity interest in, or

obtain financial control of, any unaffiliated alarm monitoring service entity after November 30, 1995, and until 5 years after the date of enactment of the Telecommunications Act of 1996, except that this sentence shall not prohibit an exchange of customers for the customers of an unaffiliated alarm monitoring service entity.

`(b) NONDISCRIMINATION- An incumbent local exchange carrier (as defined in section 251(h)) engaged in the provision of alarm monitoring services shall--

`(1) provide nonaffiliated entities, upon reasonable request, with the network services it provides to its own alarm monitoring operations, on nondiscriminatory terms and conditions; and

`(2) not subsidize its alarm monitoring services either directly or indirectly from telephone exchange service operations.

`(c) EXPEDITED CONSIDERATION OF COMPLAINTS- The Commission shall establish procedures for the receipt and review of complaints concerning violations of subsection (b) or the regulations thereunder that result in material financial harm to a provider of alarm monitoring service. Such procedures shall ensure that the Commission will make a final determination with respect to any such complaint within 120 days after receipt of the complaint. If the complaint contains an appropriate showing that the alleged violation occurred, as determined by the Commission in accordance with such regulations, the Commission shall, within 60 days after receipt of the complaint, order the incumbent local exchange carrier (as defined in section 251(h)) and its affiliates to cease engaging in such violation pending such final determination.

`(d) USE OF DATA- A local exchange carrier may not record or use in any fashion the occurrence or contents of calls received by providers of alarm monitoring services for the purposes of marketing such services on behalf of such local exchange carrier, or any other entity. Any regulations necessary to enforce this subsection shall be issued initially within 6 months after the date of enactment of the Telecommunications Act of 1996.

`(e) DEFINITION OF ALARM MONITORING SERVICE- The term `alarm monitoring service' means a service that uses a device located at a residence, place of business, or other fixed premises--

`(1) to receive signals from other devices located at or about such premises regarding a possible threat at such premises to life, safety, or property, from burglary, fire, vandalism, bodily injury, or other emergency, and

`(2) to transmit a signal regarding such threat by means of transmission facilities of a local exchange carrier or one of

its affiliates to a remote monitoring center to alert a person at such center of the need to inform the customer or another person or police, fire, rescue, security, or public safety personnel of such threat,

but does not include a service that uses a medical monitoring device attached to an individual for the automatic surveillance of an ongoing medical condition.

`SEC. 276. PROVISION OF PAYPHONE SERVICE.

`(a) NONDISCRIMINATION SAFEGUARDS- After the effective date of the rules prescribed pursuant to subsection (b), any Bell operating company that provides payphone service--

`(1) shall not subsidize its payphone service directly or indirectly from its telephone exchange service operations or its exchange access operations; and

`(2) shall not prefer or discriminate in favor of its payphone service.

`(b) REGULATIONS-

`(1) CONTENTS OF REGULATIONS- In order to promote competition among payphone service providers and promote the widespread deployment of payphone services to the benefit of the general public, within 9 months after the date of enactment of the Telecommunications Act of 1996, the Commission shall take all actions necessary (including any reconsideration) to prescribe regulations that--

`(A) establish a per call compensation plan to ensure that all payphone service providers are fairly compensated for each and every completed intrastate and interstate call using their payphone, except that emergency calls and telecommunications relay service calls for hearing disabled individuals shall not be subject to such compensation;

`(B) discontinue the intrastate and interstate carrier access charge payphone service elements and payments in effect on such date of enactment, and all intrastate and interstate payphone subsidies from basic exchange and exchange access revenues, in favor of a compensation plan as specified in subparagraph (A);

`(C) prescribe a set of nonstructural safeguards for Bell operating company payphone service to implement the provisions of paragraphs (1) and (2) of subsection (a), which safeguards shall, at a minimum, include the nonstructural safeguards equal to those adopted in the Computer Inquiry-III (CC Docket No. 90-623) proceeding;

`(D) provide for Bell operating company payphone service providers to have the same right that independent payphone providers have to negotiate with the location provider on

the location provider's selecting and contracting with, and, subject to the terms of any agreement with the location provider, to select and contract with, the carriers that carry interLATA calls from their payphones, unless the Commission determines in the rulemaking pursuant to this section that it is not in the public interest; and

`(E) provide for all payphone service providers to have the right to negotiate with the location provider on the location provider's selecting and contracting with, and, subject to the terms of any agreement with the location provider, to select and contract with, the carriers that carry intraLATA calls from their payphones.

`(2) PUBLIC INTEREST TELEPHONES- In the rulemaking conducted pursuant to paragraph (1), the Commission shall determine whether public interest payphones, which are provided in the interest of public health, safety, and welfare, in locations where there would otherwise not be a payphone, should be maintained, and if so, ensure that such public interest payphones are supported fairly and equitably.

`(3) EXISTING CONTRACTS- Nothing in this section shall affect any existing contracts between location providers and payphone service providers or interLATA or intraLATA carriers that are in force and effect as of the date of enactment of the Telecommunications Act of 1996.

`(c) STATE PREEMPTION- To the extent that any State requirements are inconsistent with the Commission's regulations, the Commission's regulations on such matters shall preempt such State requirements.

`(d) DEFINITION- As used in this section, the term `payphone service' means the provision of public or semi-public pay telephones, the provision of inmate telephone service in correctional institutions, and any ancillary services.'.

(b) REVIEW OF ENTRY DECISIONS- Section 402(b) (47 U.S.C. 402(b)) is amended--

(1) in paragraph (6), by striking `(3), and (4)' and inserting `(3), (4), and (9)'; and

(2) by adding at the end the following new paragraph:

`(9) By any applicant for authority to provide interLATA services under section 271 of this Act whose application is denied by the Commission.'.

TITLE II--BROADCAST SERVICES

SEC. 201. BROADCAST SPECTRUM FLEXIBILITY.

Title III is amended by inserting after section 335 (47 U.S.C. 335) the following new section:

`SEC. 336. BROADCAST SPECTRUM FLEXIBILITY.

`(a) COMMISSION ACTION- If the Commission determines to issue additional licenses for advanced television services, the Commission--

`(1) should limit the initial eligibility for such licenses to persons that, as of the date of such issuance, are licensed to operate a television broadcast station or hold a permit to construct such a station (or both); and

`(2) shall adopt regulations that allow the holders of such licenses to offer such ancillary or supplementary services on designated frequencies as may be consistent with the public interest, convenience, and necessity.

`(b) CONTENTS OF REGULATIONS- In prescribing the regulations required by subsection (a), the Commission shall--

`(1) only permit such licensee or permittee to offer ancillary or supplementary services if the use of a designated frequency for such services is consistent with the technology or method designated by the Commission for the provision of advanced television services;

`(2) limit the broadcasting of ancillary or supplementary services on designated frequencies so as to avoid derogation of any advanced television services, including high definition television broadcasts, that the Commission may require using such frequencies;

`(3) apply to any other ancillary or supplementary service such of the Commission's regulations as are applicable to the offering of analogous services by any other person, except that no ancillary or supplementary service shall have any rights to carriage under section 614 or 615 or be deemed a multichannel video programming distributor for purposes of section 628;

`(4) adopt such technical and other requirements as may be necessary or appropriate to assure the quality of the signal used to provide advanced television services, and may adopt regulations that stipulate the minimum number of hours per day that such signal must be transmitted; and

`(5) prescribe such other regulations as may be necessary for the protection of the public interest, convenience, and necessity.

`(c) RECOVERY OF LICENSE- If the Commission grants a license for advanced television services to a person that, as of the date of such issuance, is licensed to operate a television broadcast station or holds a permit to construct such a station (or both), the Commission shall, as a condition of such license, require that either the additional license or the original license held by the licensee be surrendered to the Commission for reallocation or reassignment (or both) pursuant to Commission regulation.

`(d) PUBLIC INTEREST REQUIREMENT- Nothing in this section shall be construed as relieving a television broadcasting station from its obligation to serve the public interest, convenience, and necessity. In the Commission's review of any application for renewal of a broadcast license for a television station that provides ancillary or supplementary services, the television licensee shall establish that all of its program services on the existing or advanced television spectrum are in the public interest. Any violation of the Commission rules applicable to ancillary or supplementary services shall reflect upon the licensee's qualifications for renewal of its license.

`(e) FEES-

`(1) SERVICES TO WHICH FEES APPLY- If the regulations prescribed pursuant to subsection (a) permit a licensee to offer ancillary or supplementary services on a designated frequency--

`(A) for which the payment of a subscription fee is required in order to receive such services, or

`(B) for which the licensee directly or indirectly receives compensation from a third party in return for transmitting material furnished by such third party (other than commercial advertisements used to support broadcasting for which a subscription fee is not required),

the Commission shall establish a program to assess and collect from the licensee for such designated frequency an annual fee or other schedule or method of payment that promotes the objectives described in subparagraphs (A) and (B) of paragraph (2).

`(2) COLLECTION OF FEES- The program required by paragraph (1) shall--

`(A) be designed (i) to recover for the public a portion of the value of the public spectrum resource made available for such commercial use, and (ii) to avoid unjust enrichment through the method employed to permit such uses of that resource;

`(B) recover for the public an amount that, to the extent feasible, equals but does not exceed (over the term of the license) the amount that would have been recovered had such services been licensed pursuant to the provisions of section 309(j) of this Act and the Commission's regulations thereunder; and

`(C) be adjusted by the Commission from time to time in order to continue to comply with the requirements of this paragraph.

`(3) TREATMENT OF REVENUES-

`(A) GENERAL RULE- Except as provided in subparagraph (B), all proceeds obtained pursuant to the regulations required by this subsection shall be deposited in the Treasury in accordance with chapter 33 of title 31, United States Code.

`(B) RETENTION OF REVENUES- Notwithstanding subparagraph (A), the salaries and expenses account of the Commission shall retain as an offsetting collection such sums as may be necessary from such proceeds for the costs of developing and implementing the program required by this section and regulating and supervising advanced television services. Such offsetting collections shall be available for obligation subject to the terms and conditions of the receiving appropriations account, and shall be deposited in such accounts on a quarterly basis.

`(4) REPORT- Within 5 years after the date of enactment of the Telecommunications Act of 1996, the Commission shall report to the Congress on the implementation of the program required by this subsection, and shall annually thereafter advise the Congress on the amounts collected pursuant to such program.

`(f) EVALUATION- Within 10 years after the date the Commission first issues additional licenses for advanced television services, the Commission shall conduct an evaluation of the advanced television services program. Such evaluation shall include--

`(1) an assessment of the willingness of consumers to purchase the television receivers necessary to receive broadcasts of advanced television services;

`(2) an assessment of alternative uses, including public safety use, of the frequencies used for such broadcasts; and

`(3) the extent to which the Commission has been or will be able to reduce the amount of spectrum assigned to licensees.

`(g) DEFINITIONS- As used in this section:

`(1) ADVANCED TELEVISION SERVICES- The term `advanced television services' means television services provided using digital or other advanced technology as further defined in the opinion, report, and order of the Commission entitled `Advanced Television Systems and Their Impact Upon the Existing Television Broadcast Service', MM Docket 87-268, adopted September 17, 1992, and successor proceedings.

`(2) DESIGNATED FREQUENCIES- The term `designated frequency' means each of the frequencies designated by the Commission for licenses for advanced television services.

`(3) HIGH DEFINITION TELEVISION- The term `high definition television' refers to systems that offer approximately twice the vertical and horizontal resolution of receivers generally

available on the date of enactment of the Telecommunications Act of 1996, as further defined in the proceedings described in paragraph (1) of this subsection.'.

SEC. 202. BROADCAST OWNERSHIP.

(a) NATIONAL RADIO STATION OWNERSHIP RULE CHANGES REQUIRED- The Commission shall modify section 73.3555 of its regulations (47 C.F.R. 73.3555) by eliminating any provisions limiting the number of AM or FM broadcast stations which may be owned or controlled by one entity nationally.

(b) LOCAL RADIO DIVERSITY-

(1) APPLICABLE CAPS- The Commission shall revise section 73.3555(a) of its regulations (47 C.F.R. 73.3555) to provide that--

(A) in a radio market with 45 or more commercial radio stations, a party may own, operate, or control up to 8 commercial radio stations, not more than 5 of which are in the same service (AM or FM);

(B) in a radio market with between 30 and 44 (inclusive) commercial radio stations, a party may own, operate, or control up to 7 commercial radio stations, not more than 4 of which are in the same service (AM or FM);

(C) in a radio market with between 15 and 29 (inclusive) commercial radio stations, a party may own, operate, or control up to 6 commercial radio stations, not more than 4 of which are in the same service (AM or FM); and

(D) in a radio market with 14 or fewer commercial radio stations, a party may own, operate, or control up to 5 commercial radio stations, not more than 3 of which are in the same service (AM or FM), except that a party may not own, operate, or control more than 50 percent of the stations in such market.

(2) EXCEPTION- Notwithstanding any limitation authorized by this subsection, the Commission may permit a person or entity to own, operate, or control, or have a cognizable interest in, radio broadcast stations if the Commission determines that such ownership, operation, control, or interest will result in an increase in the number of radio broadcast stations in operation.

(c) TELEVISION OWNERSHIP LIMITATIONS-

(1) NATIONAL OWNERSHIP LIMITATIONS- The Commission shall modify its rules for multiple ownership set forth in section 73.3555 of its regulations (47 C.F.R. 73.3555)--

(A) by eliminating the restrictions on the number of television stations that a person or entity may directly or indirectly own, operate, or control, or have a cognizable interest in, nationwide; and

(B) by increasing the national audience reach limitation for television stations to 35 percent.

(2) LOCAL OWNERSHIP LIMITATIONS- The Commission shall conduct a rulemaking proceeding to determine whether to retain, modify, or eliminate its limitations on the number of television stations that a person or entity may own, operate, or control, or have a cognizable interest in, within the same television market.

(d) RELAXATION OF ONE-TO-A-MARKET- With respect to its enforcement of its one-to-a-market ownership rules under section 73.3555 of its regulations, the Commission shall extend its waiver policy to any of the top 50 markets, consistent with the public interest, convenience, and necessity.

(e) DUAL NETWORK CHANGES- The Commission shall revise section 73.658(g) of its regulations (47 C.F.R. 658(g)) to permit a television broadcast station to affiliate with a person or entity that maintains 2 or more networks of television broadcast stations unless such dual or multiple networks are composed of--

(1) two or more persons or entities that, on the date of enactment of the Telecommunications Act of 1996, are `networks' as defined in section 73.3613(a)(1) of the Commission's regulations (47 C.F.R. 73.3613(a)(1)); or

(2) any network described in paragraph (1) and an English-language program distribution service that, on such date, provides 4 or more hours of programming per week on a national basis pursuant to network affiliation arrangements with local television broadcast stations in markets reaching more than 75 percent of television homes (as measured by a national ratings service).

(f) CABLE CROSS OWNERSHIP-

(1) ELIMINATION OF RESTRICTIONS- The Commission shall revise section 76.501 of its regulations (47 C.F.R. 76.501) to permit a person or entity to own or control a network of broadcast stations and a cable system.

(2) SAFEGUARDS AGAINST DISCRIMINATION- The Commission shall revise such regulations if necessary to ensure carriage, channel positioning, and nondiscriminatory treatment of nonaffiliated broadcast stations by a cable system described in paragraph (1).

(g) LOCAL MARKETING AGREEMENTS- Nothing in this section shall be construed to prohibit the origination, continuation, or renewal of any television local marketing agreement that is in compliance with the regulations of the Commission.

(h) FURTHER COMMISSION REVIEW- The Commission shall review its rules adopted pursuant to this section and all of its ownership

rules biennially as part of its regulatory reform review under section 11 of the Communications Act of 1934 and shall determine whether any of such rules are necessary in the public interest as the result of competition. The Commission shall repeal or modify any regulation it determines to be no longer in the public interest.

(i) ELIMINATION OF STATUTORY RESTRICTION- Section 613(a) (47 U.S.C. 533(a)) is amended--

(1) by striking paragraph (1);

(2) by redesignating paragraph (2) as subsection (a);

(3) by redesignating subparagraphs (A) and (B) as paragraphs (1) and (2), respectively;

(4) by striking `and' at the end of paragraph (1) (as so redesignated);

(5) by striking the period at the end of paragraph (2) (as so redesignated) and inserting `; and'; and

(6) by adding at the end the following new paragraph:

`(3) shall not apply the requirements of this subsection to any cable operator in any franchise area in which a cable operator is subject to effective competition as determined under section 623(l).'.

SEC. 203. TERM OF LICENSES.

Section 307(c) (47 U.S.C. 307(c)) is amended to read as follows:

`(c) TERMS OF LICENSES-

`(1) INITIAL AND RENEWAL LICENSES- Each license granted for the operation of a broadcasting station shall be for a term of not to exceed 8 years. Upon application therefor, a renewal of such license may be granted from time to time for a term of not to exceed 8 years from the date of expiration of the preceding license, if the Commission finds that public interest, convenience, and necessity would be served thereby. Consistent with the foregoing provisions of this subsection, the Commission may by rule prescribe the period or periods for which licenses shall be granted and renewed for particular classes of stations, but the Commission may not adopt or follow any rule which would preclude it, in any case involving a station of a particular class, from granting or renewing a license for a shorter period than that prescribed for stations of such class if, in its judgment, the public interest, convenience, or necessity would be served by such action.

`(2) MATERIALS IN APPLICATION- In order to expedite action on applications for renewal of broadcasting station licenses and in order to avoid needless expense to applicants for such renewals, the Commission shall not require any such applicant to file any information which previously has been furnished to the Commission or which is not directly material to the

considerations that affect the granting or denial of such application, but the Commission may require any new or additional facts it deems necessary to make its findings.

`(3) CONTINUATION PENDING DECISION- Pending any hearing and final decision on such an application and the disposition of any petition for rehearing pursuant to section 405, the Commission shall continue such license in effect.'.

SEC. 204. BROADCAST LICENSE RENEWAL PROCEDURES.

(a) RENEWAL PROCEDURES-

(1) AMENDMENT- Section 309 (47 U.S.C. 309) is amended by adding at the end thereof the following new subsection:

`(k) BROADCAST STATION RENEWAL PROCEDURES-

`(1) STANDARDS FOR RENEWAL- If the licensee of a broadcast station submits an application to the Commission for renewal of such license, the Commission shall grant the application if it finds, with respect to that station, during the preceding term of its license--

`(A) the station has served the public interest, convenience, and necessity;

`(B) there have been no serious violations by the licensee of this Act or the rules and regulations of the Commission; and

`(C) there have been no other violations by the licensee of this Act or the rules and regulations of the Commission which, taken together, would constitute a pattern of abuse.

`(2) CONSEQUENCE OF FAILURE TO MEET STANDARD- If any licensee of a broadcast station fails to meet the requirements of this subsection, the Commission may deny the application for renewal in accordance with paragraph (3), or grant such application on terms and conditions as are appropriate, including renewal for a term less than the maximum otherwise permitted.

`(3) STANDARDS FOR DENIAL- If the Commission determines, after notice and opportunity for a hearing as provided in subsection (e), that a licensee has failed to meet the requirements specified in paragraph (1) and that no mitigating factors justify the imposition of lesser sanctions, the Commission shall--

`(A) issue an order denying the renewal application filed by such licensee under section 308; and

`(B) only thereafter accept and consider such applications for a construction permit as may be filed under section 308 specifying the channel or broadcasting facilities of the former licensee.

`(4) COMPETITOR CONSIDERATION PROHIBITED- In making the determinations specified in paragraph (1) or (2), the

Commission shall not consider whether the public interest, convenience, and necessity might be served by the grant of a license to a person other than the renewal applicant.'.

(2) CONFORMING AMENDMENT- Section 309(d) (47 U.S.C. 309(d)) is amended by inserting after `with subsection (a)' each place it appears the following: `(or subsection (k) in the case of renewal of any broadcast station license)'.

(b) SUMMARY OF COMPLAINTS ON VIOLENT PROGRAMMING- Section 308 (47 U.S.C. 308) is amended by adding at the end the following new subsection:

`(d) SUMMARY OF COMPLAINTS- Each applicant for the renewal of a commercial or noncommercial television license shall attach as an exhibit to the application a summary of written comments and suggestions received from the public and maintained by the licensee (in accordance with Commission regulations) that comment on the applicant's programming, if any, and that are characterized by the commentor as constituting violent programming.'.

(c) EFFECTIVE DATE- The amendments made by this section apply to applications filed after May 1, 1995.

SEC. 205. DIRECT BROADCAST SATELLITE SERVICE.

(a) DBS SIGNAL SECURITY- Section 705(e)(4) (47 U.S.C. 605(e)(4)) is amended by inserting `or direct-to-home satellite services,' after `programming,'.

(b) FCC JURISDICTION OVER DIRECT-TO-HOME SATELLITE SERVICES- Section 303 (47 U.S.C. 303) is amended by adding at the end thereof the following new subsection:

`(v) Have exclusive jurisdiction to regulate the provision of direct-to-home satellite services. As used in this subsection, the term `direct-to-home satellite services' means the distribution or broadcasting of programming or services by satellite directly to the subscriber's premises without the use of ground receiving or distribution equipment, except at the subscriber's premises or in the uplink process to the satellite.'.

SEC. 206. AUTOMATED SHIP DISTRESS AND SAFETY SYSTEMS.

Part II of title III is amended by inserting after section 364 (47 U.S.C. 362) the following new section:

`SEC. 365. AUTOMATED SHIP DISTRESS AND SAFETY SYSTEMS.

`Notwithstanding any provision of this Act or any other provision of law or regulation, a ship documented under the laws of the United States operating in accordance with the Global Maritime Distress and Safety System provisions of the Safety of Life at Sea Convention shall not be required to be equipped with a radio telegraphy station operated by one or more radio officers or operators. This section shall take effect for each vessel upon a determination by the United States Coast Guard that such vessel has

the equipment required to implement the Global Maritime Distress and Safety System installed and operating in good working condition.'.

SEC. 207. RESTRICTIONS ON OVER-THE-AIR RECEPTION DEVICES.

Within 180 days after the date of enactment of this Act, the Commission shall, pursuant to section 303 of the Communications Act of 1934, promulgate regulations to prohibit restrictions that impair a viewer's ability to receive video programming services through devices designed for over-the-air reception of television broadcast signals, multichannel multipoint distribution service, or direct broadcast satellite services.

TITLE III--CABLE SERVICES

SEC. 301. CABLE ACT REFORM.

(a) DEFINITIONS-

(1) DEFINITION OF CABLE SERVICE- Section 602(6)(B) (47 U.S.C. 522(6)(B)) is amended by inserting `or use' after `the selection'.

(2) CHANGE IN DEFINITION OF CABLE SYSTEM- Section 602(7) (47 U.S.C. 522(7)) is amended by striking `(B) a facility that serves only subscribers in 1 or more multiple unit dwellings under common ownership, control, or management, unless such facility or facilities uses any public right-of-way;' and inserting `(B) a facility that serves subscribers without using any public right-of-way;'.

(b) RATE DEREGULATION-

(1) UPPER TIER REGULATION- Section 623(c) (47 U.S.C. 543(c)) is amended--

(A) in paragraph (1)(B), by striking `subscriber, franchising authority, or other relevant State or local government entity' and inserting `franchising authority (in accordance with paragraph (3))';

(B) in paragraph (1)(C), by striking `such complaint' and inserting `the first complaint filed with the franchising authority under paragraph (3)'; and

(C) by striking paragraph (3) and inserting the following:

`(3) REVIEW OF RATE CHANGES- The Commission shall review any complaint submitted by a franchising authority after the date of enactment of the Telecommunications Act of 1996 concerning an increase in rates for cable programming services and issue a final order within 90 days after it receives such a complaint, unless the parties agree to extend the period for such review. A franchising authority may not file a complaint under this paragraph unless, within 90 days after such increase becomes effective it receives subscriber complaints.

`(4) SUNSET OF UPPER TIER RATE REGULATION- This subsection

shall not apply to cable programming services provided after March 31, 1999.'.

(2) SUNSET OF UNIFORM RATE STRUCTURE IN MARKETS WITH EFFECTIVE COMPETITION- Section 623(d) (47 U.S.C. 543(d)) is amended by adding at the end thereof the following: `This subsection does not apply to (1) a cable operator with respect to the provision of cable service over its cable system in any geographic area in which the video programming services offered by the operator in that area are subject to effective competition, or (2) any video programming offered on a per channel or per program basis. Bulk discounts to multiple dwelling units shall not be subject to this subsection, except that a cable operator of a cable system that is not subject to effective competition may not charge predatory prices to a multiple dwelling unit. Upon a prima facie showing by a complainant that there are reasonable grounds to believe that the discounted price is predatory, the cable system shall have the burden of showing that its discounted price is not predatory.'.

(3) EFFECTIVE COMPETITION- Section 623(l)(1) (47 U.S.C. 543(l)(1)) is amended--

(A) by striking `or' at the end of subparagraph (B);

(B) by striking the period at the end of subparagraph (C) and inserting `; or'; and

(C) by adding at the end the following:

`(D) a local exchange carrier or its affiliate (or any multichannel video programming distributor using the facilities of such carrier or its affiliate) offers video programming services directly to subscribers by any means (other than direct-to-home satellite services) in the franchise area of an unaffiliated cable operator which is providing cable service in that franchise area, but only if the video programming services so offered in that area are comparable to the video programming services provided by the unaffiliated cable operator in that area.'.

(c) GREATER DEREGULATION FOR SMALLER CABLE COMPANIES- Section 623 (47 U.S.C 543) is amended by adding at the end thereof the following:

`(m) SPECIAL RULES FOR SMALL COMPANIES-

`(1) IN GENERAL- Subsections (a), (b), and (c) do not apply to a small cable operator with respect to--

`(A) cable programming services, or

`(B) a basic service tier that was the only service tier subject to regulation as of December 31, 1994,

in any franchise area in which that operator services 50,000 or

fewer subscribers.

`(2) DEFINITION OF SMALL CABLE OPERATOR- For purposes of this subsection, the term `small cable operator' means a cable operator that, directly or through an affiliate, serves in the aggregate fewer than 1 percent of all subscribers in the United States and is not affiliated with any entity or entities whose gross annual revenues in the aggregate exceed $250,000,000.'.

(d) MARKET DETERMINATIONS-

(1) MARKET DETERMINATIONS; EXPEDITED DECISIONMAKING- Section 614(h)(1)(C) (47 U.S.C. 534(h)(1)(C)) is amended--

(A) by striking `in the manner provided in section 73.3555(d)(3)(i) of title 47, Code of Federal Regulations, as in effect on May 1, 1991,' in clause (i) and inserting `by the Commission by regulation or order using, where available, commercial publications which delineate television markets based on viewing patterns,'; and

(B) by striking clause (iv) and inserting the following:

`(iv) Within 120 days after the date on which a request is filed under this subparagraph (or 120 days after the date of enactment of the Telecommunications Act of 1996, if later), the Commission shall grant or deny the request.'.

(2) APPLICATION TO PENDING REQUESTS- The amendment made by paragraph (1) shall apply to--

(A) any request pending under section 614(h)(1)(C) of the Communications Act of 1934 (47 U.S.C. 534(h)(1)(C)) on the date of enactment of this Act; and

(B) any request filed under that section after that date.

(e) TECHNICAL STANDARDS- Section 624(e) (47 U.S.C. 544(e)) is amended by striking the last two sentences and inserting the following: `No State or franchising authority may prohibit, condition, or restrict a cable system's use of any type of subscriber equipment or any transmission technology.'.

(f) CABLE EQUIPMENT COMPATIBILITY- Section 624A (47 U.S.C. 544A) is amended--

(1) in subsection (a) by striking `and' at the end of paragraph (2), by striking the period at the end of paragraph (3) and inserting `; and'; and by adding at the end the following new paragraph:

`(4) compatibility among televisions, video cassette recorders, and cable systems can be assured with narrow technical standards that mandate a minimum degree of common design and operation, leaving all features, functions, protocols, and other product and service options for selection through open competition in the market.';

(2) in subsection (c)(1)--

(A) by redesignating subparagraphs (A) and (B) as subparagraphs (B) and (C), respectively; and

(B) by inserting before such redesignated subparagraph (B) the following new subparagraph:

`(A) the need to maximize open competition in the market for all features, functions, protocols, and other product and service options of converter boxes and other cable converters unrelated to the descrambling or decryption of cable television signals;'; and

(3) in subsection (c)(2)--

(A) by redesignating subparagraphs (D) and (E) as subparagraphs (E) and (F), respectively; and

(B) by inserting after subparagraph (C) the following new subparagraph:

`(D) to ensure that any standards or regulations developed under the authority of this section to ensure compatibility between televisions, video cassette recorders, and cable systems do not affect features, functions, protocols, and other product and service options other than those specified in paragraph (1)(B), including telecommunications interface equipment, home automation communications, and computer network services;'.

(g) SUBSCRIBER NOTICE- Section 632 (47 U.S.C. 552) is amended--

(1) by redesignating subsection (c) as subsection (d); and

(2) by inserting after subsection (b) the following new subsection:

`(c) SUBSCRIBER NOTICE- A cable operator may provide notice of service and rate changes to subscribers using any reasonable written means at its sole discretion. Notwithstanding section 623(b)(6) or any other provision of this Act, a cable operator shall not be required to provide prior notice of any rate change that is the result of a regulatory fee, franchise fee, or any other fee, tax, assessment, or charge of any kind imposed by any Federal agency, State, or franchising authority on the transaction between the operator and the subscriber.'.

(h) PROGRAM ACCESS- Section 628 (47 U.S.C. 548) is amended by adding at the end the following:

`(j) COMMON CARRIERS- Any provision that applies to a cable operator under this section shall apply to a common carrier or its affiliate that provides video programming by any means directly to subscribers. Any such provision that applies to a satellite cable programming vendor in which a cable operator has an attributable interest shall apply to any satellite cable programming vendor in which such common carrier has an attributable interest. For the

purposes of this subsection, two or fewer common officers or directors shall not by itself establish an attributable interest by a common carrier in a satellite cable programming vendor (or its parent company).'.

(i) ANTITRAFFICKING- Section 617 (47 U.S.C. 537) is amended--

(1) by striking subsections (a) through (d); and

(2) in subsection (e), by striking `(e)' and all that follows through `a franchising authority' and inserting `A franchising authority'.

(j) AGGREGATION OF EQUIPMENT COSTS- Section 623(a) (47 U.S.C. 543(a)) is amended by adding at the end the following new paragraph:

`(7) AGGREGATION OF EQUIPMENT COSTS-

`(A) IN GENERAL- The Commission shall allow cable operators, pursuant to any rules promulgated under subsection (b)(3), to aggregate, on a franchise, system, regional, or company level, their equipment costs into broad categories, such as converter boxes, regardless of the varying levels of functionality of the equipment within each such broad category. Such aggregation shall not be permitted with respect to equipment used by subscribers who receive only a rate regulated basic service tier.

`(B) REVISION TO COMMISSION RULES; FORMS- Within 120 days of the date of enactment of the Telecommunications Act of 1996, the Commission shall issue revisions to the appropriate rules and forms necessary to implement subparagraph (A).'.

(k) TREATMENT OF PRIOR YEAR LOSSES-

(1) AMENDMENT- Section 623 (48 U.S.C. 543) is amended by adding at the end thereof the following:

`(n) TREATMENT OF PRIOR YEAR LOSSES- Notwithstanding any other provision of this section or of section 612, losses associated with a cable system (including losses associated with the grant or award of a franchise) that were incurred prior to September 4, 1992, with respect to a cable system that is owned and operated by the original franchisee of such system shall not be disallowed, in whole or in part, in the determination of whether the rates for any tier of service or any type of equipment that is subject to regulation under this section are lawful.'.

(2) EFFECTIVE DATE- The amendment made by paragraph (1) shall take effect on the date of enactment of this Act and shall be applicable to any rate proposal filed on or after September 4, 1993, upon which no final action has been taken by December 1, 1995.

SEC. 302. CABLE SERVICE PROVIDED BY TELEPHONE COMPANIES.

(a) PROVISIONS FOR REGULATION OF CABLE SERVICE PROVIDED BY

TELEPHONE COMPANIES- Title VI (47 U.S.C. 521 et seq.) is amended by adding at the end the following new part:

`PART V--VIDEO PROGRAMMING SERVICES PROVIDED BY TELEPHONE COMPANIES

`SEC. 651. REGULATORY TREATMENT OF VIDEO PROGRAMMING SERVICES.

`(a) LIMITATIONS ON CABLE REGULATION-

`(1) RADIO-BASED SYSTEMS- To the extent that a common carrier (or any other person) is providing video programming to subscribers using radio communication, such carrier (or other person) shall be subject to the requirements of title III and section 652, but shall not otherwise be subject to the requirements of this title.

`(2) COMMON CARRIAGE OF VIDEO TRAFFIC- To the extent that a common carrier is providing transmission of video programming on a common carrier basis, such carrier shall be subject to the requirements of title II and section 652, but shall not otherwise be subject to the requirements of this title. This paragraph shall not affect the treatment under section 602(7)(C) of a facility of a common carrier as a cable system.

`(3) CABLE SYSTEMS AND OPEN VIDEO SYSTEMS- To the extent that a common carrier is providing video programming to its subscribers in any manner other than that described in paragraphs (1) and (2)--

`(A) such carrier shall be subject to the requirements of this title, unless such programming is provided by means of an open video system for which the Commission has approved a certification under section 653; or

`(B) if such programming is provided by means of an open video system for which the Commission has approved a certification under section 653, such carrier shall be subject to the requirements of this part, but shall be subject to parts I through IV of this title only as provided in 653(c).

`(4) ELECTION TO OPERATE AS OPEN VIDEO SYSTEM- A common carrier that is providing video programming in a manner described in paragraph (1) or (2), or a combination thereof, may elect to provide such programming by means of an open video system that complies with section 653. If the Commission approves such carrier's certification under section 653, such carrier shall be subject to the requirements of this part, but shall be subject to parts I through IV of this title only as provided in 653(c).

`(b) LIMITATIONS ON INTERCONNECTION OBLIGATIONS- A local exchange carrier that provides cable service through an open video system or a cable system shall not be required, pursuant to title II of this

Act, to make capacity available on a nondiscriminatory basis to any other person for the provision of cable service directly to subscribers.

`(c) ADDITIONAL REGULATORY RELIEF- A common carrier shall not be required to obtain a certificate under section 214 with respect to the establishment or operation of a system for the delivery of video programming.

`SEC. 652. PROHIBITION ON BUY OUTS.

`(a) ACQUISITIONS BY CARRIERS- No local exchange carrier or any affiliate of such carrier owned by, operated by, controlled by, or under common control with such carrier may purchase or otherwise acquire directly or indirectly more than a 10 percent financial interest, or any management interest, in any cable operator providing cable service within the local exchange carrier's telephone service area.

`(b) ACQUISITIONS BY CABLE OPERATORS- No cable operator or affiliate of a cable operator that is owned by, operated by, controlled by, or under common ownership with such cable operator may purchase or otherwise acquire, directly or indirectly, more than a 10 percent financial interest, or any management interest, in any local exchange carrier providing telephone exchange service within such cable operator's franchise area.

`(c) JOINT VENTURES- A local exchange carrier and a cable operator whose telephone service area and cable franchise area, respectively, are in the same market may not enter into any joint venture or partnership to provide video programming directly to subscribers or to provide telecommunications services within such market.

`(d) EXCEPTIONS-

`(1) RURAL SYSTEMS- Notwithstanding subsections (a), (b), and (c) of this section, a local exchange carrier (with respect to a cable system located in its telephone service area) and a cable operator (with respect to the facilities of a local exchange carrier used to provide telephone exchange service in its cable franchise area) may obtain a controlling interest in, management interest in, or enter into a joint venture or partnership with the operator of such system or facilities for the use of such system or facilities to the extent that--

`(A) such system or facilities only serve incorporated or unincorporated--

`(i) places or territories that have fewer than 35,000 inhabitants; and

`(ii) are outside an urbanized area, as defined by the Bureau of the Census; and

`(B) in the case of a local exchange carrier, such

system, in the aggregate with any other system in which such carrier has an interest, serves less than 10 percent of the households in the telephone service area of such carrier.

`(2) JOINT USE- Notwithstanding subsection (c), a local exchange carrier may obtain, with the concurrence of the cable operator on the rates, terms, and conditions, the use of that part of the transmission facilities of a cable system extending from the last multi-user terminal to the premises of the end user, if such use is reasonably limited in scope and duration, as determined by the Commission.

`(3) ACQUISITIONS IN COMPETITIVE MARKETS- Notwithstanding subsections (a) and (c), a local exchange carrier may obtain a controlling interest in, or form a joint venture or other partnership with, or provide financing to, a cable system (hereinafter in this paragraph referred to as `the subject cable system'), if--

`(A) the subject cable system operates in a television market that is not in the top 25 markets, and such market has more than 1 cable system operator, and the subject cable system is not the cable system with the most subscribers in such television market;

`(B) the subject cable system and the cable system with the most subscribers in such television market held on May 1, 1995, cable television franchises from the largest municipality in the television market and the boundaries of such franchises were identical on such date;

`(C) the subject cable system is not owned by or under common ownership or control of any one of the 50 cable system operators with the most subscribers as such operators existed on May 1, 1995; and

`(D) the system with the most subscribers in the television market is owned by or under common ownership or control of any one of the 10 largest cable system operators as such operators existed on May 1, 1995.

`(4) EXEMPT CABLE SYSTEMS- Subsection (a) does not apply to any cable system if--

`(A) the cable system serves no more than 17,000 cable subscribers, of which no less than 8,000 live within an urban area, and no less than 6,000 live within a nonurbanized area as of June 1, 1995;

`(B) the cable system is not owned by, or under common ownership or control with, any of the 50 largest cable system operators in existence on June 1, 1995; and

`(C) the cable system operates in a television market

that was not in the top 100 television markets as of June 1, 1995.

`(5) SMALL CABLE SYSTEMS IN NONURBAN AREAS- Notwithstanding subsections (a) and (c), a local exchange carrier with less than $100,000,000 in annual operating revenues (or any affiliate of such carrier owned by, operated by, controlled by, or under common control with such carrier) may purchase or otherwise acquire more than a 10 percent financial interest in, or any management interest in, or enter into a joint venture or partnership with, any cable system within the local exchange carrier's telephone service area that serves no more than 20,000 cable subscribers, if no more than 12,000 of those subscribers live within an urbanized area, as defined by the Bureau of the Census.

`(6) WAIVERS- The Commission may waive the restrictions of subsections (a), (b), or (c) only if--

`(A) the Commission determines that, because of the nature of the market served by the affected cable system or facilities used to provide telephone exchange service--

`(i) the affected cable operator or local exchange carrier would be subjected to undue economic distress by the enforcement of such provisions;

`(ii) the system or facilities would not be economically viable if such provisions were enforced; or

`(iii) the anticompetitive effects of the proposed transaction are clearly outweighed in the public interest by the probable effect of the transaction in meeting the convenience and needs of the community to be served; and

`(B) the local franchising authority approves of such waiver.

`(e) DEFINITION OF TELEPHONE SERVICE AREA- For purposes of this section, the term `telephone service area' when used in connection with a common carrier subject in whole or in part to title II of this Act means the area within which such carrier provided telephone exchange service as of January 1, 1993, but if any common carrier after such date transfers its telephone exchange service facilities to another common carrier, the area to which such facilities provide telephone exchange service shall be treated as part of the telephone service area of the acquiring common carrier and not of the selling common carrier.

`SEC. 653. ESTABLISHMENT OF OPEN VIDEO SYSTEMS.

`(a) OPEN VIDEO SYSTEMS-

`(1) CERTIFICATES OF COMPLIANCE- A local exchange carrier may provide cable service to its cable service subscribers in its

telephone service area through an open video system that complies with this section. To the extent permitted by such regulations as the Commission may prescribe consistent with the public interest, convenience, and necessity, an operator of a cable system or any other person may provide video programming through an open video system that complies with this section. An operator of an open video system shall qualify for reduced regulatory burdens under subsection (c) of this section if the operator of such system certifies to the Commission that such carrier complies with the Commission's regulations under subsection (b) and the Commission approves such certification. The Commission shall publish notice of the receipt of any such certification and shall act to approve or disapprove any such certification within 10 days after receipt of such certification.

`(2) DISPUTE RESOLUTION- The Commission shall have the authority to resolve disputes under this section and the regulations prescribed thereunder. Any such dispute shall be resolved within 180 days after notice of such dispute is submitted to the Commission. At that time or subsequently in a separate damages proceeding, the Commission may, in the case of any violation of this section, require carriage, award damages to any person denied carriage, or any combination of such sanctions. Any aggrieved party may seek any other remedy available under this Act.

`(b) COMMISSION ACTIONS-

`(1) REGULATIONS REQUIRED- Within 6 months after the date of enactment of the Telecommunications Act of 1996, the Commission shall complete all actions necessary (including any reconsideration) to prescribe regulations that--

`(A) except as required pursuant to section 611, 614, or 615, prohibit an operator of an open video system from discriminating among video programming providers with regard to carriage on its open video system, and ensure that the rates, terms, and conditions for such carriage are just and reasonable, and are not unjustly or unreasonably discriminatory;

`(B) if demand exceeds the channel capacity of the open video system, prohibit an operator of an open video system and its affiliates from selecting the video programming services for carriage on more than one-third of the activated channel capacity on such system, but nothing in this subparagraph shall be construed to limit the number of channels that the carrier and its affiliates may offer to provide directly to subscribers;

`(C) permit an operator of an open video system to carry

on only one channel any video programming service that is offered by more than one video programming provider (including the local exchange carrier's video programming affiliate): [Italic->] Provided, [<-Italic] That subscribers have ready and immediate access to any such video programming service;

`(D) extend to the distribution of video programming over open video systems the Commission's regulations concerning sports exclusivity (47 C.F.R. 76.67), network nonduplication (47 C.F.R. 76.92 et seq.), and syndicated exclusivity (47 C.F.R. 76.151 et seq.); and

`(E)(i) prohibit an operator of an open video system from unreasonably discriminating in favor of the operator or its affiliates with regard to material or information (including advertising) provided by the operator to subscribers for the purposes of selecting programming on the open video system, or in the way such material or information is presented to subscribers;

`(ii) require an operator of an open video system to ensure that video programming providers or copyright holders (or both) are able suitably and uniquely to identify their programming services to subscribers;

`(iii) if such identification is transmitted as part of the programming signal, require the carrier to transmit such identification without change or alteration; and

`(iv) prohibit an operator of an open video system from omitting television broadcast stations or other unaffiliated video programming services carried on such system from any navigational device, guide, or menu.

`(2) CONSUMER ACCESS- Subject to the requirements of paragraph (1) and the regulations thereunder, nothing in this section prohibits a common carrier or its affiliate from negotiating mutually agreeable terms and conditions with over-the-air broadcast stations and other unaffiliated video programming providers to allow consumer access to their signals on any level or screen of any gateway, menu, or other program guide, whether provided by the carrier or its affiliate.

`(c) REDUCED REGULATORY BURDENS FOR OPEN VIDEO SYSTEMS-

`(1) IN GENERAL- Any provision that applies to a cable operator under--

`(A) sections 613 (other than subsection (a) thereof), 616, 623(f), 628, 631, and 634 of this title, shall apply,

`(B) sections 611, 614, and 615 of this title, and section 325 of title III, shall apply in accordance with the regulations prescribed under paragraph (2), and

`(C) sections 612 and 617, and parts III and IV (other than sections 623(f), 628, 631, and 634), of this title shall not apply,

to any operator of an open video system for which the Commission has approved a certification under this section.

`(2) IMPLEMENTATION-

`(A) COMMISSION ACTION- In the rulemaking proceeding to prescribe the regulations required by subsection (b)(1), the Commission shall, to the extent possible, impose obligations that are no greater or lesser than the obligations contained in the provisions described in paragraph (1)(B) of this subsection. The Commission shall complete all action (including any reconsideration) to prescribe such regulations no later than 6 months after the date of enactment of the Telecommunications Act of 1996.

`(B) FEES- An operator of an open video system under this part may be subject to the payment of fees on the gross revenues of the operator for the provision of cable service imposed by a local franchising authority or other governmental entity, in lieu of the franchise fees permitted under section 622. The rate at which such fees are imposed shall not exceed the rate at which franchise fees are imposed on any cable operator transmitting video programming in the franchise area, as determined in accordance with regulations prescribed by the Commission. An operator of an open video system may designate that portion of a subscriber's bill attributable to the fee under this subparagraph as a separate item on the bill.

`(3) REGULATORY STREAMLINING- With respect to the establishment and operation of an open video system, the requirements of this section shall apply in lieu of, and not in addition to, the requirements of title II.

`(4) TREATMENT AS CABLE OPERATOR- Nothing in this Act precludes a video programming provider making use of an open video system from being treated as an operator of a cable system for purposes of section 111 of title 17, United States Code.

`(d) DEFINITION OF TELEPHONE SERVICE AREA- For purposes of this section, the term `telephone service area' when used in connection with a common carrier subject in whole or in part to title II of this Act means the area within which such carrier is offering telephone exchange service.'.

(b) CONFORMING AND TECHNICAL AMENDMENTS-

(1) REPEAL- Subsection (b) of section 613 (47 U.S.C. 533(b)) is repealed.

(2) DEFINITIONS- Section 602 (47 U.S.C. 531) is amended--

(A) in paragraph (7), by striking `, or (D)' and inserting the following: `, unless the extent of such use is solely to provide interactive on-demand services; (D) an open video system that complies with section 653 of this title; or (E)';

(B) by redesignating paragraphs (12) through (19) as paragraphs (13) through (20), respectively; and

(C) by inserting after paragraph (11) the following new paragraph:

`(12) the term `interactive on-demand services' means a service providing video programming to subscribers over switched networks on an on-demand, point-to-point basis, but does not include services providing video programming prescheduled by the programming provider;'.

(3) TERMINATION OF VIDEO-DIALTONE REGULATIONS- The Commission's regulations and policies with respect to video dialtone requirements issued in CC Docket No. 87-266 shall cease to be effective on the date of enactment of this Act. This paragraph shall not be construed to require the termination of any video-dialtone system that the Commission has approved before the date of enactment of this Act.

SEC. 303. PREEMPTION OF FRANCHISING AUTHORITY REGULATION OF TELECOMMUNICATIONS SERVICES.

(a) PROVISION OF TELECOMMUNICATIONS SERVICES BY A CABLE OPERATOR-

Section 621(b) (47 U.S.C. 541(b)) is amended by adding at the end thereof the following new paragraph:

`(3)(A) If a cable operator or affiliate thereof is engaged in the provision of telecommunications services--

`(i) such cable operator or affiliate shall not be required to obtain a franchise under this title for the provision of telecommunications services; and

`(ii) the provisions of this title shall not apply to such cable operator or affiliate for the provision of telecommunications services.

`(B) A franchising authority may not impose any requirement under this title that has the purpose or effect of prohibiting, limiting, restricting, or conditioning the provision of a telecommunications service by a cable operator or an affiliate thereof.

`(C) A franchising authority may not order a cable operator or affiliate thereof--

`(i) to discontinue the provision of a telecommunications service, or

`(ii) to discontinue the operation of a cable system, to the

extent such cable system is used for the provision of a telecommunications service, by reason of the failure of such cable operator or affiliate thereof to obtain a franchise or franchise renewal under this title with respect to the provision of such telecommunications service.

`(D) Except as otherwise permitted by sections 611 and 612, a franchising authority may not require a cable operator to provide any telecommunications service or facilities, other than institutional networks, as a condition of the initial grant of a franchise, a franchise renewal, or a transfer of a franchise.'.

(b) FRANCHISE FEES- Section 622(b) (47 U.S.C. 542(b)) is amended by inserting `to provide cable services' immediately before the period at the end of the first sentence thereof.

SEC. 304. COMPETITIVE AVAILABILITY OF NAVIGATION DEVICES.

Part III of title VI is amended by inserting after section 628 (47 U.S.C. 548) the following new section:

`SEC. 629. COMPETITIVE AVAILABILITY OF NAVIGATION DEVICES.

`(a) COMMERCIAL CONSUMER AVAILABILITY OF EQUIPMENT USED TO ACCESS SERVICES PROVIDED BY MULTICHANNEL VIDEO PROGRAMMING DISTRIBUTORS-

The Commission shall, in consultation with appropriate industry standard-setting organizations, adopt regulations to assure the commercial availability, to consumers of multichannel video programming and other services offered over multichannel video programming systems, of converter boxes, interactive communications equipment, and other equipment used by consumers to access multichannel video programming and other services offered over multichannel video programming systems, from manufacturers, retailers, and other vendors not affiliated with any multichannel video programming distributor. Such regulations shall not prohibit any multichannel video programming distributor from also offering converter boxes, interactive communications equipment, and other equipment used by consumers to access multichannel video programming and other services offered over multichannel video programming systems, to consumers, if the system operator's charges to consumers for such devices and equipment are separately stated and not subsidized by charges for any such service.

`(b) PROTECTION OF SYSTEM SECURITY- The Commission shall not prescribe regulations under subsection (a) which would jeopardize security of multichannel video programming and other services offered over multichannel video programming systems, or impede the legal rights of a provider of such services to prevent theft of service.

`(c) WAIVER- The Commission shall waive a regulation adopted

under subsection (a) for a limited time upon an appropriate showing by a provider of multichannel video programming and other services offered over multichannel video programming systems, or an equipment provider, that such waiver is necessary to assist the development or introduction of a new or improved multichannel video programming or other service offered over multichannel video programming systems, technology, or products. Upon an appropriate showing, the Commission shall grant any such waiver request within 90 days of any application filed under this subsection, and such waiver shall be effective for all service providers and products in that category and for all providers of services and products.

`(d) AVOIDANCE OF REDUNDANT REGULATIONS-

`(1) COMMERCIAL AVAILABILITY DETERMINATIONS- Determinations made or regulations prescribed by the Commission with respect to commercial availability to consumers of converter boxes, interactive communications equipment, and other equipment used by consumers to access multichannel video programming and other services offered over multichannel video programming systems, before the date of enactment of the Telecommunications Act of 1996 shall fulfill the requirements of this section.

`(2) REGULATIONS- Nothing in this section affects section 64.702(e) of the Commission's regulations (47 C.F.R. 64.702(e)) or other Commission regulations governing interconnection and competitive provision of customer premises equipment used in connection with basic common carrier communications services.

`(e) SUNSET- The regulations adopted under this section shall cease to apply when the Commission determines that--

`(1) the market for the multichannel video programming distributors is fully competitive;

`(2) the market for converter boxes, and interactive communications equipment, used in conjunction with that service is fully competitive; and

`(3) elimination of the regulations would promote competition and the public interest.

`(f) COMMISSION'S AUTHORITY- Nothing in this section shall be construed as expanding or limiting any authority that the Commission may have under law in effect before the date of enactment of the Telecommunications Act of 1996.'.

SEC. 305. VIDEO PROGRAMMING ACCESSIBILITY.

Title VII is amended by inserting after section 712 (47 U.S.C. 612) the following new section:

`SEC. 713. VIDEO PROGRAMMING ACCESSIBILITY.

`(a) COMMISSION INQUIRY- Within 180 days after the date of enactment of the Telecommunications Act of 1996, the Federal Communications Commission shall complete an inquiry to ascertain

the level at which video programming is closed captioned. Such inquiry shall examine the extent to which existing or previously published programming is closed captioned, the size of the video programming provider or programming owner providing closed captioning, the size of the market served, the relative audience shares achieved, or any other related factors. The Commission shall submit to the Congress a report on the results of such inquiry.

`(b) ACCOUNTABILITY CRITERIA- Within 18 months after such date of enactment, the Commission shall prescribe such regulations as are necessary to implement this section. Such regulations shall ensure that--

`(1) video programming first published or exhibited after the effective date of such regulations is fully accessible through the provision of closed captions, except as provided in subsection (d); and

`(2) video programming providers or owners maximize the accessibility of video programming first published or exhibited prior to the effective date of such regulations through the provision of closed captions, except as provided in subsection (d).

`(c) DEADLINES FOR CAPTIONING- Such regulations shall include an appropriate schedule of deadlines for the provision of closed captioning of video programming.

`(d) EXEMPTIONS- Notwithstanding subsection (b)--

`(1) the Commission may exempt by regulation programs, classes of programs, or services for which the Commission has determined that the provision of closed captioning would be economically burdensome to the provider or owner of such programming;

`(2) a provider of video programming or the owner of any program carried by the provider shall not be obligated to supply closed captions if such action would be inconsistent with contracts in effect on the date of enactment of the Telecommunications Act of 1996, except that nothing in this section shall be construed to relieve a video programming provider of its obligations to provide services required by Federal law; and

`(3) a provider of video programming or program owner may petition the Commission for an exemption from the requirements of this section, and the Commission may grant such petition upon a showing that the requirements contained in this section would result in an undue burden.

`(e) UNDUE BURDEN- The term `undue burden' means significant difficulty or expense. In determining whether the closed captions necessary to comply with the requirements of this paragraph would

result in an undue economic burden, the factors to be considered include--

`(1) the nature and cost of the closed captions for the programming;

`(2) the impact on the operation of the provider or program owner;

`(3) the financial resources of the provider or program owner; and

`(4) the type of operations of the provider or program owner.

`(f) VIDEO DESCRIPTIONS INQUIRY- Within 6 months after the date of enactment of the Telecommunications Act of 1996, the Commission shall commence an inquiry to examine the use of video descriptions on video programming in order to ensure the accessibility of video programming to persons with visual impairments, and report to Congress on its findings. The Commission's report shall assess appropriate methods and schedules for phasing video descriptions into the marketplace, technical and quality standards for video descriptions, a definition of programming for which video descriptions would apply, and other technical and legal issues that the Commission deems appropriate.

`(g) VIDEO DESCRIPTION- For purposes of this section, `video description' means the insertion of audio narrated descriptions of a television program's key visual elements into natural pauses between the program's dialogue.

`(h) PRIVATE RIGHTS OF ACTIONS PROHIBITED- Nothing in this section shall be construed to authorize any private right of action to enforce any requirement of this section or any regulation thereunder. The Commission shall have exclusive jurisdiction with respect to any complaint under this section.'.

TITLE IV--REGULATORY REFORM

SEC. 401. REGULATORY FORBEARANCE.

Title I is amended by inserting after section 9 (47 U.S.C. 159) the following new section:

`SEC. 10. COMPETITION IN PROVISION OF TELECOMMUNICATIONS SERVICE.

`(a) REGULATORY FLEXIBILITY- Notwithstanding section 332(c)(1)(A) of this Act, the Commission shall forbear from applying any regulation or any provision of this Act to a telecommunications carrier or telecommunications service, or class of telecommunications carriers or telecommunications services, in any or some of its or their geographic markets, if the Commission determines that--

`(1) enforcement of such regulation or provision is not necessary to ensure that the charges, practices, classifications, or regulations by, for, or in connection with that telecommunications carrier or telecommunications service

are just and reasonable and are not unjustly or unreasonably discriminatory;

`(2) enforcement of such regulation or provision is not necessary for the protection of consumers; and

`(3) forbearance from applying such provision or regulation is consistent with the public interest.

`(b) COMPETITIVE EFFECT TO BE WEIGHED- In making the determination under subsection (a)(3), the Commission shall consider whether forbearance from enforcing the provision or regulation will promote competitive market conditions, including the extent to which such forbearance will enhance competition among providers of telecommunications services. If the Commission determines that such forbearance will promote competition among providers of telecommunications services, that determination may be the basis for a Commission finding that forbearance is in the public interest.

`(c) PETITION FOR FORBEARANCE- Any telecommunications carrier, or class of telecommunications carriers, may submit a petition to the Commission requesting that the Commission exercise the authority granted under this section with respect to that carrier or those carriers, or any service offered by that carrier or carriers. Any such petition shall be deemed granted if the Commission does not deny the petition for failure to meet the requirements for forbearance under subsection (a) within one year after the Commission receives it, unless the one-year period is extended by the Commission. The Commission may extend the initial one-year period by an additional 90 days if the Commission finds that an extension is necessary to meet the requirements of subsection (a). The Commission may grant or deny a petition in whole or in part and shall explain its decision in writing.

`(d) LIMITATION- Except as provided in section 251(f), the Commission may not forbear from applying the requirements of section 251(c) or 271 under subsection (a) of this section until it determines that those requirements have been fully implemented.

`(e) STATE ENFORCEMENT AFTER COMMISSION FORBEARANCE- A State commission may not continue to apply or enforce any provision of this Act that the Commission has determined to forbear from applying under subsection (a).'.

SEC. 402. BIENNIAL REVIEW OF REGULATIONS; REGULATORY RELIEF.

(a) BIENNIAL REVIEW- Title I is amended by inserting after section 10 (as added by section 401) the following new section:

`SEC. 11. REGULATORY REFORM.

`(a) BIENNIAL REVIEW OF REGULATIONS- In every even-numbered year (beginning with 1998), the Commission--

`(1) shall review all regulations issued under this Act in

effect at the time of the review that apply to the operations or activities of any provider of telecommunications service; and

`(2) shall determine whether any such regulation is no longer necessary in the public interest as the result of meaningful economic competition between providers of such service.

`(b) EFFECT OF DETERMINATION- The Commission shall repeal or modify any regulation it determines to be no longer necessary in the public interest.'.

(b) REGULATORY RELIEF-

(1) Streamlined procedures for changes in charges, classifications, regulations, or practices-

(A) Section 204(a) (47 U.S.C. 204(a)) is amended--

(i) by striking `12 months' the first place it appears in paragraph (2)(A) and inserting `5 months';

(ii) by striking `effective,' and all that follows in paragraph (2)(A) and inserting `effective.'; and

(iii) by adding at the end thereof the following:

`(3) A local exchange carrier may file with the Commission a new or revised charge, classification, regulation, or practice on a streamlined basis. Any such charge, classification, regulation, or practice shall be deemed lawful and shall be effective 7 days (in the case of a reduction in rates) or 15 days (in the case of an increase in rates) after the date on which it is filed with the Commission unless the Commission takes action under paragraph (1) before the end of that 7-day or 15-day period, as is appropriate.'.

(B) Section 208(b) (47 U.S.C. 208(b)) is amended--

(i) by striking `12 months' the first place it appears in paragraph (1) and inserting `5 months'; and

(ii) by striking `filed,' and all that follows in paragraph (1) and inserting `filed.'.

(2) EXTENSIONS OF LINES UNDER SECTION 214; ARMIS REPORTS- The Commission shall permit any common carrier--

(A) to be exempt from the requirements of section 214 of the Communications Act of 1934 for the extension of any line; and

(B) to file cost allocation manuals and ARMIS reports annually, to the extent such carrier is required to file such manuals or reports.

(3) FORBEARANCE AUTHORITY NOT LIMITED- Nothing in this subsection shall be construed to limit the authority of the Commission to waive, modify, or forbear from applying any of the requirements to which reference is made in paragraph (1) under any other provision of this Act or other law.

(4) EFFECTIVE DATE OF AMENDMENTS- The amendments made by

paragraph (1) of this subsection shall apply with respect to any charge, classification, regulation, or practice filed on or after one year after the date of enactment of this Act.

(c) CLASSIFICATION OF CARRIERS- In classifying carriers according to section 32.11 of its regulations (47 C.F.R. 32.11) and in establishing reporting requirements pursuant to part 43 of its regulations (47 C.F.R. part 43) and section 64.903 of its regulations (47 C.F.R. 64.903), the Commission shall adjust the revenue requirements to account for inflation as of the release date of the Commission's Report and Order in CC Docket No. 91-141, and annually thereafter. This subsection shall take effect on the date of enactment of this Act.

SEC. 403. ELIMINATION OF UNNECESSARY COMMISSION REGULATIONS AND FUNCTIONS.

(a) MODIFICATION OF AMATEUR RADIO EXAMINATION PROCEDURES- Section 4(f)(4) (47 U.S.C. 154(f)(4)) is amended--

(1) in subparagraph (A)--

(A) by inserting `or administering' after `for purposes of preparing';

(B) by inserting `of' after `than the class'; and

(C) by inserting `or administered' after `for which the examination is being prepared';

(2) by striking subparagraph (B);

(3) in subparagraph (H), by striking `(A), (B), and (C)' and inserting `(A) and (B)';

(4) in subparagraph (J)--

(A) by striking `or (B)'; and

(B) by striking the last sentence; and

(5) by redesignating subparagraphs (C) through (J) as subparagraphs (B) through (I), respectively.

(b) AUTHORITY TO DESIGNATE ENTITIES TO INSPECT- Section 4(f)(3) (47 U.S.C. 154(f)(3)) is amended by inserting before the period at the end the following: `: and [Italic->] Provided further, [<-Italic] That, in the alternative, an entity designated by the Commission may make the inspections referred to in this paragraph'.

(c) EXPEDITING INSTRUCTIONAL TELEVISION FIXED SERVICE PROCESSING-

Section 5(c)(1) (47 U.S.C. 155(c)(1)) is amended by striking the last sentence and inserting the following: `Except for cases involving the authorization of service in the instructional television fixed service, or as otherwise provided in this Act, nothing in this paragraph shall authorize the Commission to provide for the conduct, by any person or persons other than persons referred to in paragraph (2) or (3) of section 556(b) of title 5,

United States Code, of any hearing to which such section applies.'.

(d) REPEAL SETTING OF DEPRECIATION RATES- The first sentence of section 220(b) (47 U.S.C. 220(b)) is amended by striking `shall prescribe for such carriers' and inserting `may prescribe, for such carriers as it determines to be appropriate,'.

(e) USE OF INDEPENDENT AUDITORS- Section 220(c) (47 U.S.C. 220(c)) is amended by adding at the end thereof the following: `The Commission may obtain the services of any person licensed to provide public accounting services under the law of any State to assist with, or conduct, audits under this section. While so employed or engaged in conducting an audit for the Commission under this section, any such person shall have the powers granted the Commission under this subsection and shall be subject to subsection (f) in the same manner as if that person were an employee of the Commission.'.

(f) DELEGATION OF EQUIPMENT TESTING AND CERTIFICATION TO PRIVATE LABORATORIES- Section 302 (47 U.S.C. 302) is amended by adding at the end the following:

`(e) The Commission may--

`(1) authorize the use of private organizations for testing and certifying the compliance of devices or home electronic equipment and systems with regulations promulgated under this section;

`(2) accept as prima facie evidence of such compliance the certification by any such organization; and

`(3) establish such qualifications and standards as it deems appropriate for such private organizations, testing, and certification.'.

(g) MAKING LICENSE MODIFICATION UNIFORM- Section 303(f) (47 U.S.C. 303(f)) is amended by striking `unless, after a public hearing,' and inserting `unless'.

(h) ELIMINATE FCC JURISDICTION OVER GOVERNMENT-OWNED SHIP RADIO STATIONS-

(1) Section 305 (47 U.S.C. 305) is amended by striking subsection (b) and redesignating subsections (c) and (d) as (b) and (c), respectively.

(2) Section 382(2) (47 U.S.C. 382(2)) is amended by striking `except a vessel of the United States Maritime Administration, the Inland and Coastwise Waterways Service, or the Panama Canal Company,'.

(i) PERMIT OPERATION OF DOMESTIC SHIP AND AIRCRAFT RADIOS WITHOUT LICENSE- Section 307(e) (47 U.S.C. 307(e)) is amended to read as

follows:

`(e)(1) Notwithstanding any license requirement established in this Act, if the Commission determines that such authorization serves the public interest, convenience, and necessity, the Commission may by rule authorize the operation of radio stations without individual licenses in the following radio services: (A) the citizens band radio service; (B) the radio control service; (C) the aviation radio service for aircraft stations operated on domestic flights when such aircraft are not otherwise required to carry a radio station; and (D) the maritime radio service for ship stations navigated on domestic voyages when such ships are not otherwise required to carry a radio station.

`(2) Any radio station operator who is authorized by the Commission to operate without an individual license shall comply with all other provisions of this Act and with rules prescribed by the Commission under this Act.

`(3) For purposes of this subsection, the terms `citizens band radio service', `radio control service', `aircraft station' and `ship station' shall have the meanings given them by the Commission by rule.'.

(j) EXPEDITED LICENSING FOR FIXED MICROWAVE SERVICE- Section 309(b)(2) (47 U.S.C. 309(b)(2)) is amended by striking subparagraph (A) and redesignating subparagraphs (B) through (G) as subparagraphs (A) through (F), respectively.

(k) FOREIGN DIRECTORS- Section 310(b) (47 U.S.C. 310(b)) is amended--

(1) in paragraph (3), by striking `of which any officer or director is an alien or'; and

(2) in paragraph (4), by striking `of which any officer or more than one-fourth of the directors are aliens, or'.

(l) LIMITATION ON SILENT STATION AUTHORIZATIONS- Section 312 (47 U.S.C. 312) is amended by adding at the end the following:

`(g) If a broadcasting station fails to transmit broadcast signals for any consecutive 12-month period, then the station license granted for the operation of that broadcast station expires at the end of that period, notwithstanding any provision, term, or condition of the license to the contrary.'.

(m) MODIFICATION OF CONSTRUCTION PERMIT REQUIREMENT- Section 319(d) is amended by striking the last two sentences and inserting the following: `With respect to any broadcasting station, the Commission shall not have any authority to waive the requirement of a permit for construction, except that the Commission may by regulation determine that a permit shall not be required for minor changes in the facilities of authorized broadcast stations. With respect to any other station or class of stations, the Commission

shall not waive the requirement for a construction permit unless the Commission determines that the public interest, convenience, and necessity would be served by such a waiver.'.

(n) CONDUCT OF INSPECTIONS- Section 362(b) (47 U.S.C. 362(b)) is amended to read as follows:

`(b) Every ship of the United States that is subject to this part shall have the equipment and apparatus prescribed therein inspected at least once each year by the Commission or an entity designated by the Commission. If, after such inspection, the Commission is satisfied that all relevant provisions of this Act and the station license have been complied with, the fact shall be so certified on the station license by the Commission. The Commission shall make such additional inspections at frequent intervals as the Commission determines may be necessary to ensure compliance with the requirements of this Act. The Commission may, upon a finding that the public interest could be served thereby--

`(1) waive the annual inspection required under this section for a period of up to 90 days for the sole purpose of enabling a vessel to complete its voyage and proceed to a port in the United States where an inspection can be held; or

`(2) waive the annual inspection required under this section for a vessel that is in compliance with the radio provisions of the Safety Convention and that is operating solely in waters beyond the jurisdiction of the United States: [Italic->] Provided, [<-Italic] That such inspection shall be performed within 30 days of such vessel's return to the United States.'.

(o) INSPECTION BY OTHER ENTITIES- Section 385 (47 U.S.C. 385) is amended--

(1) by inserting `or an entity designated by the Commission' after `The Commission'; and

(2) by adding at the end thereof the following: `In accordance with such other provisions of law as apply to Government contracts, the Commission may enter into contracts with any person for the purpose of carrying out such inspections and certifying compliance with those requirements, and may, as part of any such contract, allow any such person to accept reimbursement from the license holder for travel and expense costs of any employee conducting an inspection or certification.'.

TITLE V--OBSCENITY AND VIOLENCE

SUBTITLE A--OBSCENE, HARASSING, AND WRONGFUL UTILIZATION OF TELECOMMUNICATIONS FACILITIES

SEC. 501. SHORT TITLE.

This title may be cited as the `Communications Decency Act of 1996'.

SEC. 502. OBSCENE OR HARASSING USE OF TELECOMMUNICATIONS FACILITIES

UNDER THE COMMUNICATIONS ACT OF 1934.

Section 223 (47 U.S.C. 223) is amended--

(1) by striking subsection (a) and inserting in lieu thereof:

`(a) Whoever--

`(1) in interstate or foreign communications--

`(A) by means of a telecommunications device knowingly--

`(i) makes, creates, or solicits, and

`(ii) initiates the transmission of,

any comment, request, suggestion, proposal, image, or other communication which is obscene, lewd, lascivious, filthy, or indecent, with intent to annoy, abuse, threaten, or harass another person;

`(B) by means of a telecommunications device knowingly--

`(i) makes, creates, or solicits, and

`(ii) initiates the transmission of,

any comment, request, suggestion, proposal, image, or other communication which is obscene or indecent, knowing that the recipient of the communication is under 18 years of age, regardless of whether the maker of such communication placed the call or initiated the communication;

`(C) makes a telephone call or utilizes a telecommunications device, whether or not conversation or communication ensues, without disclosing his identity and with intent to annoy, abuse, threaten, or harass any person at the called number or who receives the communications;

`(D) makes or causes the telephone of another repeatedly or continuously to ring, with intent to harass any person at the called number; or

`(E) makes repeated telephone calls or repeatedly initiates communication with a telecommunications device, during which conversation or communication ensues, solely to harass any person at the called number or who receives the communication; or

`(2) knowingly permits any telecommunications facility under his control to be used for any activity prohibited by paragraph (1) with the intent that it be used for such activity,

shall be fined under title 18, United States Code, or imprisoned not more than two years, or both.'; and

(2) by adding at the end the following new subsections:

`(d) Whoever--

`(1) in interstate or foreign communications knowingly--

`(A) uses an interactive computer service to send to a specific person or persons under 18 years of age, or

`(B) uses any interactive computer service to display in a manner available to a person under 18 years of age, any comment, request, suggestion, proposal, image, or other communication that, in context, depicts or describes, in terms patently offensive as measured by contemporary community standards, sexual or excretory activities or organs, regardless of whether the user of such service placed the call or initiated the communication; or

`(2) knowingly permits any telecommunications facility under such person's control to be used for an activity prohibited by paragraph (1) with the intent that it be used for such activity, shall be fined under title 18, United States Code, or imprisoned not more than two years, or both.

`(e) In addition to any other defenses available by law:

`(1) No person shall be held to have violated subsection (a) or (d) solely for providing access or connection to or from a facility, system, or network not under that person's control, including transmission, downloading, intermediate storage, access software, or other related capabilities that are incidental to providing such access or connection that does not include the creation of the content of the communication.

`(2) The defenses provided by paragraph (1) of this subsection shall not be applicable to a person who is a conspirator with an entity actively involved in the creation or knowing distribution of communications that violate this section, or who knowingly advertises the availability of such communications.

`(3) The defenses provided in paragraph (1) of this subsection shall not be applicable to a person who provides access or connection to a facility, system, or network engaged in the violation of this section that is owned or controlled by such person.

`(4) No employer shall be held liable under this section for the actions of an employee or agent unless the employee's or agent's conduct is within the scope of his or her employment or agency and the employer (A) having knowledge of such conduct, authorizes or ratifies such conduct, or (B) recklessly disregards such conduct.

`(5) It is a defense to a prosecution under subsection (a)(1)(B) or (d), or under subsection (a)(2) with respect to the use of a facility for an activity under subsection (a)(1)(B) that a person--

`(A) has taken, in good faith, reasonable, effective, and appropriate actions under the circumstances to restrict or prevent access by minors to a communication specified in

such subsections, which may involve any appropriate measures to restrict minors from such communications, including any method which is feasible under available technology; or

`(B) has restricted access to such communication by requiring use of a verified credit card, debit account, adult access code, or adult personal identification number.

`(6) The Commission may describe measures which are reasonable, effective, and appropriate to restrict access to prohibited communications under subsection (d). Nothing in this section authorizes the Commission to enforce, or is intended to provide the Commission with the authority to approve, sanction, or permit, the use of such measures. The Commission shall have no enforcement authority over the failure to utilize such measures. The Commission shall not endorse specific products relating to such measures. The use of such measures shall be admitted as evidence of good faith efforts for purposes of paragraph (5) in any action arising under subsection (d). Nothing in this section shall be construed to treat interactive computer services as common carriers or telecommunications carriers.

`(f)(1) No cause of action may be brought in any court or administrative agency against any person on account of any activity that is not in violation of any law punishable by criminal or civil penalty, and that the person has taken in good faith to implement a defense authorized under this section or otherwise to restrict or prevent the transmission of, or access to, a communication specified in this section.

`(2) No State or local government may impose any liability for commercial activities or actions by commercial entities, nonprofit libraries, or institutions of higher education in connection with an activity or action described in subsection (a)(2) or (d) that is inconsistent with the treatment of those activities or actions under this section: [Italic->] Provided, however [<-Italic] , That nothing herein shall preclude any State or local government from enacting and enforcing complementary oversight, liability, and regulatory systems, procedures, and requirements, so long as such systems, procedures, and requirements govern only intrastate services and do not result in the imposition of inconsistent rights, duties or obligations on the provision of interstate services. Nothing in this subsection shall preclude any State or local government from governing conduct not covered by this section.

`(g) Nothing in subsection (a), (d), (e), or (f) or in the defenses to prosecution under subsection (a) or (d) shall be construed to affect or limit the application or enforcement of any

other Federal law.

`(h) For purposes of this section--

`(1) The use of the term `telecommunications device' in this section--

`(A) shall not impose new obligations on broadcasting station licensees and cable operators covered by obscenity and indecency provisions elsewhere in this Act; and

`(B) does not include an interactive computer service.

`(2) The term `interactive computer service' has the meaning provided in section 230(e)(2).

`(3) The term `access software' means software (including client or server software) or enabling tools that do not create or provide the content of the communication but that allow a user to do any one or more of the following:

`(A) filter, screen, allow, or disallow content;

`(B) pick, choose, analyze, or digest content; or

`(C) transmit, receive, display, forward, cache, search, subset, organize, reorganize, or translate content.

`(4) The term `institution of higher education' has the meaning provided in section 1201 of the Higher Education Act of 1965 (20 U.S.C. 1141).

`(5) The term `library' means a library eligible for participation in State-based plans for funds under title III of the Library Services and Construction Act (20 U.S.C. 355e et seq.).'.

SEC. 503. OBSCENE PROGRAMMING ON CABLE TELEVISION.

Section 639 (47 U.S.C. 559) is amended by striking `not more than $10,000' and inserting `under title 18, United States Code,'.

SEC. 504. SCRAMBLING OF CABLE CHANNELS FOR NONSUBSCRIBERS.

Part IV of title VI (47 U.S.C. 551 et seq.) is amended by adding at the end the following:

`SEC. 640. SCRAMBLING OF CABLE CHANNELS FOR NONSUBSCRIBERS.

`(a) SUBSCRIBER REQUEST- Upon request by a cable service subscriber, a cable operator shall, without charge, fully scramble or otherwise fully block the audio and video programming of each channel carrying such programming so that one not a subscriber does not receive it.

`(b) DEFINITION- As used in this section, the term `scramble' means to rearrange the content of the signal of the programming so that the programming cannot be viewed or heard in an understandable manner.'.

SEC. 505. SCRAMBLING OF SEXUALLY EXPLICIT ADULT VIDEO SERVICE PROGRAMMING.

(a) REQUIREMENT- Part IV of title VI (47 U.S.C. 551 et seq.), as amended by this Act, is further amended by adding at the end the

following:

`SEC. 641. SCRAMBLING OF SEXUALLY EXPLICIT ADULT VIDEO SERVICE PROGRAMMING.

`(a) REQUIREMENT- In providing sexually explicit adult programming or other programming that is indecent on any channel of its service primarily dedicated to sexually-oriented programming, a multichannel video programming distributor shall fully scramble or otherwise fully block the video and audio portion of such channel so that one not a subscriber to such channel or programming does not receive it.

`(b) IMPLEMENTATION- Until a multichannel video programming distributor complies with the requirement set forth in subsection (a), the distributor shall limit the access of children to the programming referred to in that subsection by not providing such programming during the hours of the day (as determined by the Commission) when a significant number of children are likely to view it.

`(c) DEFINITION- As used in this section, the term `scramble' means to rearrange the content of the signal of the programming so that the programming cannot be viewed or heard in an understandable manner.'.

(b) EFFECTIVE DATE- The amendment made by subsection (a) shall take effect 30 days after the date of enactment of this Act.

SEC. 506. CABLE OPERATOR REFUSAL TO CARRY CERTAIN PROGRAMS.

(a) PUBLIC, EDUCATIONAL, AND GOVERNMENTAL CHANNELS- Section 611(e) (47 U.S.C. 531(e)) is amended by inserting before the period the following: `, except a cable operator may refuse to transmit any public access program or portion of a public access program which contains obscenity, indecency, or nudity'.

(b) CABLE CHANNELS FOR COMMERCIAL USE- Section 612(c)(2) (47 U.S.C. 532(c)(2)) is amended by striking `an operator' and inserting `a cable operator may refuse to transmit any leased access program or portion of a leased access program which contains obscenity, indecency, or nudity and'.

SEC. 507. CLARIFICATION OF CURRENT LAWS REGARDING COMMUNICATION OF OBSCENE MATERIALS THROUGH THE USE OF COMPUTERS.

(a) IMPORTATION OR TRANSPORTATION- Section 1462 of title 18, United States Code, is amended--

(1) in the first undesignated paragraph, by inserting `or interactive computer service (as defined in section 230(e)(2) of the Communications Act of 1934)' after `carrier'; and

(2) in the second undesignated paragraph--

(A) by inserting `or receives,' after `takes';

(B) by inserting `or interactive computer service (as

defined in section 230(e)(2) of the Communications Act of 1934)' after `common carrier'; and

(C) by inserting `or importation' after `carriage'.

(b) TRANSPORTATION FOR PURPOSES OF SALE OR DISTRIBUTION- The first undesignated paragraph of section 1465 of title 18, United States Code, is amended--

(1) by striking `transports in' and inserting `transports or travels in, or uses a facility or means of,';

(2) by inserting `or an interactive computer service (as defined in section 230(e)(2) of the Communications Act of 1934) in or affecting such commerce' after `foreign commerce' the first place it appears;

(3) by striking `, or knowingly travels in' and all that follows through `obscene material in interstate or foreign commerce,' and inserting `of'.

(c) INTERPRETATION- The amendments made by this section are clarifying and shall not be interpreted to limit or repeal any prohibition contained in sections 1462 and 1465 of title 18, United States Code, before such amendment, under the rule established in United States v. Alpers, 338 U.S. 680 (1950).

SEC. 508. COERCION AND ENTICEMENT OF MINORS.

Section 2422 of title 18, United States Code, is amended--

(1) by inserting `(a)' before `Whoever knowingly'; and

(2) by adding at the end the following:

`(b) Whoever, using any facility or means of interstate or foreign commerce, including the mail, or within the special maritime and territorial jurisdiction of the United States, knowingly persuades, induces, entices, or coerces any individual who has not attained the age of 18 years to engage in prostitution or any sexual act for which any person may be criminally prosecuted, or attempts to do so, shall be fined under this title or imprisoned not more than 10 years, or both.'.

SEC. 509. ONLINE FAMILY EMPOWERMENT.

Title II of the Communications Act of 1934 (47 U.S.C. 201 et seq.) is amended by adding at the end the following new section:

`SEC. 230. PROTECTION FOR PRIVATE BLOCKING AND SCREENING OF OFFENSIVE MATERIAL.

`(a) FINDINGS- The Congress finds the following:

`(1) The rapidly developing array of Internet and other interactive computer services available to individual Americans represent an extraordinary advance in the availability of educational and informational resources to our citizens.

`(2) These services offer users a great degree of control over the information that they receive, as well as the potential for even greater control in the future as technology

develops.

`(3) The Internet and other interactive computer services offer a forum for a true diversity of political discourse, unique opportunities for cultural development, and myriad avenues for intellectual activity.

`(4) The Internet and other interactive computer services have flourished, to the benefit of all Americans, with a minimum of government regulation.

`(5) Increasingly Americans are relying on interactive media for a variety of political, educational, cultural, and entertainment services.

`(b) POLICY- It is the policy of the United States--

`(1) to promote the continued development of the Internet and other interactive computer services and other interactive media;

`(2) to preserve the vibrant and competitive free market that presently exists for the Internet and other interactive computer services, unfettered by Federal or State regulation;

`(3) to encourage the development of technologies which maximize user control over what information is received by individuals, families, and schools who use the Internet and other interactive computer services;

`(4) to remove disincentives for the development and utilization of blocking and filtering technologies that empower parents to restrict their children's access to objectionable or inappropriate online material; and

`(5) to ensure vigorous enforcement of Federal criminal laws to deter and punish trafficking in obscenity, stalking, and harassment by means of computer.

`(c) PROTECTION FOR `GOOD SAMARITAN' BLOCKING AND SCREENING OF OFFENSIVE MATERIAL-

`(1) TREATMENT OF PUBLISHER OR SPEAKER- No provider or user of an interactive computer service shall be treated as the publisher or speaker of any information provided by another information content provider.

`(2) CIVIL LIABILITY- No provider or user of an interactive computer service shall be held liable on account of--

`(A) any action voluntarily taken in good faith to restrict access to or availability of material that the provider or user considers to be obscene, lewd, lascivious, filthy, excessively violent, harassing, or otherwise objectionable, whether or not such material is constitutionally protected; or

`(B) any action taken to enable or make available to information content providers or others the technical means to restrict access to material described in paragraph (1).

`(d) EFFECT ON OTHER LAWS-

`(1) NO EFFECT ON CRIMINAL LAW- Nothing in this section shall be construed to impair the enforcement of section 223 of this Act, chapter 71 (relating to obscenity) or 110 (relating to sexual exploitation of children) of title 18, United States Code, or any other Federal criminal statute.

`(2) NO EFFECT ON INTELLECTUAL PROPERTY LAW- Nothing in this section shall be construed to limit or expand any law pertaining to intellectual property.

`(3) STATE LAW- Nothing in this section shall be construed to prevent any State from enforcing any State law that is consistent with this section. No cause of action may be brought and no liability may be imposed under any State or local law that is inconsistent with this section.

`(4) NO EFFECT ON COMMUNICATIONS PRIVACY LAW- Nothing in this section shall be construed to limit the application of the Electronic Communications Privacy Act of 1986 or any of the amendments made by such Act, or any similar State law.

`(e) DEFINITIONS- As used in this section:

`(1) INTERNET- The term `Internet' means the international computer network of both Federal and non-Federal interoperable packet switched data networks.

`(2) INTERACTIVE COMPUTER SERVICE- The term `interactive computer service' means any information service, system, or access software provider that provides or enables computer access by multiple users to a computer server, including specifically a service or system that provides access to the Internet and such systems operated or services offered by libraries or educational institutions.

`(3) INFORMATION CONTENT PROVIDER- The term `information content provider' means any person or entity that is responsible, in whole or in part, for the creation or development of information provided through the Internet or any other interactive computer service.

`(4) ACCESS SOFTWARE PROVIDER- The term `access software provider' means a provider of software (including client or server software), or enabling tools that do any one or more of the following:

`(A) filter, screen, allow, or disallow content;

`(B) pick, choose, analyze, or digest content; or

`(C) transmit, receive, display, forward, cache, search, subset, organize, reorganize, or translate content.'.

SUBTITLE B--VIOLENCE

SEC. 551. PARENTAL CHOICE IN TELEVISION PROGRAMMING.

(a) FINDINGS- The Congress makes the following findings:

(1) Television influences children's perception of the values and behavior that are common and acceptable in society.

(2) Television station operators, cable television system operators, and video programmers should follow practices in connection with video programming that take into consideration that television broadcast and cable programming has established a uniquely pervasive presence in the lives of American children.

(3) The average American child is exposed to 25 hours of television each week and some children are exposed to as much as 11 hours of television a day.

(4) Studies have shown that children exposed to violent video programming at a young age have a higher tendency for violent and aggressive behavior later in life than children not so exposed, and that children exposed to violent video programming are prone to assume that acts of violence are acceptable behavior.

(5) Children in the United States are, on average, exposed to an estimated 8,000 murders and 100,000 acts of violence on television by the time the child completes elementary school.

(6) Studies indicate that children are affected by the pervasiveness and casual treatment of sexual material on television, eroding the ability of parents to develop responsible attitudes and behavior in their children.

(7) Parents express grave concern over violent and sexual video programming and strongly support technology that would give them greater control to block video programming in the home that they consider harmful to their children.

(8) There is a compelling governmental interest in empowering parents to limit the negative influences of video programming that is harmful to children.

(9) Providing parents with timely information about the nature of upcoming video programming and with the technological tools that allow them easily to block violent, sexual, or other programming that they believe harmful to their children is a nonintrusive and narrowly tailored means of achieving that compelling governmental interest.

(b) ESTABLISHMENT OF TELEVISION RATING CODE-

(1) AMENDMENT- Section 303 (47 U.S.C. 303) is amended by adding at the end the following:

`(w) Prescribe--

`(1) on the basis of recommendations from an advisory committee established by the Commission in accordance with section 551(b)(2) of the Telecommunications Act of 1996, guidelines and recommended procedures for the identification and rating of video programming that contains sexual, violent,

or other indecent material about which parents should be informed before it is displayed to children: [Italic->] Provided, [<-Italic] That nothing in this paragraph shall be construed to authorize any rating of video programming on the basis of its political or religious content; and

`(2) with respect to any video programming that has been rated, and in consultation with the television industry, rules requiring distributors of such video programming to transmit such rating to permit parents to block the display of video programming that they have determined is inappropriate for their children.'.

(2) ADVISORY COMMITTEE REQUIREMENTS- In establishing an advisory committee for purposes of the amendment made by paragraph (1) of this subsection, the Commission shall--

(A) ensure that such committee is composed of parents, television broadcasters, television programming producers, cable operators, appropriate public interest groups, and other interested individuals from the private sector and is fairly balanced in terms of political affiliation, the points of view represented, and the functions to be performed by the committee;

(B) provide to the committee such staff and resources as may be necessary to permit it to perform its functions efficiently and promptly; and

(C) require the committee to submit a final report of its recommendations within one year after the date of the appointment of the initial members.

(c) REQUIREMENT FOR MANUFACTURE OF TELEVISIONS THAT BLOCK PROGRAMS- Section 303 (47 U.S.C. 303), as amended by subsection (a), is further amended by adding at the end the following:

`(x) Require, in the case of an apparatus designed to receive television signals that are shipped in interstate commerce or manufactured in the United States and that have a picture screen 13 inches or greater in size (measured diagonally), that such apparatus be equipped with a feature designed to enable viewers to block display of all programs with a common rating, except as otherwise permitted by regulations pursuant to section 330(c)(4).'.

(d) SHIPPING OF TELEVISIONS THAT BLOCK PROGRAMS-

(1) REGULATIONS- Section 330 (47 U.S.C. 330) is amended--

(A) by redesignating subsection (c) as subsection (d); and

(B) by adding after subsection (b) the following new subsection (c):

`(c)(1) Except as provided in paragraph (2), no person shall ship in interstate commerce or manufacture in the United States any apparatus described in section 303(x) of this Act except in

accordance with rules prescribed by the Commission pursuant to the authority granted by that section.

`(2) This subsection shall not apply to carriers transporting apparatus referred to in paragraph (1) without trading in it.

`(3) The rules prescribed by the Commission under this subsection shall provide for the oversight by the Commission of the adoption of standards by industry for blocking technology. Such rules shall require that all such apparatus be able to receive the rating signals which have been transmitted by way of line 21 of the vertical blanking interval and which conform to the signal and blocking specifications established by industry under the supervision of the Commission.

`(4) As new video technology is developed, the Commission shall take such action as the Commission determines appropriate to ensure that blocking service continues to be available to consumers. If the Commission determines that an alternative blocking technology exists that--

`(A) enables parents to block programming based on identifying programs without ratings,

`(B) is available to consumers at a cost which is comparable to the cost of technology that allows parents to block programming based on common ratings, and

`(C) will allow parents to block a broad range of programs on a multichannel system as effectively and as easily as technology that allows parents to block programming based on common ratings,

the Commission shall amend the rules prescribed pursuant to section 303(x) to require that the apparatus described in such section be equipped with either the blocking technology described in such section or the alternative blocking technology described in this paragraph.'.

(2) CONFORMING AMENDMENT- Section 330(d), as redesignated by subsection (d)(1)(A), is amended by striking `section 303(s), and section 303(u)' and inserting in lieu thereof `and sections 303(s), 303(u), and 303(x)'.

(e) APPLICABILITY AND EFFECTIVE DATES-

(1) APPLICABILITY OF RATING PROVISION- The amendment made by subsection (b) of this section shall take effect 1 year after the date of enactment of this Act, but only if the Commission determines, in consultation with appropriate public interest groups and interested individuals from the private sector, that distributors of video programming have not, by such date--

(A) established voluntary rules for rating video programming that contains sexual, violent, or other indecent material about which parents should be informed

before it is displayed to children, and such rules are acceptable to the Commission; and

(B) agreed voluntarily to broadcast signals that contain ratings of such programming.

(2) EFFECTIVE DATE OF MANUFACTURING PROVISION- In prescribing regulations to implement the amendment made by subsection (c), the Federal Communications Commission shall, after consultation with the television manufacturing industry, specify the effective date for the applicability of the requirement to the apparatus covered by such amendment, which date shall not be less than two years after the date of enactment of this Act.

SEC. 552. TECHNOLOGY FUND.

It is the policy of the United States to encourage broadcast television, cable, satellite, syndication, other video programming distributors, and relevant related industries (in consultation with appropriate public interest groups and interested individuals from the private sector) to--

(1) establish a technology fund to encourage television and electronics equipment manufacturers to facilitate the development of technology which would empower parents to block programming they deem inappropriate for their children and to encourage the availability thereof to low income parents;

(2) report to the viewing public on the status of the development of affordable, easy to use blocking technology; and

(3) establish and promote effective procedures, standards, systems, advisories, or other mechanisms for ensuring that users have easy and complete access to the information necessary to effectively utilize blocking technology and to encourage the availability thereof to low income parents.

SUBTITLE C--JUDICIAL REVIEW

SEC. 561. EXPEDITED REVIEW.

(a) THREE-JUDGE DISTRICT COURT HEARING- Notwithstanding any other provision of law, any civil action challenging the constitutionality, on its face, of this title or any amendment made by this title, or any provision thereof, shall be heard by a district court of 3 judges convened pursuant to the provisions of section 2284 of title 28, United States Code.

(b) APPELLATE REVIEW- Notwithstanding any other provision of law, an interlocutory or final judgment, decree, or order of the court of 3 judges in an action under subsection (a) holding this title or an amendment made by this title, or any provision thereof, unconstitutional shall be reviewable as a matter of right by direct appeal to the Supreme Court. Any such appeal shall be filed not more than 20 days after entry of such judgment, decree, or order.

TITLE VI--EFFECT ON OTHER LAWS

SEC. 601. APPLICABILITY OF CONSENT DECREES AND OTHER LAW.

(a) APPLICABILITY OF AMENDMENTS TO FUTURE CONDUCT-

(1) AT&T CONSENT DECREE- Any conduct or activity that was, before the date of enactment of this Act, subject to any restriction or obligation imposed by the AT&T Consent Decree shall, on and after such date, be subject to the restrictions and obligations imposed by the Communications Act of 1934 as amended by this Act and shall not be subject to the restrictions and the obligations imposed by such Consent Decree.

(2) GTE CONSENT DECREE- Any conduct or activity that was, before the date of enactment of this Act, subject to any restriction or obligation imposed by the GTE Consent Decree shall, on and after such date, be subject to the restrictions and obligations imposed by the Communications Act of 1934 as amended by this Act and shall not be subject to the restrictions and the obligations imposed by such Consent Decree.

(3) MCCAW CONSENT DECREE- Any conduct or activity that was, before the date of enactment of this Act, subject to any restriction or obligation imposed by the McCaw Consent Decree shall, on and after such date, be subject to the restrictions and obligations imposed by the Communications Act of 1934 as amended by this Act and subsection (d) of this section and shall not be subject to the restrictions and the obligations imposed by such Consent Decree.

(b) ANTITRUST LAWS-

(1) SAVINGS CLAUSE- Except as provided in paragraphs (2) and (3), nothing in this Act or the amendments made by this Act shall be construed to modify, impair, or supersede the applicability of any of the antitrust laws.

(2) REPEAL- Subsection (a) of section 221 (47 U.S.C. 221(a)) is repealed.

(3) CLAYTON ACT- Section 7 of the Clayton Act (15 U.S.C. 18) is amended in the last paragraph by striking `Federal Communications Commission,'.

(c) FEDERAL, STATE, AND LOCAL LAW-

(1) NO IMPLIED EFFECT- This Act and the amendments made by this Act shall not be construed to modify, impair, or supersede Federal, State, or local law unless expressly so provided in such Act or amendments.

(2) STATE TAX SAVINGS PROVISION- Notwithstanding paragraph (1), nothing in this Act or the amendments made by this Act shall be construed to modify, impair, or supersede, or authorize the modification, impairment, or supersession of, any State or local law pertaining to taxation, except as provided in sections 622 and 653(c) of the Communications Act of 1934

and section 602 of this Act.

(d) COMMERCIAL MOBILE SERVICE JOINT MARKETING- Notwithstanding section 22.903 of the Commission's regulations (47 C.F.R. 22.903) or any other Commission regulation, a Bell operating company or any other company may, except as provided in sections 271(e)(1) and 272 of the Communications Act of 1934 as amended by this Act as they relate to wireline service, jointly market and sell commercial mobile services in conjunction with telephone exchange service, exchange access, intraLATA telecommunications service, interLATA telecommunications service, and information services.

(e) DEFINITIONS- As used in this section:

(1) AT&T CONSENT DECREE- The term `AT&T Consent Decree' means the order entered August 24, 1982, in the antitrust action styled United States v. Western Electric, Civil Action No. 82-0192, in the United States District Court for the District of Columbia, and includes any judgment or order with respect to such action entered on or after August 24, 1982.

(2) GTE CONSENT DECREE- The term `GTE Consent Decree' means the order entered December 21, 1984, as restated January 11, 1985, in the action styled United States v. GTE Corp., Civil Action No. 83-1298, in the United States District Court for the District of Columbia, and any judgment or order with respect to such action entered on or after December 21, 1984.

(3) MCCAW CONSENT DECREE- The term `McCaw Consent Decree' means the proposed consent decree filed on July 15, 1994, in the antitrust action styled United States v. AT&T Corp. and McCaw Cellular Communications, Inc., Civil Action No. 94-01555, in the United States District Court for the District of Columbia. Such term includes any stipulation that the parties will abide by the terms of such proposed consent decree until it is entered and any order entering such proposed consent decree.

(4) ANTITRUST LAWS- The term `antitrust laws' has the meaning given it in subsection (a) of the first section of the Clayton Act (15 U.S.C. 12(a)), except that such term includes the Act of June 19, 1936 (49 Stat. 1526; 15 U.S.C. 13 et seq.), commonly known as the Robinson-Patman Act, and section 5 of the Federal Trade Commission Act (15 U.S.C. 45) to the extent that such section 5 applies to unfair methods of competition.

SEC. 602. PREEMPTION OF LOCAL TAXATION WITH RESPECT TO DIRECT-TO-HOME SERVICES.

(a) PREEMPTION- A provider of direct-to-home satellite service shall be exempt from the collection or remittance, or both, of any tax or fee imposed by any local taxing jurisdiction on direct-to-home satellite service.

(b) DEFINITIONS- For the purposes of this section--

(1) DIRECT-TO-HOME SATELLITE SERVICE- The term `direct-to-home satellite service' means only programming transmitted or broadcast by satellite directly to the subscribers' premises without the use of ground receiving or distribution equipment, except at the subscribers' premises or in the uplink process to the satellite.

(2) PROVIDER OF DIRECT-TO-HOME SATELLITE SERVICE- For purposes of this section, a `provider of direct-to-home satellite service' means a person who transmits, broadcasts, sells, or distributes direct-to-home satellite service.

(3) LOCAL TAXING JURISDICTION- The term `local taxing jurisdiction' means any municipality, city, county, township, parish, transportation district, or assessment jurisdiction, or any other local jurisdiction in the territorial jurisdiction of the United States with the authority to impose a tax or fee, but does not include a State.

(4) STATE- The term `State' means any of the several States, the District of Columbia, or any territory or possession of the United States.

(5) TAX OR FEE- The terms `tax' and `fee' mean any local sales tax, local use tax, local intangible tax, local income tax, business license tax, utility tax, privilege tax, gross receipts tax, excise tax, franchise fees, local telecommunications tax, or any other tax, license, or fee that is imposed for the privilege of doing business, regulating, or raising revenue for a local taxing jurisdiction.

(c) PRESERVATION OF STATE AUTHORITY- This section shall not be construed to prevent taxation of a provider of direct-to-home satellite service by a State or to prevent a local taxing jurisdiction from receiving revenue derived from a tax or fee imposed and collected by a State.

TITLE VII--MISCELLANEOUS PROVISIONS

SEC. 701. PREVENTION OF UNFAIR BILLING PRACTICES FOR INFORMATION OR SERVICES PROVIDED OVER TOLL-FREE TELEPHONE CALLS.

(a) PREVENTION OF UNFAIR BILLING PRACTICES-

(1) IN GENERAL- Section 228(c) (47 U.S.C. 228(c)) is amended--

(A) by striking out subparagraph (C) of paragraph (7) and inserting in lieu thereof the following:

`(C) the calling party being charged for information conveyed during the call unless--

`(i) the calling party has a written agreement (including an agreement transmitted through electronic medium) that meets the requirements of paragraph (8); or

`(ii) the calling party is charged for the information in accordance with paragraph (9); or';

(B)(i) by striking `or' at the end of subparagraph (C) of such paragraph;

(ii) by striking the period at the end of subparagraph (D) of such paragraph and inserting a semicolon and `or'; and

(iii) by adding at the end thereof the following:

`(E) the calling party being assessed, by virtue of being asked to connect or otherwise transfer to a pay-per-call service, a charge for the call.'; and

(C) by adding at the end the following new paragraphs:

`(8) SUBSCRIPTION AGREEMENTS FOR BILLING FOR INFORMATION PROVIDED VIA TOLL-FREE CALLS-

`(A) IN GENERAL- For purposes of paragraph (7)(C)(i), a written subscription does not meet the requirements of this paragraph unless the agreement specifies the material terms and conditions under which the information is offered and includes--

`(i) the rate at which charges are assessed for the information;

`(ii) the information provider's name;

`(iii) the information provider's business address;

`(iv) the information provider's regular business telephone number;

`(v) the information provider's agreement to notify the subscriber at least one billing cycle in advance of all future changes in the rates charged for the information; and

`(vi) the subscriber's choice of payment method, which may be by direct remit, debit, prepaid account, phone bill, or credit or calling card.

`(B) BILLING ARRANGEMENTS- If a subscriber elects, pursuant to subparagraph (A)(vi), to pay by means of a phone bill--

`(i) the agreement shall clearly explain that the subscriber will be assessed for calls made to the information service from the subscriber's phone line;

`(ii) the phone bill shall include, in prominent type, the following disclaimer:

`Common carriers may not disconnect local or long distance telephone service for failure to pay disputed charges for information services.'; and

`(iii) the phone bill shall clearly list the 800 number dialed.

`(C) USE OF PINS TO PREVENT UNAUTHORIZED USE- A written

agreement does not meet the requirements of this paragraph unless it--

`(i) includes a unique personal identification number or other subscriber-specific identifier and requires a subscriber to use this number or identifier to obtain access to the information provided and includes instructions on its use; and

`(ii) assures that any charges for services accessed by use of the subscriber's personal identification number or subscriber-specific identifier be assessed to subscriber's source of payment elected pursuant to subparagraph (A)(vi).

`(D) EXCEPTIONS- Notwithstanding paragraph (7)(C), a written agreement that meets the requirements of this paragraph is not required--

`(i) for calls utilizing telecommunications devices for the deaf;

`(ii) for directory services provided by a common carrier or its affiliate or by a local exchange carrier or its affiliate; or

`(iii) for any purchase of goods or of services that are not information services.

`(E) TERMINATION OF SERVICE- On receipt by a common carrier of a complaint by any person that an information provider is in violation of the provisions of this section, a carrier shall--

`(i) promptly investigate the complaint; and

`(ii) if the carrier reasonably determines that the complaint is valid, it may terminate the provision of service to an information provider unless the provider supplies evidence of a written agreement that meets the requirements of this section.

`(F) TREATMENT OF REMEDIES- The remedies provided in this paragraph are in addition to any other remedies that are available under title V of this Act.

`(9) CHARGES BY CREDIT, PREPAID, DEBIT, CHARGE, OR CALLING CARD IN ABSENCE OF AGREEMENT- For purposes of paragraph (7)(C)(ii), a calling party is not charged in accordance with this paragraph unless the calling party is charged by means of a credit, prepaid, debit, charge, or calling card and the information service provider includes in response to each call an introductory disclosure message that--

`(A) clearly states that there is a charge for the call;

`(B) clearly states the service's total cost per minute and any other fees for the service or for any service to

which the caller may be transferred;

`(C) explains that the charges must be billed on either a credit, prepaid, debit, charge, or calling card;

`(D) asks the caller for the card number;

`(E) clearly states that charges for the call begin at the end of the introductory message; and

`(F) clearly states that the caller can hang up at or before the end of the introductory message without incurring any charge whatsoever.

`(10) BYPASS OF INTRODUCTORY DISCLOSURE MESSAGE- The requirements of paragraph (9) shall not apply to calls from repeat callers using a bypass mechanism to avoid listening to the introductory message: [Italic->] Provided, [<-Italic] That information providers shall disable such a bypass mechanism after the institution of any price increase and for a period of time determined to be sufficient by the Federal Trade Commission to give callers adequate and sufficient notice of a price increase.

`(11) DEFINITION OF CALLING CARD- As used in this subsection, the term `calling card' means an identifying number or code unique to the individual, that is issued to the individual by a common carrier and enables the individual to be charged by means of a phone bill for charges incurred independent of where the call originates.'.

(2) REGULATIONS- The Federal Communications Commission shall revise its regulations to comply with the amendment made by paragraph (1) not later than 180 days after the date of enactment of this Act.

(3) EFFECTIVE DATE- The amendments made by paragraph (1) shall take effect on the date of enactment of this Act.

(b) CLARIFICATION OF `PAY-PER-CALL SERVICES'-

(1) TELEPHONE DISCLOSURE AND DISPUTE RESOLUTION ACT- Section 204(1) of the Telephone Disclosure and Dispute Resolution Act (15 U.S.C. 5714(1)) is amended to read as follows:

`(1) The term `pay-per-call services' has the meaning provided in section 228(i) of the Communications Act of 1934, except that the Commission by rule may, notwithstanding subparagraphs (B) and (C) of section 228(i)(1) of such Act, extend such definition to other similar services providing audio information or audio entertainment if the Commission determines that such services are susceptible to the unfair and deceptive practices that are prohibited by the rules prescribed pursuant to section 201(a).'.

(2) COMMUNICATIONS ACT- Section 228(i)(2) (47 U.S.C. 228(i)(2)) is amended by striking `or any service the charge

for which is tariffed,'.

SEC. 702. PRIVACY OF CUSTOMER INFORMATION.

Title II is amended by inserting after section 221 (47 U.S.C. 221) the following new section:

`SEC. 222. PRIVACY OF CUSTOMER INFORMATION.

`(a) IN GENERAL- Every telecommunications carrier has a duty to protect the confidentiality of proprietary information of, and relating to, other telecommunication carriers, equipment manufacturers, and customers, including telecommunication carriers reselling telecommunications services provided by a telecommunications carrier.

`(b) CONFIDENTIALITY OF CARRIER INFORMATION- A telecommunications carrier that receives or obtains proprietary information from another carrier for purposes of providing any telecommunications service shall use such information only for such purpose, and shall not use such information for its own marketing efforts.

`(c) CONFIDENTIALITY OF CUSTOMER PROPRIETARY NETWORK INFORMATION-

`(1) PRIVACY REQUIREMENTS FOR TELECOMMUNICATIONS CARRIERS- Except as required by law or with the approval of the customer, a telecommunications carrier that receives or obtains customer proprietary network information by virtue of its provision of a telecommunications service shall only use, disclose, or permit access to individually identifiable customer proprietary network information in its provision of (A) the telecommunications service from which such information is derived, or (B) services necessary to, or used in, the provision of such telecommunications service, including the publishing of directories.

`(2) DISCLOSURE ON REQUEST BY CUSTOMERS- A telecommunications carrier shall disclose customer proprietary network information, upon affirmative written request by the customer, to any person designated by the customer.

`(3) AGGREGATE CUSTOMER INFORMATION- A telecommunications carrier that receives or obtains customer proprietary network information by virtue of its provision of a telecommunications service may use, disclose, or permit access to aggregate customer information other than for the purposes described in paragraph (1). A local exchange carrier may use, disclose, or permit access to aggregate customer information other than for purposes described in paragraph (1) only if it provides such aggregate information to other carriers or persons on reasonable and nondiscriminatory terms and conditions upon reasonable request therefor.

`(d) EXCEPTIONS- Nothing in this section prohibits a

telecommunications carrier from using, disclosing, or permitting access to customer proprietary network information obtained from its customers, either directly or indirectly through its agents--

`(1) to initiate, render, bill, and collect for telecommunications services;

`(2) to protect the rights or property of the carrier, or to protect users of those services and other carriers from fraudulent, abusive, or unlawful use of, or subscription to, such services; or

`(3) to provide any inbound telemarketing, referral, or administrative services to the customer for the duration of the call, if such call was initiated by the customer and the customer approves of the use of such information to provide such service.

`(e) SUBSCRIBER LIST INFORMATION- Notwithstanding subsections (b), (c), and (d), a telecommunications carrier that provides telephone exchange service shall provide subscriber list information gathered in its capacity as a provider of such service on a timely and unbundled basis, under nondiscriminatory and reasonable rates, terms, and conditions, to any person upon request for the purpose of publishing directories in any format.

`(f) DEFINITIONS- As used in this section:

`(1) CUSTOMER PROPRIETARY NETWORK INFORMATION- The term `customer proprietary network information' means--

`(A) information that relates to the quantity, technical configuration, type, destination, and amount of use of a telecommunications service subscribed to by any customer of a telecommunications carrier, and that is made available to the carrier by the customer solely by virtue of the carrier-customer relationship; and

`(B) information contained in the bills pertaining to telephone exchange service or telephone toll service received by a customer of a carrier;

except that such term does not include subscriber list information.

`(2) AGGREGATE INFORMATION- The term `aggregate customer information' means collective data that relates to a group or category of services or customers, from which individual customer identities and characteristics have been removed.

`(3) SUBSCRIBER LIST INFORMATION- The term `subscriber list information' means any information--

`(A) identifying the listed names of subscribers of a carrier and such subscribers' telephone numbers, addresses, or primary advertising classifications (as such classifications are assigned at the time of the

establishment of such service), or any combination of such listed names, numbers, addresses, or classifications; and

`(B) that the carrier or an affiliate has published, caused to be published, or accepted for publication in any directory format.'.

SEC. 703. POLE ATTACHMENTS.

Section 224 (47 U.S.C. 224) is amended--

(1) in subsection (a)(1), by striking the first sentence and inserting the following: `The term `utility' means any person who is a local exchange carrier or an electric, gas, water, steam, or other public utility, and who owns or controls poles, ducts, conduits, or rights-of-way used, in whole or in part, for any wire communications.';

(2) in subsection (a)(4), by inserting after `system' the following: `or provider of telecommunications service';

(3) by inserting after subsection (a)(4) the following:

`(5) For purposes of this section, the term `telecommunications carrier' (as defined in section 3 of this Act) does not include any incumbent local exchange carrier as defined in section 251(h).';

(4) by inserting after `conditions' in subsection (c)(1) a comma and the following: `or access to poles, ducts, conduits, and rights-of-way as provided in subsection (f),';

(5) in subsection (c)(2)(B), by striking `cable television services' and inserting `the services offered via such attachments';

(6) by inserting after subsection (d)(2) the following:

`(3) This subsection shall apply to the rate for any pole attachment used by a cable television system solely to provide cable service. Until the effective date of the regulations required under subsection (e), this subsection shall also apply to the rate for any pole attachment used by a cable system or any telecommunications carrier (to the extent such carrier is not a party to a pole attachment agreement) to provide any telecommunications service.'; and

(7) by adding at the end thereof the following:

`(e)(1) The Commission shall, no later than 2 years after the date of enactment of the Telecommunications Act of 1996, prescribe regulations in accordance with this subsection to govern the charges for pole attachments used by telecommunications carriers to provide telecommunications services, when the parties fail to resolve a dispute over such charges. Such regulations shall ensure that a utility charges just, reasonable, and nondiscriminatory rates for pole attachments.

`(2) A utility shall apportion the cost of providing space on a

pole, duct, conduit, or right-of-way other than the usable space among entities so that such apportionment equals two-thirds of the costs of providing space other than the usable space that would be allocated to such entity under an equal apportionment of such costs among all attaching entities.

`(3) A utility shall apportion the cost of providing usable space among all entities according to the percentage of usable space required for each entity.

`(4) The regulations required under paragraph (1) shall become effective 5 years after the date of enactment of the Telecommunications Act of 1996. Any increase in the rates for pole attachments that result from the adoption of the regulations required by this subsection shall be phased in equal annual increments over a period of 5 years beginning on the effective date of such regulations.

`(f)(1) A utility shall provide a cable television system or any telecommunications carrier with nondiscriminatory access to any pole, duct, conduit, or right-of-way owned or controlled by it.

`(2) Notwithstanding paragraph (1), a utility providing electric service may deny a cable television system or any telecommunications carrier access to its poles, ducts, conduits, or rights-of-way, on a non-discriminatory basis where there is insufficient capacity and for reasons of safety, reliability and generally applicable engineering purposes.

`(g) A utility that engages in the provision of telecommunications services or cable services shall impute to its costs of providing such services (and charge any affiliate, subsidiary, or associate company engaged in the provision of such services) an equal amount to the pole attachment rate for which such company would be liable under this section.

`(h) Whenever the owner of a pole, duct, conduit, or right-of-way intends to modify or alter such pole, duct, conduit, or right-of-way, the owner shall provide written notification of such action to any entity that has obtained an attachment to such conduit or right-of-way so that such entity may have a reasonable opportunity to add to or modify its existing attachment. Any entity that adds to or modifies its existing attachment after receiving such notification shall bear a proportionate share of the costs incurred by the owner in making such pole, duct, conduit, or right-of-way accessible.

`(i) An entity that obtains an attachment to a pole, conduit, or right-of-way shall not be required to bear any of the costs of rearranging or replacing its attachment, if such rearrangement or replacement is required as a result of an additional attachment or the modification of an existing attachment sought by any other

entity (including the owner of such pole, duct, conduit, or right-of-way).'.

SEC. 704. FACILITIES SITING; RADIO FREQUENCY EMISSION STANDARDS.

(a) NATIONAL WIRELESS TELECOMMUNICATIONS SITING POLICY- Section 332(c) (47 U.S.C. 332(c)) is amended by adding at the end the following new paragraph:

`(7) PRESERVATION OF LOCAL ZONING AUTHORITY-

`(A) GENERAL AUTHORITY- Except as provided in this paragraph, nothing in this Act shall limit or affect the authority of a State or local government or instrumentality thereof over decisions regarding the placement, construction, and modification of personal wireless service facilities.

`(B) LIMITATIONS-

`(i) The regulation of the placement, construction, and modification of personal wireless service facilities by any State or local government or instrumentality thereof--

`(I) shall not unreasonably discriminate among providers of functionally equivalent services; and

`(II) shall not prohibit or have the effect of prohibiting the provision of personal wireless services.

`(ii) A State or local government or instrumentality thereof shall act on any request for authorization to place, construct, or modify personal wireless service facilities within a reasonable period of time after the request is duly filed with such government or instrumentality, taking into account the nature and scope of such request.

`(iii) Any decision by a State or local government or instrumentality thereof to deny a request to place, construct, or modify personal wireless service facilities shall be in writing and supported by substantial evidence contained in a written record.

`(iv) No State or local government or instrumentality thereof may regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Commission's regulations concerning such emissions.

`(v) Any person adversely affected by any final action or failure to act by a State or local government or any instrumentality thereof that is inconsistent with this subparagraph may, within 30 days after such

action or failure to act, commence an action in any court of competent jurisdiction. The court shall hear and decide such action on an expedited basis. Any person adversely affected by an act or failure to act by a State or local government or any instrumentality thereof that is inconsistent with clause (iv) may petition the Commission for relief.

`(C) DEFINITIONS- For purposes of this paragraph--

`(i) the term `personal wireless services' means commercial mobile services, unlicensed wireless services, and common carrier wireless exchange access services;

`(ii) the term `personal wireless service facilities' means facilities for the provision of personal wireless services; and

`(iii) the term `unlicensed wireless service' means the offering of telecommunications services using duly authorized devices which do not require individual licenses, but does not mean the provision of direct-to-home satellite services (as defined in section 303(v)).'.

(b) RADIO FREQUENCY EMISSIONS- Within 180 days after the enactment of this Act, the Commission shall complete action in ET Docket 93-62 to prescribe and make effective rules regarding the environmental effects of radio frequency emissions.

(c) AVAILABILITY OF PROPERTY- Within 180 days of the enactment of this Act, the President or his designee shall prescribe procedures by which Federal departments and agencies may make available on a fair, reasonable, and nondiscriminatory basis, property, rights-of-way, and easements under their control for the placement of new telecommunications services that are dependent, in whole or in part, upon the utilization of Federal spectrum rights for the transmission or reception of such services. These procedures may establish a presumption that requests for the use of property, rights-of-way, and easements by duly authorized providers should be granted absent unavoidable direct conflict with the department or agency's mission, or the current or planned use of the property, rights-of-way, and easements in question. Reasonable fees may be charged to providers of such telecommunications services for use of property, rights-of-way, and easements. The Commission shall provide technical support to States to encourage them to make property, rights-of-way, and easements under their jurisdiction available for such purposes.

SEC. 705. MOBILE SERVICES DIRECT ACCESS TO LONG DISTANCE CARRIERS.

Section 332(c) (47 U.S.C. 332(c)) is amended by adding at the end

the following new paragraph:

`(8) MOBILE SERVICES ACCESS- A person engaged in the provision of commercial mobile services, insofar as such person is so engaged, shall not be required to provide equal access to common carriers for the provision of telephone toll services. If the Commission determines that subscribers to such services are denied access to the provider of telephone toll services of the subscribers' choice, and that such denial is contrary to the public interest, convenience, and necessity, then the Commission shall prescribe regulations to afford subscribers unblocked access to the provider of telephone toll services of the subscribers' choice through the use of a carrier identification code assigned to such provider or other mechanism. The requirements for unblocking shall not apply to mobile satellite services unless the Commission finds it to be in the public interest to apply such requirements to such services.'.

SEC. 706. ADVANCED TELECOMMUNICATIONS INCENTIVES.

(a) IN GENERAL- The Commission and each State commission with regulatory jurisdiction over telecommunications services shall encourage the deployment on a reasonable and timely basis of advanced telecommunications capability to all Americans (including, in particular, elementary and secondary schools and classrooms) by utilizing, in a manner consistent with the public interest, convenience, and necessity, price cap regulation, regulatory forbearance, measures that promote competition in the local telecommunications market, or other regulating methods that remove barriers to infrastructure investment.

(b) INQUIRY- The Commission shall, within 30 months after the date of enactment of this Act, and regularly thereafter, initiate a notice of inquiry concerning the availability of advanced telecommunications capability to all Americans (including, in particular, elementary and secondary schools and classrooms) and shall complete the inquiry within 180 days after its initiation. In the inquiry, the Commission shall determine whether advanced telecommunications capability is being deployed to all Americans in a reasonable and timely fashion. If the Commission's determination is negative, it shall take immediate action to accelerate deployment of such capability by removing barriers to infrastructure investment and by promoting competition in the telecommunications market.

(c) DEFINITIONS- For purposes of this subsection:

(1) ADVANCED TELECOMMUNICATIONS CAPABILITY- The term `advanced telecommunications capability' is defined, without regard to any transmission media or technology, as high-speed,

switched, broadband telecommunications capability that enables users to originate and receive high-quality voice, data, graphics, and video telecommunications using any technology.

(2) ELEMENTARY AND SECONDARY SCHOOLS- The term `elementary and secondary schools' means elementary and secondary schools, as defined in paragraphs (14) and (25), respectively, of section 14101 of the Elementary and Secondary Education Act of 1965 (20 U.S.C. 8801).

SEC. 707. TELECOMMUNICATIONS DEVELOPMENT FUND.

(a) DEPOSIT AND USE OF AUCTION ESCROW ACCOUNTS- Section 309(j)(8) (47 U.S.C. 309(j)(8)) is amended by adding at the end the following new subparagraph:

`(C) DEPOSIT AND USE OF AUCTION ESCROW ACCOUNTS- Any deposits the Commission may require for the qualification of any person to bid in a system of competitive bidding pursuant to this subsection shall be deposited in an interest bearing account at a financial institution designated for purposes of this subsection by the Commission (after consultation with the Secretary of the Treasury). Within 45 days following the conclusion of the competitive bidding--

`(i) the deposits of successful bidders shall be paid to the Treasury;

`(ii) the deposits of unsuccessful bidders shall be returned to such bidders; and

`(iii) the interest accrued to the account shall be transferred to the Telecommunications Development Fund established pursuant to section 714 of this Act.'.

(b) ESTABLISHMENT AND OPERATION OF FUND- Title VII is amended by inserting after section 713 (as added by section 305) the following new section:

`SEC. 714. TELECOMMUNICATIONS DEVELOPMENT FUND.

`(a) PURPOSE OF SECTION- It is the purpose of this section--

`(1) to promote access to capital for small businesses in order to enhance competition in the telecommunications industry;

`(2) to stimulate new technology development, and promote employment and training; and

`(3) to support universal service and promote delivery of telecommunications services to underserved rural and urban areas.

`(b) ESTABLISHMENT OF FUND- There is hereby established a body corporate to be known as the Telecommunications Development Fund, which shall have succession until dissolved. The Fund shall maintain its principal office in the District of Columbia and shall be deemed, for purposes of venue and jurisdiction in civil actions, to be a resident and citizen thereof.

`(c) BOARD OF DIRECTORS-

`(1) COMPOSITION OF BOARD; CHAIRMAN- The Fund shall have a Board of Directors which shall consist of 7 persons appointed by the Chairman of the Commission. Four of such directors shall be representative of the private sector and three of such directors shall be representative of the Commission, the Small Business Administration, and the Department of the Treasury, respectively. The Chairman of the Commission shall appoint one of the representatives of the private sector to serve as chairman of the Fund within 30 days after the date of enactment of this section, in order to facilitate rapid creation and implementation of the Fund. The directors shall include members with experience in a number of the following areas: finance, investment banking, government banking, communications law and administrative practice, and public policy.

`(2) TERMS OF APPOINTED AND ELECTED MEMBERS- The directors shall be eligible to serve for terms of 5 years, except of the initial members, as designated at the time of their appointment--

`(A) 1 shall be eligible to service for a term of 1 year;

`(B) 1 shall be eligible to service for a term of 2 years;

`(C) 1 shall be eligible to service for a term of 3 years;

`(D) 2 shall be eligible to service for a term of 4 years; and

`(E) 2 shall be eligible to service for a term of 5 years (1 of whom shall be the Chairman).

Directors may continue to serve until their successors have been appointed and have qualified.

`(3) MEETINGS AND FUNCTIONS OF THE BOARD- The Board of Directors shall meet at the call of its Chairman, but at least quarterly. The Board shall determine the general policies which shall govern the operations of the Fund. The Chairman of the Board shall, with the approval of the Board, select, appoint, and compensate qualified persons to fill the offices as may be provided for in the bylaws, with such functions, powers, and duties as may be prescribed by the bylaws or by the Board of Directors, and such persons shall be the officers of the Fund and shall discharge all such functions, powers, and duties.

`(d) ACCOUNTS OF THE FUND- The Fund shall maintain its accounts at a financial institution designated for purposes of this section by the Chairman of the Board (after consultation with the Commission and the Secretary of the Treasury). The accounts of the Fund shall consist of--

`(1) interest transferred pursuant to section 309(j)(8)(C) of this Act;

`(2) such sums as may be appropriated to the Commission for

advances to the Fund;

`(3) any contributions or donations to the Fund that are accepted by the Fund; and

`(4) any repayment of, or other payment made with respect to, loans, equity, or other extensions of credit made from the Fund.

`(e) USE OF THE FUND- All moneys deposited into the accounts of the Fund shall be used solely for--

`(1) the making of loans, investments, or other extensions of credits to eligible small businesses in accordance with subsection (f);

`(2) the provision of financial advice to eligible small businesses;

`(3) expenses for the administration and management of the Fund (including salaries, expenses, and the rental or purchase of office space for the fund);

`(4) preparation of research, studies, or financial analyses; and

`(5) other services consistent with the purposes of this section.

`(f) LENDING AND CREDIT OPERATIONS- Loans or other extensions of credit from the Fund shall be made available in accordance with the requirements of the Federal Credit Reform Act of 1990 (2 U.S.C. 661 et seq.) and any other applicable law to an eligible small business on the basis of--

`(1) the analysis of the business plan of the eligible small business;

`(2) the reasonable availability of collateral to secure the loan or credit extension;

`(3) the extent to which the loan or credit extension promotes the purposes of this section; and

`(4) other lending policies as defined by the Board.

`(g) RETURN OF ADVANCES- Any advances appropriated pursuant to subsection (d)(2) shall be disbursed upon such terms and conditions (including conditions relating to the time or times of repayment) as are specified in any appropriations Act providing such advances.

`(h) GENERAL CORPORATE POWERS- The Fund shall have power--

`(1) to sue and be sued, complain and defend, in its corporate name and through its own counsel;

`(2) to adopt, alter, and use the corporate seal, which shall be judicially noticed;

`(3) to adopt, amend, and repeal by its Board of Directors, bylaws, rules, and regulations as may be necessary for the conduct of its business;

`(4) to conduct its business, carry on its operations, and have officers and exercise the power granted by this section in

any State without regard to any qualification or similar statute in any State;

`(5) to lease, purchase, or otherwise acquire, own, hold, improve, use, or otherwise deal in and with any property, real, personal, or mixed, or any interest therein, wherever situated, for the purposes of the Fund;

`(6) to accept gifts or donations of services, or of property, real, personal, or mixed, tangible or intangible, in aid of any of the purposes of the Fund;

`(7) to sell, convey, mortgage, pledge, lease, exchange, and otherwise dispose of its property and assets;

`(8) to appoint such officers, attorneys, employees, and agents as may be required, to determine their qualifications, to define their duties, to fix their salaries, require bonds for them, and fix the penalty thereof; and

`(9) to enter into contracts, to execute instruments, to incur liabilities, to make loans and equity investment, and to do all things as are necessary or incidental to the proper management of its affairs and the proper conduct of its business.

`(i) ACCOUNTING, AUDITING, AND REPORTING- The accounts of the Fund shall be audited annually. Such audits shall be conducted in accordance with generally accepted auditing standards by independent certified public accountants. A report of each such audit shall be furnished to the Secretary of the Treasury and the Commission. The representatives of the Secretary and the Commission shall have access to all books, accounts, financial records, reports, files, and all other papers, things, or property belonging to or in use by the Fund and necessary to facilitate the audit.

`(j) REPORT ON AUDITS BY TREASURY- A report of each such audit for a fiscal year shall be made by the Secretary of the Treasury to the President and to the Congress not later than 6 months following the close of such fiscal year. The report shall set forth the scope of the audit and shall include a statement of assets and liabilities, capital and surplus or deficit; a statement of surplus or deficit analysis; a statement of income and expense; a statement of sources and application of funds; and such comments and information as may be deemed necessary to keep the President and the Congress informed of the operations and financial condition of the Fund, together with such recommendations with respect thereto as the Secretary may deem advisable.

`(k) DEFINITIONS- As used in this section:

`(1) ELIGIBLE SMALL BUSINESS- The term `eligible small business' means business enterprises engaged in the telecommunications industry that have $50,000,000 or less in annual revenues, on average over the past 3 years prior to

submitting the application under this section.

`(2) FUND- The term `Fund' means the Telecommunications Development Fund established pursuant to this section.

`(3) TELECOMMUNICATIONS INDUSTRY- The term `telecommunications industry' means communications businesses using regulated or unregulated facilities or services and includes broadcasting, telecommunications, cable, computer, data transmission, software, programming, advanced messaging, and electronics businesses.'.

SEC. 708. NATIONAL EDUCATION TECHNOLOGY FUNDING CORPORATION.

(a) FINDINGS; PURPOSE-

(1) FINDINGS- The Congress finds as follows:

(A) CORPORATION- There has been established in the District of Columbia a private, nonprofit corporation known as the National Education Technology Funding Corporation which is not an agency or independent establishment of the Federal Government.

(B) BOARD OF DIRECTORS- The Corporation is governed by a Board of Directors, as prescribed in the Corporation's articles of incorporation, consisting of 15 members, of which--

(i) five members are representative of public agencies representative of schools and public libraries;

(ii) five members are representative of State government, including persons knowledgeable about State finance, technology and education; and

(iii) five members are representative of the private sector, with expertise in network technology, finance and management.

(C) CORPORATE PURPOSES- The purposes of the Corporation, as set forth in its articles of incorporation, are--

(i) to leverage resources and stimulate private investment in education technology infrastructure;

(ii) to designate State education technology agencies to receive loans, grants or other forms of assistance from the Corporation;

(iii) to establish criteria for encouraging States to--

(I) create, maintain, utilize and upgrade interactive high capacity networks capable of providing audio, visual and data communications for elementary schools, secondary schools and public libraries;

(II) distribute resources to assure equitable aid to all elementary schools and secondary schools in the State and achieve universal access to network technology; and

(III) upgrade the delivery and development of learning through

innovative technology-based instructional tools and applications;

(iv) to provide loans, grants and other forms of assistance to State education technology agencies, with due regard for providing a fair balance among types of school districts and public libraries assisted and the disparate needs of such districts and libraries;

(v) to leverage resources to provide maximum aid to elementary schools, secondary schools and public libraries; and

(vi) to encourage the development of education telecommunications and information technologies through public-private ventures, by serving as a clearinghouse for information on new education technologies, and by providing technical assistance, including assistance to States, if needed, to establish State education technology agencies.

(2) PURPOSE- The purpose of this section is to recognize the Corporation as a nonprofit corporation operating under the laws of the District of Columbia, and to provide authority for Federal departments and agencies to provide assistance to the Corporation.

(b) DEFINITIONS- For the purpose of this section--

(1) the term `Corporation' means the National Education Technology Funding Corporation described in subsection (a)(1)(A);

(2) the terms `elementary school' and `secondary school' have the same meanings given such terms in section 14101 of the Elementary and Secondary Education Act of 1965; and

(3) the term `public library' has the same meaning given such term in section 3 of the Library Services and Construction Act.

(c) ASSISTANCE FOR EDUCATION TECHNOLOGY PURPOSES-

(1) RECEIPT BY CORPORATION- Notwithstanding any other provision of law, in order to carry out the corporate purposes described in subsection (a)(1)(C), the Corporation shall be eligible to receive discretionary grants, contracts, gifts, contributions, or technical assistance from any Federal department or agency, to the extent otherwise permitted by law.

(2) AGREEMENT- In order to receive any assistance described in paragraph (1) the Corporation shall enter into an agreement with the Federal department or agency providing such assistance, under which the Corporation agrees--

(A) to use such assistance to provide funding and technical assistance only for activities which the Board of Directors of the Corporation determines are consistent with the corporate purposes described in subsection (a)(1)(C);

(B) to review the activities of State education

technology agencies and other entities receiving assistance from the Corporation to assure that the corporate purposes described in subsection (a)(1)(C) are carried out;

(C) that no part of the assets of the Corporation shall accrue to the benefit of any member of the Board of Directors of the Corporation, any officer or employee of the Corporation, or any other individual, except as salary or reasonable compensation for services;

(D) that the Board of Directors of the Corporation will adopt policies and procedures to prevent conflicts of interest;

(E) to maintain a Board of Directors of the Corporation consistent with subsection (a)(1)(B);

(F) that the Corporation, and any entity receiving the assistance from the Corporation, are subject to the appropriate oversight procedures of the Congress; and

(G) to comply with--

(i) the audit requirements described in subsection (d); and

(ii) the reporting and testimony requirements described in subsection (e).

(3) CONSTRUCTION- Nothing in this section shall be construed to establish the Corporation as an agency or independent establishment of the Federal Government, or to establish the members of the Board of Directors of the Corporation, or the officers and employees of the Corporation, as officers or employees of the Federal Government.

(d) AUDITS-

(1) AUDITS BY INDEPENDENT CERTIFIED PUBLIC ACCOUNTANTS-

(A) IN GENERAL- The Corporation's financial statements shall be audited annually in accordance with generally accepted auditing standards by independent certified public accountants who are certified by a regulatory authority of a State or other political subdivision of the United States. The audits shall be conducted at the place or places where the accounts of the Corporation are normally kept. All books, accounts, financial records, reports, files, and all other papers, things, or property belonging to or in use by the Corporation and necessary to facilitate the audit shall be made available to the person or persons conducting the audits, and full facilities for verifying transactions with the balances or securities held by depositories, fiscal agents, and custodians shall be afforded to such person or persons.

(B) REPORTING REQUIREMENTS- The report of each annual

audit described in subparagraph (A) shall be included in the annual report required by subsection (e)(1).

(2) RECORDKEEPING REQUIREMENTS; AUDIT AND EXAMINATION OF BOOKS-

(A) RECORDKEEPING REQUIREMENTS- The Corporation shall ensure that each recipient of assistance from the Corporation keeps--

(i) separate accounts with respect to such assistance;

(ii) such records as may be reasonably necessary to fully disclose--

(I) the amount and the disposition by such recipient of the proceeds of such assistance;

(II) the total cost of the project or undertaking in connection with which such assistance is given or used; and

(III) the amount and nature of that portion of the cost of the project or undertaking supplied by other sources; and

(iii) such other records as will facilitate an effective audit.

(B) AUDIT AND EXAMINATION OF BOOKS- The Corporation shall ensure that the Corporation, or any of the Corporation's duly authorized representatives, shall have access for the purpose of audit and examination to any books, documents, papers, and records of any recipient of assistance from the Corporation that are pertinent to such assistance. Representatives of the Comptroller General shall also have such access for such purpose.

(e) ANNUAL REPORT; TESTIMONY TO THE CONGRESS-

(1) ANNUAL REPORT- Not later than April 30 of each year, the Corporation shall publish an annual report for the preceding fiscal year and submit that report to the President and the Congress. The report shall include a comprehensive and detailed evaluation of the Corporation's operations, activities, financial condition, and accomplishments under this section and may include such recommendations as the Corporation deems appropriate.

(2) TESTIMONY BEFORE CONGRESS- The members of the Board of Directors, and officers, of the Corporation shall be available to testify before appropriate committees of the Congress with respect to the report described in paragraph (1), the report of any audit made by the Comptroller General pursuant to this section, or any other matter which any such committee may determine appropriate.

SEC. 709. REPORT ON THE USE OF ADVANCED TELECOMMUNICATIONS SERVICES FOR MEDICAL PURPOSES.

The Secretary of Commerce, in consultation with the Secretary of Health and Human Services and other appropriate departments and agencies, shall submit a report to the Committee on Commerce of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate concerning the activities of the Joint Working Group on Telemedicine, together with any findings reached in the studies and demonstrations on telemedicine funded by the Public Health Service or other Federal agencies. The report shall examine questions related to patient safety, the efficacy and quality of the services provided, and other legal, medical, and economic issues related to the utilization of advanced telecommunications services for medical purposes. The report shall be submitted to the respective committees by January 31, 1997.

SEC. 710. AUTHORIZATION OF APPROPRIATIONS.

(a) IN GENERAL- In addition to any other sums authorized by law, there are authorized to be appropriated to the Federal Communications Commission such sums as may be necessary to carry out this Act and the amendments made by this Act.

(b) EFFECT ON FEES- For the purposes of section 9(b)(2) (47 U.S.C. 159(b)(2)), additional amounts appropriated pursuant to subsection (a) shall be construed to be changes in the amounts appropriated for the performance of activities described in section 9(a) of the Communications Act of 1934.

(c) FUNDING AVAILABILITY- Section 309(j)(8)(B) (47 U.S.C. 309(j)(8)(B)) is amended by adding at the end the following new sentence: `Such offsetting collections are authorized to remain available until expended.'.

Speaker of the House of Representatives.

Vice President of the United States and
President of the Senate.

Perspectives on the AIN Architecture

History, architecture, and evolution provide three points from which to view the Advanced Intelligent Network.

Roger K. Berman and John H. Brewster

This article will examine the Advanced Intelligent Network (AIN) from a variety of perspectives: historical, present-day architecture, and future evolution.

From a historical perspective, the history of the AIN is traced from predivestiture 800 and calling card service capabilities, through IN/1, IN/2, and IN/1+, leading to the various AIN releases. In addition, motivation for, and results from processes such as Bellcore's multivendor interactions also are discussed.

Following the historical perspective, the present-day view of the AIN architecture is described, including the switching system and other network systems, as well as operations. The AIN functionality supported by this architecture is then described from a customer point of view, by means of an illustrative service which could be provided from an AIN platform. Finally, the next steps in the AIN evolution are discussed.

Intelligent Network History

During the past 25 years telephone networks have greatly expanded in terms of the number of subscribers served and the volume of traffic carried. An even more dramatic expansion has occurred in the range of services offered to subscribers. The expansion of services has been driven by the needs of the increasingly sophisticated business and residential subscribers, and has been enabled by the widespread deployment of stored program control (SPC) technology in the telephone networks.

The intelligence provided by SPC technology initially was centered in the network switching systems. The first such system, in 1965, was AT&T's No. 1 ESS. Residential services such as Call Waiting, and business services such as Centrex were introduced early in the No. 1 ESS life cycle.

During the 1970s, SPC intelligence was beginning to be introduced in systems whose functions were to support the network's management and maintenance. These systems, collectively known as Operations Systems (OS), were needed in order to deal with the increasing complexity of the network and the services offered to its subscribers. Since their initial introduction, the functions provided by the OSs have expanded to include every aspect of network planning, engineering, administration, and maintenance.

Beginning in 1981, network intelligence reached a new plateau when AT&T introduced the use of centralized databases to support Calling Card and 800 Service. These databases are located at network control point (NCP) systems and are accessed by SPC switches via the Common Channel Interoffice Signaling (CCIS) network. This centralized approach allows the introduction of some services that would otherwise be impractical due to the complexity of managing large amounts of volatile data at every SPC switch.

After divestiture of the Bell System, the newly formed regional companies deployed centralized databases at service control points (SCP) to support alternate billing services (ABS) and 800 calling. ABS provides calling card validation and other line information functions for collect and third-party billing. Access to the SCPs from switches is provided via Signaling System 7 (SS7) networks. The functionality in the switches, SS7 network, SCPs, and OSs that support these services is collectively known as Intelligent Network 1 (IN/1) [1].

Recognizing that there was a potentially large number of services that might be offered by expanding the IN/1 functionality, efforts were undertaken in Bellcore at the request of the regional companies, to define an architecture that could realize that potential. That effort's result was a plan for an architecture known as Intelligent Network/2 (IN/2). This architecture included a greatly expanded set of switch and SCP capabilities, known as functional components (FC), and a new system, called the intelligent peripheral (IP). The FCs defined the atomic functionality elements of the architecture and the IP provided a platform for deploying service-assistance capabilities. This architecture was intended to be capable of supporting a wide range of voice and data services, and, being telco-programmable, would facilitate rapid deployment of those services.

Based upon analyses by the regional companies and switch vendors, it was determined that IN/2 was an overly ambitious proposal which would entail unacceptably high risks and could not be implemented in a sufficiently short time frame. Atten-

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tion was then focused on designing an architecture with a subset of the IN/2 functionality which could introduce service-independent capabilities to the network within a few years. The resulting architecture, known as IN/1+, was described in Bellcore SR-NPL-001052 ("IN/1+ Network Baseline Architecture") in May 1988. Similar to IN/2, it also included the use of FCs and IPs, but they were limited to a small set of functions needed to support voiceband services.

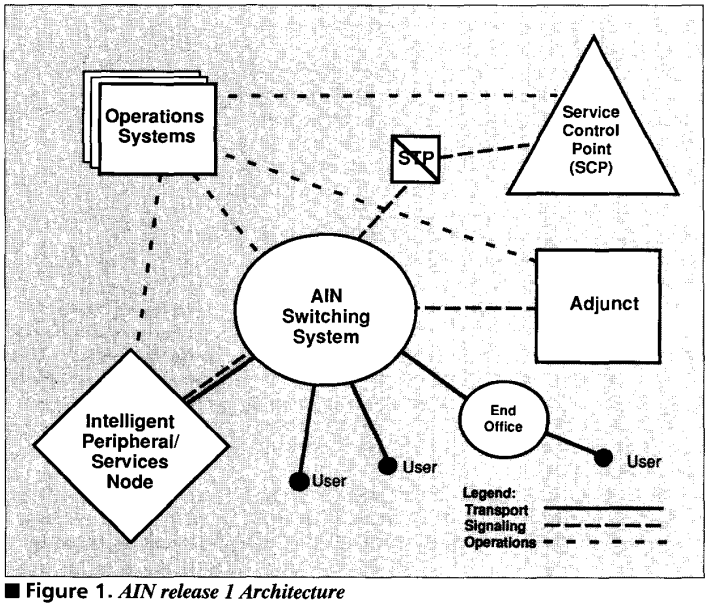
The switch vendor reactions to IN/1+ generally were supportive, but there was a growing concern that an SCP/SS7-based architecture would not be able to provide a sufficient performance level to support all the potentially desired services. There also was a perception that it would be advantageous to achieve better alignment between the IN architecture and the architectures of the network switches. Based upon these factors, it was decided to stop the IN/1+ effort and to convene a forum, called Multi-Vendor Interactions (MVI), encompassing Bellcore, the regional companies, and the vendor community, with the purpose of collecting the best ideas from all these sources to define an architecture that would meet the long-term objectives of the regional companies and have the support of the vendors.

The MVI process was initiated by Bellcore and the regional companies with a notice in the October 1988 issue of the Bellcore Digest [i]inviting participation from telecommunications switching and computer hardware and software vendors who were willing to provide significant resources to the MVI process. Sixteen vendors responded, and the MVI forum was launched at the beginning of 1989. The number of participating vendors grew quickly to 22. The technical results from the MVI process were published in March 1990 [2].

The next stage of the IN evolution begun by MVI was labeled the Advanced Intelligent Network (AIN). An evolutionary path was defined by a series of AIN releases. Each release contains additional architectural attributes and capabilities for supporting services. The initial step is AIN Release 0, which was beginning to be deployed in 1991. It is being implemented with different architectures in accordance with specifications produced independently by different regional companies. These specifications were produced in parallel with the MVI process, and thus were not based on the MVI results.

AIN Release 1, targeted for later deployment, encompasses many of the concepts from the different Release 0 architectures within a single functional architecture. AIN capabilities beyond Release 1 are in an early planning stage. They will evolve from AIN Release 1 and support an expanded range of information networking services. The MVI process addressed both the Release 1 and the post-Release 1 phases of AIN.

The following description of AIN architecture represents the present view of AIN Release 1 [3].



■ **Figure 1.** *AIN release 1 Architecture*

AIN Architecture

The AIN architecture was derived from a set of functional needs associated with the provision of voiceband telecommunications services. To support these needs, a call model that includes relevant call states and connectivity attributes was developed (see companion article on the AIN call model). The AIN call model is largely based upon results of the MVI call model work.

A primary feature of the AIN architecture is its flexibility regarding its physical realization. The physical systems and interfaces included in the AIN architecture are illustrated in Fig. 1.

Not all the systems identified as components of the AIN architecture, however, need to be deployed to provide AIN service capabilities. The decision concerning which network elements to deploy will depend on a variety of factors, including existing network characteristics and deployment plans, types of services to be deployed, and ubiquity of services to be deployed.

Although individual network implementations of AIN may vary, all share the following characteristics:

AIN services are provided through interactions between switching systems and the systems supporting AIN service logic. The switching system detects conditions for AIN service involvement (i.e., it encounters a "trigger"), formulates an AIN service request, and responds to call processing instructions from the network element in which the AIN service logic resides.

One or more vehicles for providing AIN service logic are available in the network. Depending on implementation considerations and the services to be offered, AIN service logic may be provided at a service control point (SCP), adjunct system, services node, or within a programmable platform provided at the switching system.

Methods exist to allow network interaction with users. The interaction may involve the provision of service-specific announcements to a user or the collection of digits input by a user. The participant interaction resources may reside in a switching system or may be provided by an intelligent peripheral (IP). A services node may be used to provide participant interaction capabilities and AIN service logic in a single network system.

Systems and procedures are in place supporting service negotiations, backup of customer data, trouble detection and recovery, data for traffic engineering, billing, and other operations tasks.

Each physical system in the AIN architecture shown in Fig. 1 will now be described briefly.

AIN Switching Systems

The AIN switching system [4] is the hub of the AIN architecture. The AIN switching system identifies calls associated with AIN services, detects when conditions for AIN service involvement are met, formulates requests for call processing instructions from AIN service logic, and responds to the instructions received. The call model provides a framework for formulating these requests and getting responses back from AIN service logic. (The call model is described in more detail in the appendix.)

The AIN switching system capabilities may be deployed in an access tandem, local tandem, or end office. If the AIN switching system is acting as an access tandem or local tandem, it is able to provide limited AIN services to users connected to subtending switching systems.

Switching systems which are not equipped with the AIN switching system capabilities may or may not be equipped with a Network Access Point (NAP) capability. (Although not explicitly shown in Fig. 1, the NAP capability resides in the end office shown.) Those switching systems that are NAP-equipped can provide access to certain AIN originating services for their subtending subscribers. On detecting a request for one of these AIN services, the NAP routes the call, along with the signaling information necessary to identify the calling user and the request for AIN treatment, to the AIN switching system from which it is served.

For those switching systems which are equipped with neither AIN switching system nor network access point capabilities, only AIN calls that can be detected based on existing dialed digits translation or class of service can be routed to, and recognized at, the serving AIN switching system.

Systems Supporting AIN Service Logic

The SCP [5] invokes Service Logic Programs (SLPs) [6, 7] in response to external messages received from an AIN switching system and internal messages that originate within the SCP. The Common Channel Signaling (CCS) network allows SCPs to be fully interconnected with AIN switching systems through one or more signaling transfer points (STPs). Because of this characteristic, SCPs are well-suited to support network service capabilities such as those required for 800/Freephone, area number calling or person locator services.

The adjunct has a direct communication link to an AIN switching system (as opposed to using the CCS network). Since a high-speed interface is envisioned for use between the adjunct and the AIN switching system, there may be performance considerations which make the adjunct an appropriate system for supporting services requiring quick responses to user actions (e.g., services which control provision of dial tone or which may result in reconfiguration of call connections).

The SCP and adjunct are key systems which provide the AIN programming environment allowing for rapid introduction of new subscriber services. In particular, these systems support the set of functions which define the network capabilities available for use in providing AIN services. These functions are defined in a service-independent manner so they may be used and re-used for a variety of AIN applications, as defined by the SLPs.

The services node provides access to AIN SLPs and, in the near term, the services node may be specialized to support a specific service or set of services rather than supporting the full range of network functions being defined for the SCP and adjunct. The services node communicates directly with an AIN switching system via ISDN access links. The services node, like the IP described below, supports the ability for user interaction to allow collection of dialed digits or spoken input from users, as well as provision of customized announcements to users.

Participant Interaction Systems

The intelligent peripheral (IP) [8], is a system which controls and manages resources such as voice synthesis, announcements, speech recognition, and digit collection. The AIN switching system routes a call to an IP as necessary to support the request of such resources by AIN service logic. In establishing the call connection to an IP, the AIN switching system also passes message parameters which instruct the IP to perform specific user-interaction functions. When the IP completes the requested functions, it returns any information collected from the user to AIN service logic via the AIN switching system.

In the case of a services node, the identification of the need for specific participant interaction resources and the actions required to provide the user interactions may be provided in a single system.

Operations Systems

AIN Release 1 network operations functions provide memory administration, surveillance, network testing, network traffic management, and network data collection [9]. These functions support the provisioning, maintenance, and operation of the elements of the AIN Release 1 architecture and the services that are enabled by it. The operations functions are located in the network components of the architecture, such as the switches, and in operations applications (OAs) that reside in the OSs. The functions located in the network components generally are specific to that component, whereas OAs provide functions that transcend a single network component. In many cases, the OAs will be developed as extensions to currently deployed, or replacement OSs. In other cases, however, the OAs may be in new OSs, introduced to support AIN Release 1.

Interfaces

The interfaces between AIN network elements are selected to support standard protocols: Interfaces between the switching system and SCPs or adjuncts will use the SS7 Transaction Capabilities Application Part (TCAP) as the application layer protocol [10]; ISDN interfaces will be used between the switching system and IPs or services nodes; and standard operations interfaces based on the X.25 protocol will be used for AIN. End users may access AIN services from either conventional analog or ISDN interfaces.

Service Example

We will now present an example of a service, called Portable Speed Calling List (PSCL), that could potentially be implemented using the AIN Release 1 architecture. It is given as an illustrative example, to show how the elements of the architecture could be used

The AIN switching system capabilities may be deployed in an access tandem, local tandem, or end office.

to support services. It is not implied, however, that any of the regional telephone companies are specifically planning to use AIN Release 1 to deploy PSCL.

The PSCL service can be characterized as allowing callers to use speed calling numbers, which may be one- or two-digit codes that represent complete seven- or 10-digit telephone numbers, to make calls from telephones other than their own. Each PSCL subscriber could have his/her own list of codes. To use PSCL, the caller would need to dial an access number, possibly a service code such as *55, enter a personal identification number (PIN), and the speed-calling number. To provide user friendliness, the caller could receive interruptible prompts and acknowledgments at each step.

The flow of events and actions that might take place in an AIN Release 1 implementation of PSCL are as described below. The numbers in the text refer to the communications paths shown on Fig. 2.

First, the caller dials the access code for PSCL (1). The AIN switch detects a trigger based on this access code, which causes a message to be sent to an SCP or adjunct (2) to notify it of the trigger, and to wait for subsequent processing instructions.

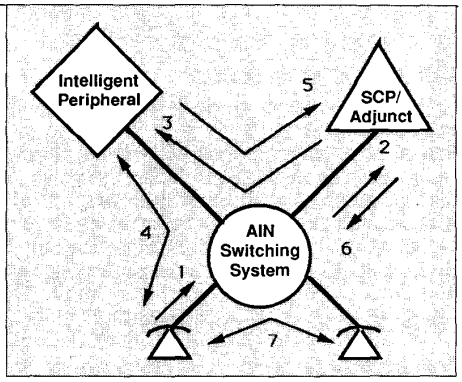
Second, the SCP/adjunct responds to the message from the AIN switch by invoking an SLP for PSCL. The PSCL SLP analyzes the information received from the AIN switch and requests the SCP/adjunct to return a message to the switch (3), instructing it to connect the caller to an intelligent peripheral (IP), and to inform the IP about the resources/procedures to be used on the call.

Third, the IP allocates resources that provide voice prompts to the caller to request that he/she enter their PIN and the speed-calling number (4). Upon receiving the information, the IP returns it in a message (5), via the AIN switch, to the PSCL SLP in the SCP/adjunct.

Lastly, the PSCL SLP validates the caller's PIN and determines the telephone number corresponding to the speed-calling number. The PSCL SLP then requests the SCP/adjunct to send a message to the AIN switch (6) directing it to set up a call from the caller to the requested number (7).

In this simple example, it is shown how the elements of the AIN Release 1 architecture can work together to implement services for telephone network users. Inevitably, an actual service design would be more complex than this example since exception conditions (such as an invalid PIN) and service management functions (such as modification of the list entries) would need to be handled. The reader, however, can easily imagine how the illustrated techniques can be utilized to provide these additional functions.

The concepts behind AIN have been evolving for more than a decade. A great deal of interaction



■ **Figure 2:** *Illustration of PSCL implementation via the AIN Release 1 architecture*

between Bellcore, the regional companies, and vendor participants has embellished these concepts, nurturing them from the speculative idea stage to a set of highly detailed specifications that provide a wide range of call processing and operations functions. We know, however, that Release 1 is not the final chapter of the AIN story. Voiceband service needs that go beyond the AIN Release 1 capabilities are already recognized. For example, to support personal communications services, additional information flows between the AIN architectural elements will be required. Broadband technology will also usher in additional functionality needs that AIN will be called upon to support. The process for managing the evolution of AIN in response to these needs is not yet defined, but it must certainly rely on the continuing cooperation and commitment of all facets of the industry.

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Appendix:

IN Call Model

The purpose of this article, which is a companion to "Perspectives on the AIN Architecture," is to provide more detailed information about the AIN Release 1 call model. It is separated from the main article because it explores details which are not necessary for a basic understanding of AIN, but which cannot be avoided when describing the AIN Release 1 call model.

The AIN Release 1 call model builds on the current call processing infrastructure of existing digital switches. The call model is comprised of two components, the basic call model (BCM) and the connection view (CV). The BCM provides a generic model of current call processing for basic two-party calls, and describes when in call processing AIN switch capabilities can be invoked. The CV describes how service logic residing in the SCP/adjunct can access these AIN switch capabilities to influence call processing in the switch.

Basic Call Model (BCM)

The BCM generically represents basic call processing in the AIN switch and when, in call processing, service logic residing in the service control point (SCP) or adjunct can receive notification of call processing events (e.g., information collected, route selected, call presented, busy, ringing timeout, etc.), so it can influence subsequent call processing in the AIN switch.

The BCM is comprised of an originating BCM (associated with the calling party) and a terminating BCM (associated with the called party), as shown in Figs. 3 and 4. The points in call (PICs) shown in the figures represent the sequence of actions the AIN switch performs at each particular point in processing a basic two-party call. The trigger check points (TCPs), also shown in the figures, identify where, in the processing of a call, service logic in the SCP/adjunct can receive notification of switch events in order to influence subsequent call processing in the AIN switch.

For example, if the AIN switch detects a trigger, it sends a message to service logic (residing in the SCP/adjunct), which may request the switch to continue processing the call as normal, to resume at a different PIC, or to manage some interactions with the user. At the completion of AIN processing, if the AIN switch then detects that a switch-based feature should be engaged, it will invoke that feature.

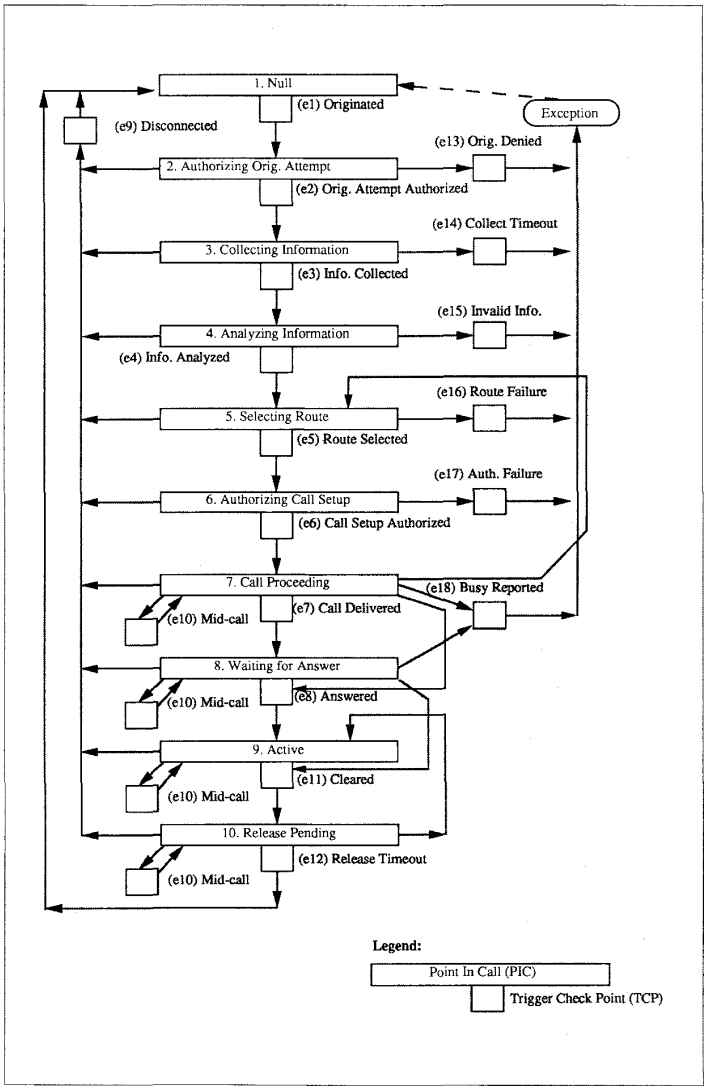
The TCPs that lead to the box labeled "Exception" model the call processing of incomplete calls and allow the SCP/adjunct to request the AIN switch to take special actions. The Exception box represents call processing that results when an exception event such as timeouts or network busy occurs.

In the originating BCM shown in Fig. 3, the PICs model three different stages of call processing: call setup (the first six PICs), stable call (PICs seven through nine), and call clearing (PIC 10). In the terminating BCM shown in Fig. 4, the PICs model the same three stages, with call setup associated with PICs 11 through 14, stable call associated with PICs 15 and 16, and call clearing associated with PIC 17.

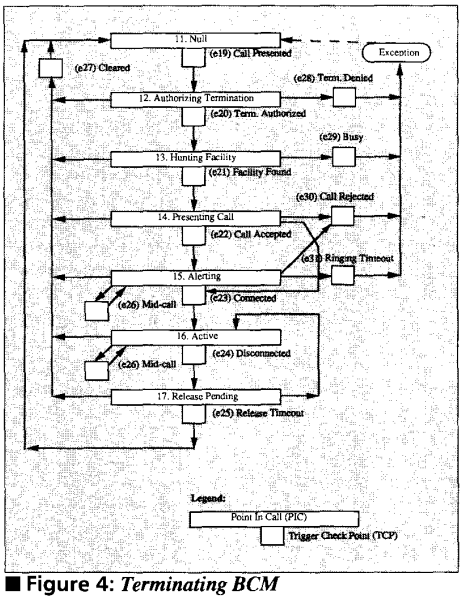
Connection View

The connection view (see Fig. 5), on the other hand, describes how service logic residing in the SCP/adjunct can access the AIN switch capabilities to influence call processing (as modeled by the BCM). It also provides a generic view of call processing resources in the AIN switch to the SCP/adjunct. This view is independent of switch vendor implementation, and represents the essential characteristics of call processing resources needed by service logic, while hiding their physical details (which may vary by vendor), and their technical complexity.

These switch characteristics include both call processing and connectivity aspects. The call processing aspects include setting up and maintaining the call (as represented by the BCM). They also include the information associated with the call, such as dialed digits, routing information, and billing information. The connectivity aspects include the communication paths to the parties involved in the call, referred to as legs, and the interconnec-



■ Figure 3. *Originating BCM*



■ **Figure 4:** *Terminating BCM*

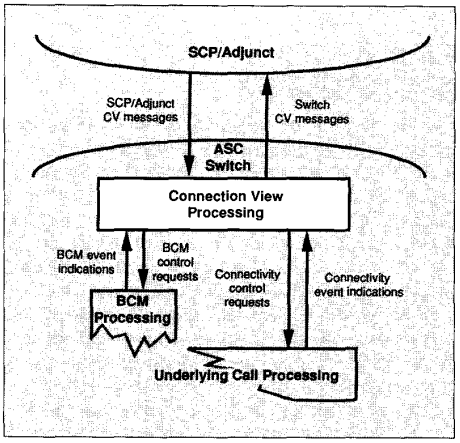
tion of these paths, referred to as a connection point.

The CV provides the ability for service logic in the SCP/adjunct to influence call processing and connectivity aspects in the switch, thereby influencing the flow of call processing (e.g., to provide serial calling or to resume call processing at specific PICs), changing call processing information (e.g., to provide address translation, alternate route selection, or alternate billing), and changing connectivity (e.g., to place parties on hold, to add a third party to the two-party call, or to conference call parties).

The particular information flows related to CV processing are highlighted in Fig. 5. Given these information flows, CV processing translates external service logic instructions (sent by a Service Logic Program in an SCP/adjunct) into operations understood by internal AIN switch call processing. Connection view processing also translates internal call processing events and the state of internal call processing resources into reports that can be understood by external service logic. With this information flow model, CV processing can be described in a generic manner without an actual implementation of AIN switch call processing.

Referring to Fig. 5, the following is a typical information flow scenario:

When a call processing event, such as information collected or route selected (TCPs e3 or e5 in



■ **Figure 5.** *Connection view information flows*

Fig. 3), occurs, BCM processing reports this event to CV processing.

When CV processing receives the indication reporting a switch event, CV processing reports the event and the state of call processing to the Service Logic Program residing in the SCP/adjunct.

Connection view processing in the switch then waits for an SCP/adjunct CV message requesting the AIN switch to perform specific actions.

When CV processing receives the SCP/adjunct CV message, it performs the operation requested in the message by sending BCM and/or connectivity control requests, as appropriate.

When these actions are successfully completed, or fail to complete, BCM processing and/or underlying call processing return BCM and/or connectivity event indications to CV processing, reporting the outcome (either success or failure) of these actions.

Based on these outcome event indications, CV processing then updates the state of call processing, and may report the outcome to the Service Logic Program.

Biography

Roger Berman received B.Sc. and M.Sc. degrees in electrical engineering from Cornell University, and an M.B.A. degree from New York University. At one time he was responsible for the Bellcore AIN Multi-Vendor Interactions and various AIN generic requirements. Mr. Berman currently is district manager at Bellcore where he is responsible for the Advanced Intelligent Network (AIN) Project Management and Standards.

John Brewster received B.Sc. and M.Sc. degrees in electrical engineering from Yale University and New York University, respectively. He was involved in network planning for the 800 Database and Alternate Billing Services of Intelligent Network/1. Currently, Mr. Brewster is a district manager at Bellcore where he is responsible for architecture and transition planning for the Advanced Intelligent Network.

(12) **United States Patent**
Baniak et al.

(10) **Patent No.: US 7,907,714 B2**
(45) **Date of Patent: *Mar. 15, 2011**

(54) **PROFILE MANAGEMENT SYSTEM INCLUDING USER INTERFACE FOR ACCESSING AND MAINTAINING PROFILE DATA OF USER SUBSCRIBED TELEPHONY SERVICES**

(75) Inventors: **Paul G. Baniak**, St. Louis, MO (US); **Kristin Chambers**, Austin, TX (US); **Katherine L. Krein**, St. Louis, MO (US); **Christopher H. Rolwes**, St. Louis, MO (US); **Terry L. Vieth**, St. Louis, MO (US); **Tracy L. Brokaw**, St. Louis, MO (US); **Mary B. Clark**, St. Louis, MO (US)

(73) Assignee: **AT&T Labs, Inc.**, Austin, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1271 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/459,121**

(22) Filed: **Jul. 21, 2006**

(65) **Prior Publication Data**

US 2007/0047714 A1 Mar. 1, 2007

Related U.S. Application Data

(63) Continuation of application No. 10/761,382, filed on Jan. 22, 2004, now Pat. No. 7,103,165, and a continuation of application No. 09/050,986, filed on Mar. 31, 1998, now abandoned.

(60) Provisional application No. 60/042,680, filed on Apr. 3, 1997.

(51) **Int. Cl.**
H04M 3/42 (2006.01)

(52) **U.S. Cl.** **379/201.02**; 379/207.13

(58) **Field of Classification Search** 379/201.01, 379/201.02, 201.12, 207.13

See application file for complete search history.

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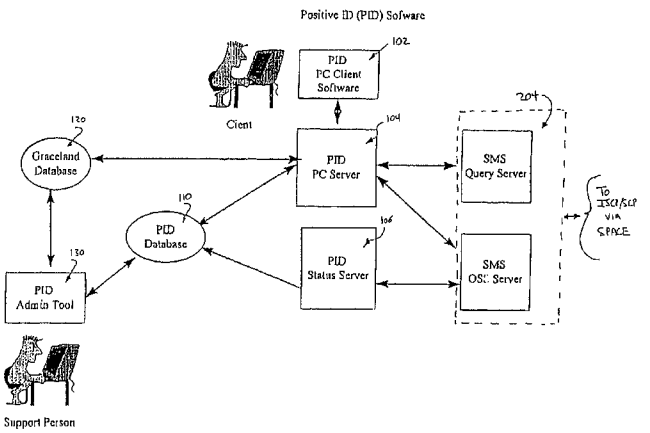
Primary Examiner — William J Deane

(74) *Attorney, Agent, or Firm* — Greenblum & Bernstein, P.L.C.

(57) **ABSTRACT**

Subscriber profile data associated with a communications service subscribed to by a subscriber is managed by a profile management system. The subscriber profile data is stored on a communications network which executes the communications service in accordance with the subscriber profile data. A subscriber request to view the subscriber profile data is received from a client which hosts a user interface configured to allow the subscriber to view and update the subscriber profile data. The subscriber profile data is retrieved from the communications network based upon receiving the subscriber request to view the subscriber profile data from the client. The subscriber profile data is forwarded to the client. A subscriber request to update the subscriber profile data is received from the client. An update for the subscriber profile data is forwarded to the communications network based upon receiving the subscriber request to update the subscriber profile data from the client.

22 Claims, 8 Drawing Sheets



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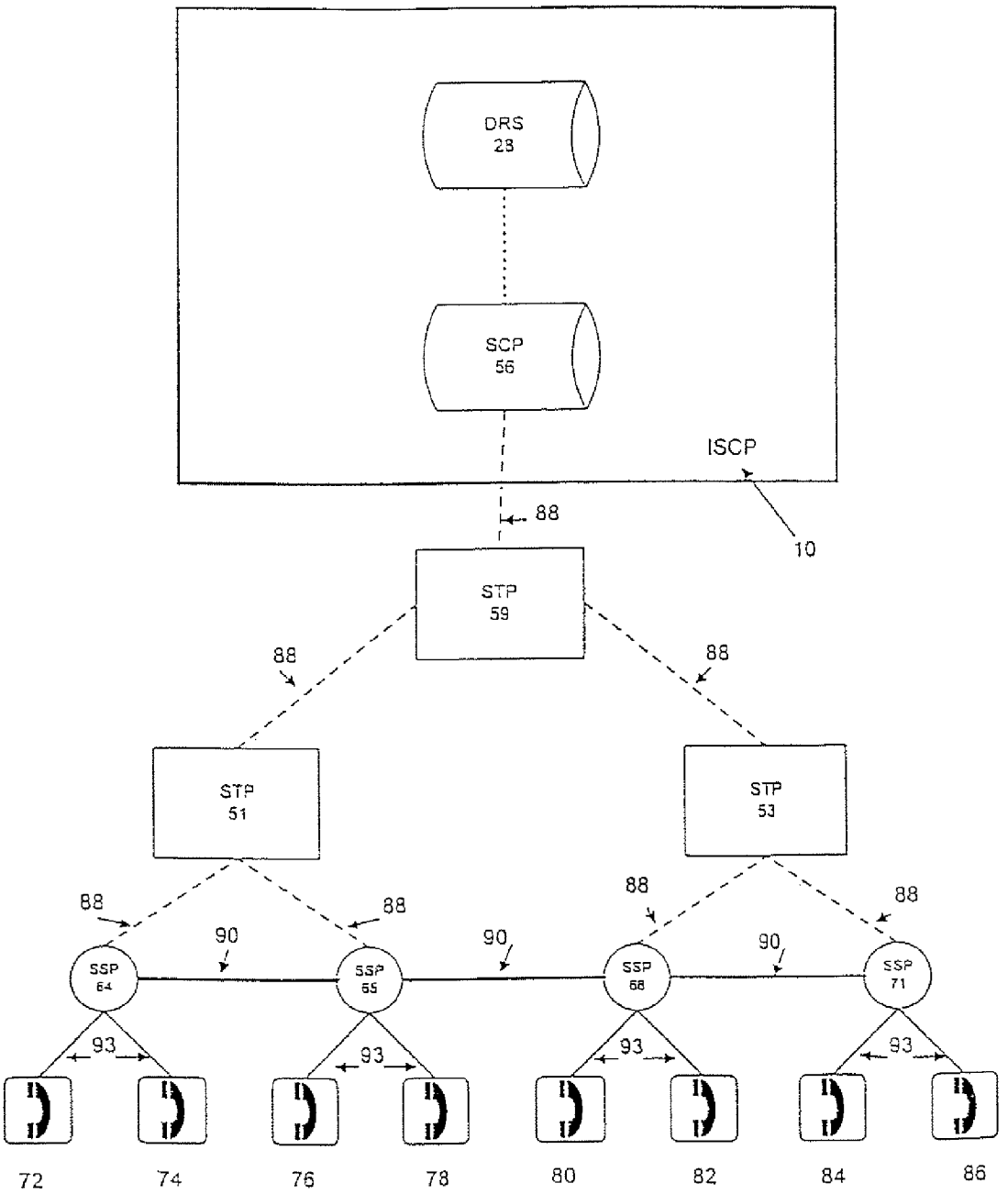

FIG. 1
(PRIOR ART)

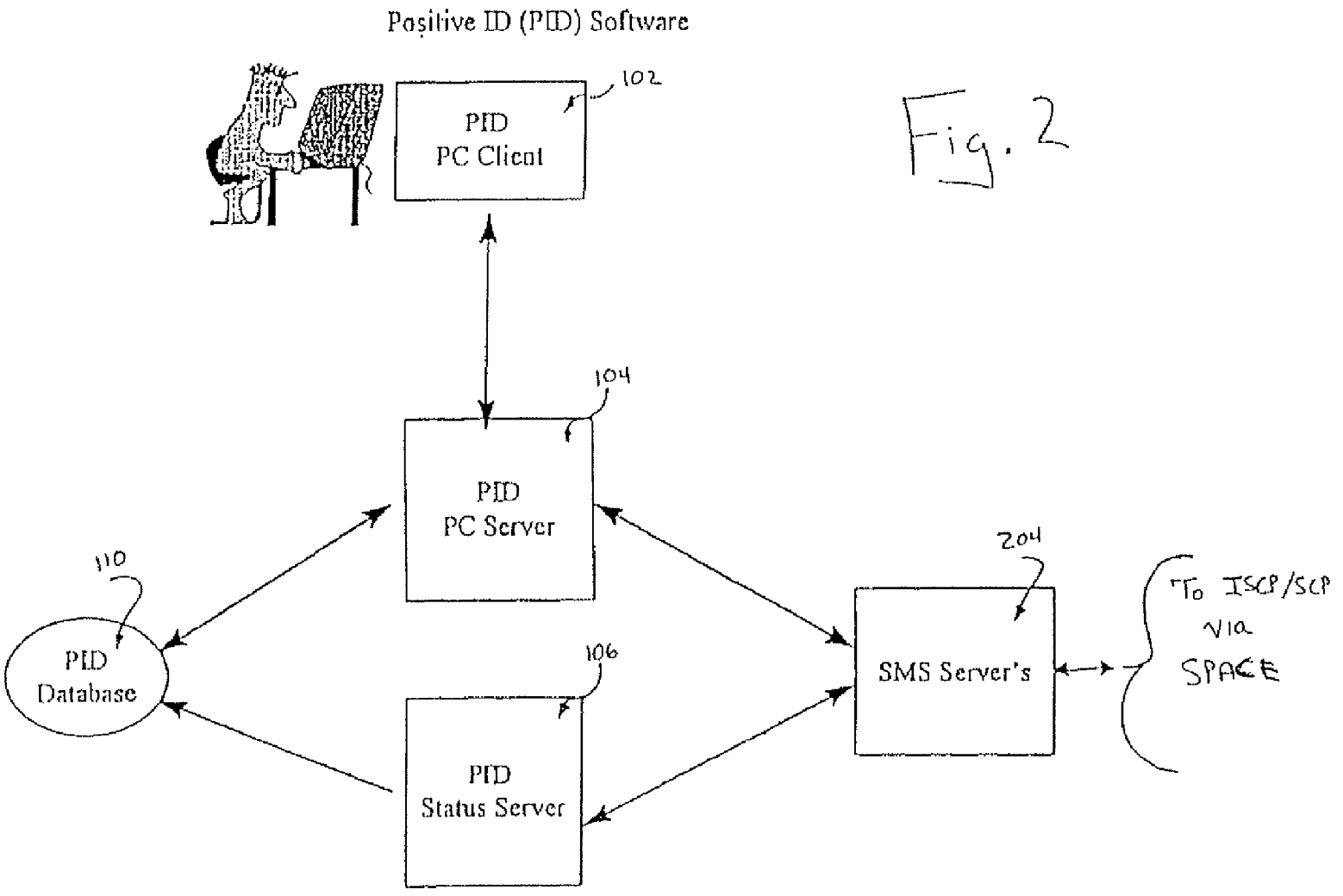
Positive ID (PID) Software
PID
PC Client
102
PID
PC Server
104
PID
Database
110
PID
Status Server
106
SMS Server's
204
To ISCP/SCP
via
SPACE

Fig. 2

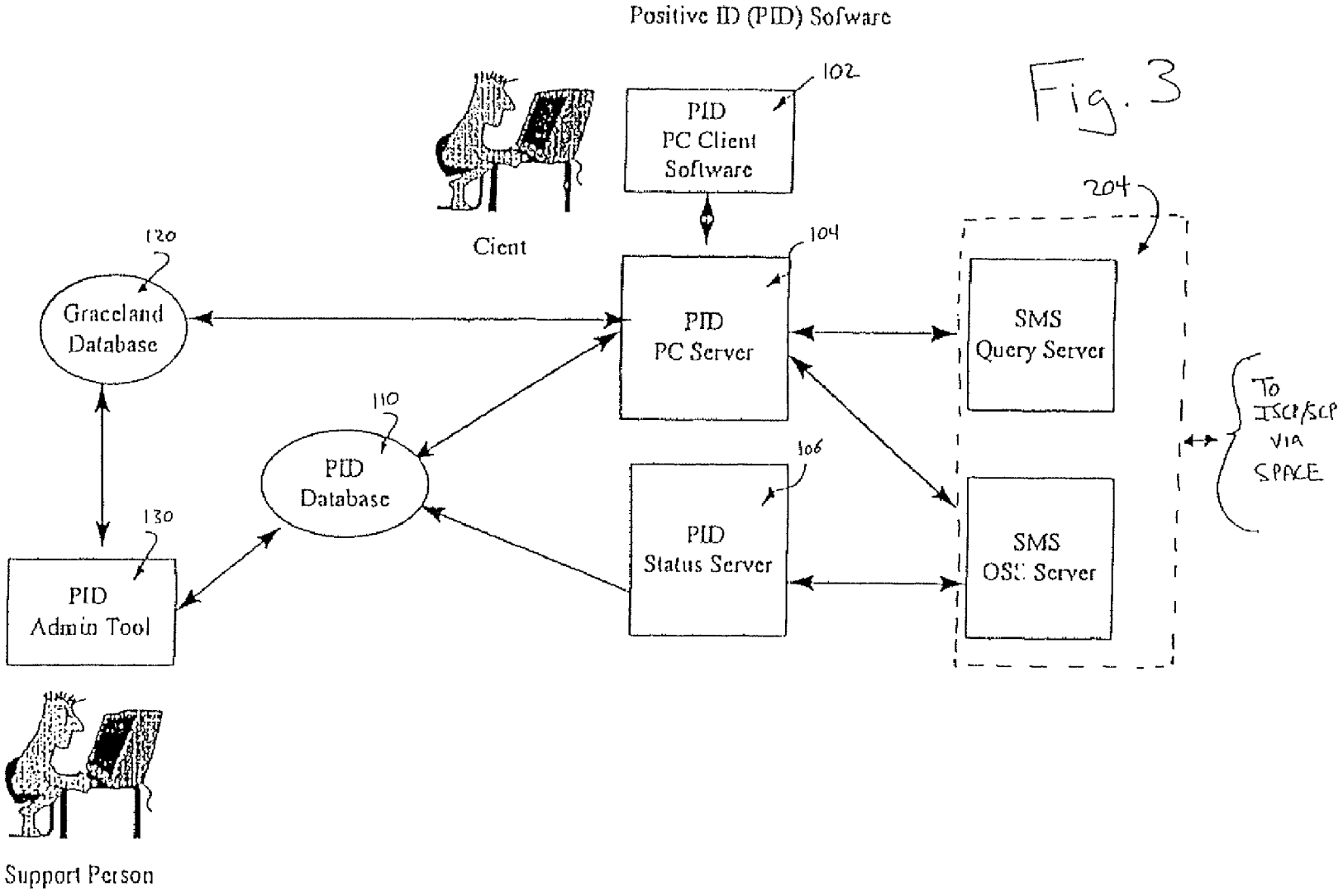
Positive ID (PID) Sofware
Fig. 3
102
PID
PC Client
Software
Client
204
120
Graceland
Database
104
PID
PC Server
SMS
Query Server
To
ISCP/SCP
VIA
SPACE
110
PID
Database
106
PID
Status Server
SMS
OSC Server
130
PID
Admin Tool
Support Person

FIG. 4

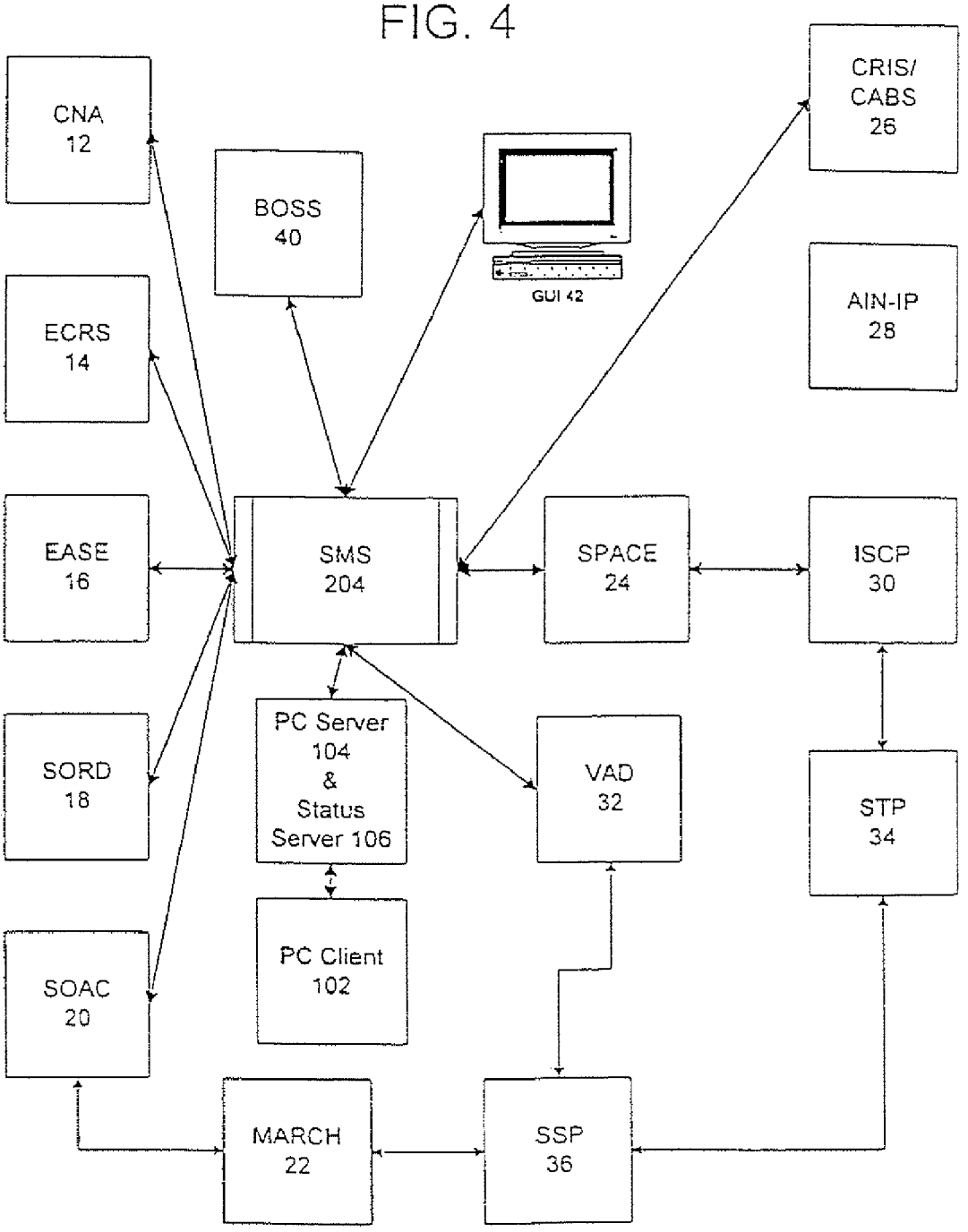
CNA
12
BOSS
40
GUI 42
CRIS/
CABS
26
ECRS
14
AIN-IP
28
EASE
16
SMS
204
SPACE
24
ISCP
30
SORD
18
PC Server
104
&
Status
Server 106
VAD
32
STP
34
PC Client
102
SOAC
20
MARCH
22
SSP
36

FIG. 5

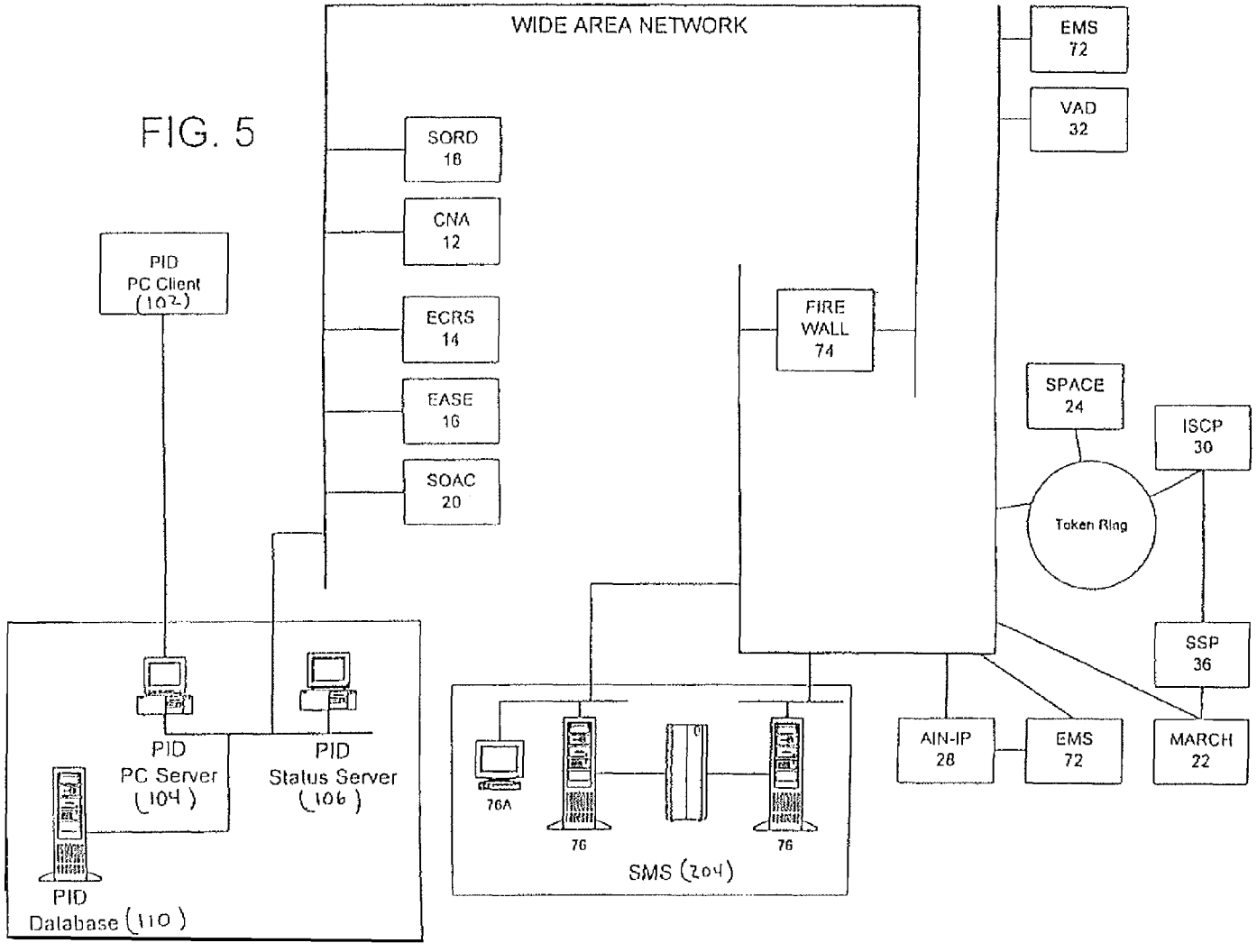
WIDE AREA NETWORK
EMS 72
VAD 32
SORD 16
CNA 12
ECRS 14
EASE 16
SOAC 20
PID PC Client (102)
FIRE WALL 74
SPACE 24
ISCP 30
Token Ring
SSP 36
MARCH 22
AIN-IP 28
EMS 72
PID PC Server (104)
PID Status Server (106)
PID Database (110)
76A
76
76
SMS (204)

FIG. 6

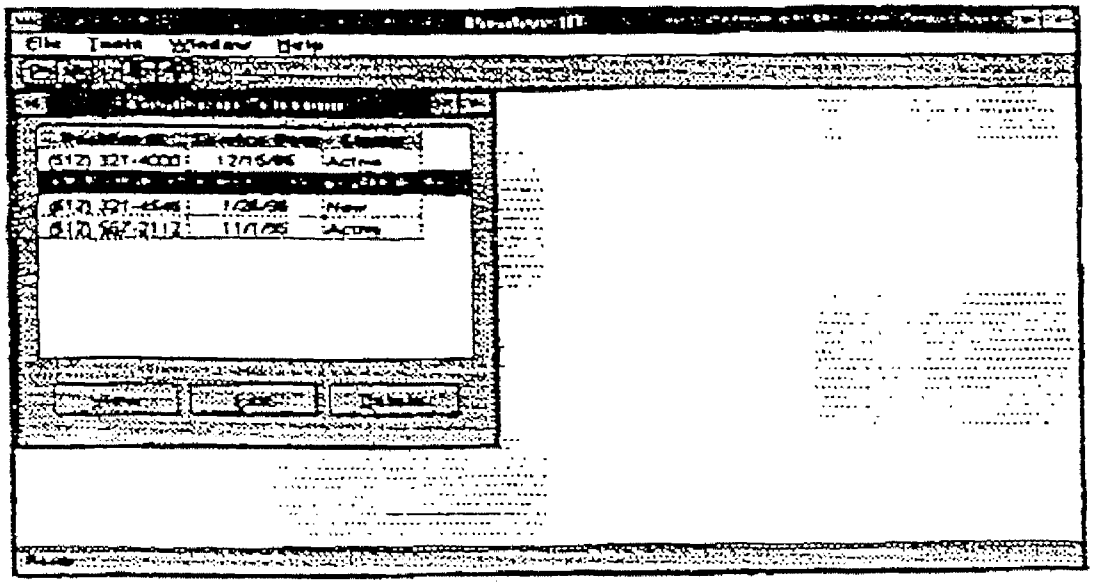

FIG. 7

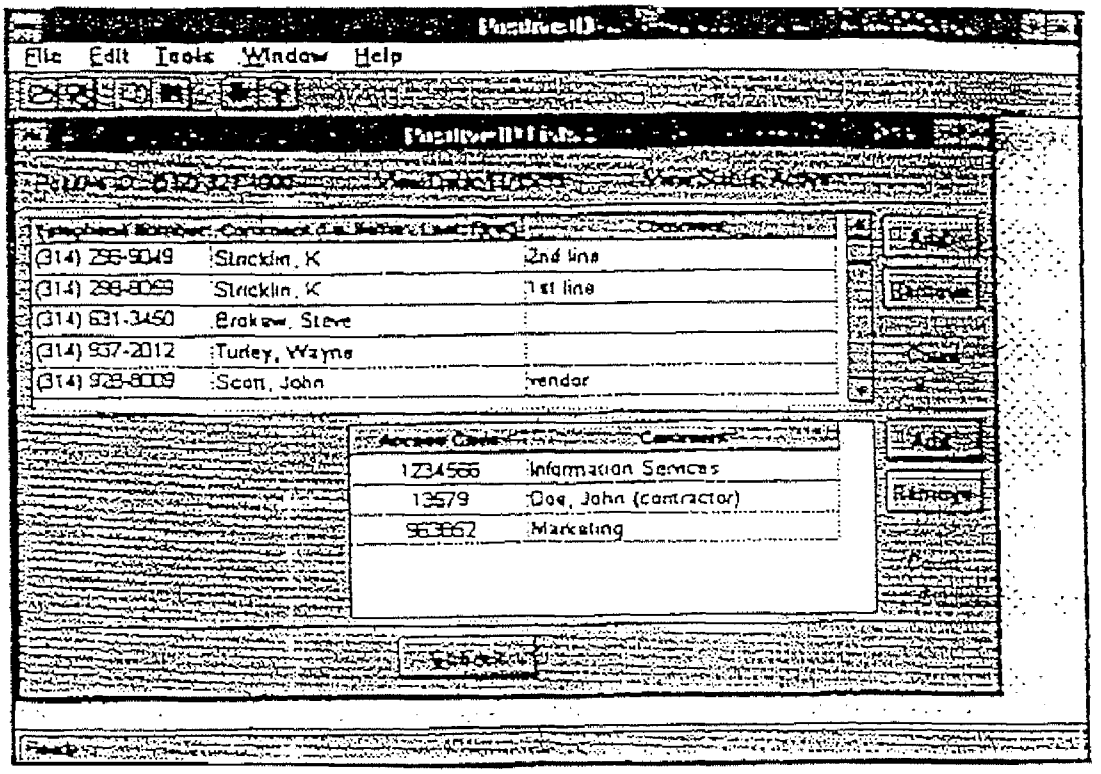
File Edit Tools Window Help
(314) 256-9049 Stricklin, K 2nd line
(314) 298-8059 Stricklin, K 1st line
(314) 631-3450 Brokaw, Steve
(314) 957-2012 Turley, Wayne
(314) 928-8009 Scott, John Vendor
1234566 Information Services
13579 Doe, John (contractor)
963662 Marketing

FIG. 8

USER ID	Positive ID Number	Activity	Date/Time	Effective Date	Status	Status Date/Time
KC1463	(314) 331-2151	Sent file	12/23/95, 08:56	1/3/96	failed	12/23/95, 09:42
KC1463	(314) 235-5000	Accessed	1/3/96, 08:30			
MT1234	(314) 235-5000	Sent file	1/3/96, 13:21	1/20/96	canceled	1/3/96, 17:35
KC1463	(314) 235-5000	Cancel send	1/3/96, 17:05	1/20/96	completed	1/3/96, 17:35
MW3344	(314) 235-6000	Sent file	1/3/96, 18:35	1/3/96	pending	

PROFILE MANAGEMENT SYSTEM INCLUDING USER INTERFACE FOR ACCESSING AND MAINTAINING PROFILE DATA OF USER SUBSCRIBED TELEPHONY SERVICES

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation application of pending U.S. patent application Ser. No. 10/761,382, filed on Jan. 22, 2004, which is a continuation of U.S. patent application Ser. No. 09/050,986, filed on Mar. 31, 1998, which claims the benefit of U.S. provisional Patent Application No. 60/042,680, filed Apr. 3, 1997, entitled "Profile Management System Including User Interface for Accessing and Maintaining Profile Data of User Subscribed Telephony Services", in the names of Baniak et al., the disclosures of which are expressly incorporated herein by reference in their entireties.

This is also related to the disclosure provided in U.S. patent application Ser. No. 08/831,892, filed Apr. 3, 1997, entitled "Apparatus and Method for Facilitating Service Management of Communications Services in a Communications Network", in the names of Larry JOST et al., the disclosure of which is expressly incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention generally relates to the field of telecommunications. More particularly, the present invention relates to a user interface, such as a personal computer (PC) interface, for accessing and maintaining profile data of a user's subscribed telephony service.

2. Acronyms

The written description provided herein contains acronyms which refer to various telecommunications services, components and techniques, as well as features relating to the present invention. Although some of these acronyms are known, use of these acronyms is not strictly standardized in the art. For purposes of the written description herein, acronyms will be defined as follows:

Advanced Intelligent Network (AIN)
Computer Access Restriction (CAR)
Common Channel Signaling (CCS)
Central Office (CO)
Calling Party Number (CPN)
Call Processing Record (CPR)
Data and Reporting System (DRS)
Integrated Service Control Point (ISCP)
Interactive Voice Response (IVR)
Local Area Network (LAN)
Personal Computer (PC)
Positive ID (PID)
Private Branch Exchange (PBX)
Service Creation Environment (SCE)
Service Control Point (SCP)
Service Order Assignment Control (SOAC)
Service Management System (SMS)
Service Provisioning And Creation Environment (SPACE)
Service Switching Point (SSP)
Signaling Transfer Point (STP)
Transaction Capabilities Applications Part (TCAP)
Transmission Control Protocol/Internet Protocol (TCP/IP)
User Interface (UI)
Wide Area Network (WAN)
Working Telephone Number (WTN)

3. Background Information

In recent years, a number of new telephony service features have been implemented and provided by an Advanced Intelligent Network (AIN). The AIN evolved out of a need to increase the capabilities of the existing telephone network architecture and meet the growing needs of telephony customers. The AIN architecture generally comprises two networks, a data messaging network and a trunked communications network. The trunked communications network handles voice and data communications between dispersed network locations, whereas the data messaging network is provided for controlling operations of the trunked communications network.

An illustration of the basic components of an AIN network environment is shown in FIG. **1**. The AIN network is provided to facilitate communication between a plurality of network locations or stations **72-86**. As shown in FIG. **1**, central offices (COs) **64-71** are provided for sending and receiving data messages from a service control point (SCP) **56** via one or more signaling transfer points (STPs) **51**, **53** and **59**. The data messages are communicated to and from the COs **64-71** and the SCP **56** along a common channel signaling (CCS) network **88**. Each CO **64-71** serves as a network service switching point (SSP) and may be equipped with CCS capabilities, which provides for the two-way communication of data messages between each SSP and the SCP **56** via CCS network **88**. These data messages may be formatted in accordance with Transaction Capabilities Applications Protocol (TCAP).

Each CO **64-71** serving as a network SSP routes AIN-service related telephone calls between a calling station (e.g., station **72**) and a called station (e.g., station **84**) based on instructions received from the SCP **56**. The SSPs **64-71** may be connected by trunked communication lines **90** to transport voice and/or data signals. Each of the stations **72-86** is connected to one or more SSPs **64-71** through private or dedicated telephone lines **93**. In AIN-type call processing, the originating SSP is responsible for: identifying calls associated with AIN services; detecting when conditions for AIN service involvement are met; formulating service requests or queries to the SCP **56** for call processing instructions; and responding to the instructions or message responses received from the SCP **56** to complete or terminate the call.

In FIG. **1**, the SCP **56** is implemented as part of an integrated service control point (ISCP) **10**. The ISCP **10** is an integrated system which may include a programmable SCP **56** and a data and reporting system (DRS) **28**. The SCP **56** executes software or programmed-based logic, in accordance with a subscriber's call processing record (CPR), and returns call routing instructions to the SSPs. The DRS **28** compiles calling information to be used for billing and administrative purposes. A service creation environment (SCE) (not shown) may also be provided for programming and provisioning the CPRs stored in the database of the SCP **56**. The CPRs define the services for each individual subscriber. The SCE may be integrated with the ISCP **10** or provided as a separate application or entity. By way of a non-limiting example, the ISCP **10** may be implemented with a Bellcore integrated service control point (ISCP) available from Bell Communications Research (Bellcore), Murray Hill, N.J., and the SCE may be implemented with SPACE, which is also available from Bellcore. SPACE is a service provisioning and creation environment. SPACE stores a copy of the data in the ISCP and is the network element used for data queries and management by the selected users which have access to it. The users do not access the ISCP directly because direct access would interfere with call processing by performing data manipulations on the same platform. Updates made through SPACE are

input into the ISCP immediately. The service order assignment control (SOAC) system receives all service order activity from service personnel and forwards the service orders to the SMS.

For additional information regarding AIN and AIN-related network environments, see Berman, Roger K., and Brewster, John H., "Perspectives on the AIN Architecture," IEEE Communications Magazine, February 1992, pp. 27-32, the disclosure of which is expressly incorporated herein by reference in its entirety.

A number of services have been provided by AIN or AIN-type intelligent networks to provide specialized call processing of incoming calls and detailed call information. Services such as call routing, call forwarding and call logging have been provided by AIN or AIN-type networks. Service activation of a particular AIN service is normally accomplished by service personnel who receive a service order from a customer, and then provision or create the CPR that is unique for each working telephone number (WTN) in the SCP or ISCP. Each customer's CPR contains subscriber or profile data which control and/or define the service features and parameters associated with the AIN service subscribed to by the customer. Modification to a customer's CPR may be performed by service personnel based on requests received from the customer (e.g., by a formal written submission for service modification or via telephone interaction with service personnel). For more "simple" AIN services (i.e., AIN services that are based on very few or limited service parameters), automated modification systems and methods have also been provided to permit a customer or user to modify their service profile data via a telephone connection and touch tone dialing or Dual Tone Multi Frequency (DTMF) response.

An example of such a simple AIN service is selective call acceptance which was deployed in Wichita, Kans. in 1994. Selective call acceptance allows residential and small business customers to provide a screening list of 50 authorized telephone numbers and one access code in order to allow people calling from one of the authorized numbers or with the access code to connect to the subscriber's working telephone number. If an unauthorized caller calls the subscriber's working telephone number, the unauthorized caller can be routed to an alternative location if desired, for example, a voice mailbox. When the subscriber chooses to modify the authorized numbers and/or access code, the subscriber either contacts service personnel or modifies their service profile data via DTMF.

While such prior systems have been provided, the ability for a customer to freely access and maintain their service profile data has been limited. Prior attempts have relied upon the involvement of service personnel or have limited a customers ability to access and modify their service profile data. DTMF-based interfaces have also not provided an efficient or user-friendly system by which customers may review and revise their service profile data. Further, for more "complex" AIN-based services (i.e., AIN services based on a large number of service parameters or including more complex sets or groups of service parameters) such prior attempts have not provided an effective solution for automated service management and maintenance. Thus, there is currently a need for an interface permitting users to freely access and maintain their service profile data. A need also exists for a user interface permitting a user to review and update their data for services, such as AIN-based services, through a computer-based interface without requiring the involvement of or interaction with service personnel.

SUMMARY OF THE INVENTION

In view of the above, the present invention, through one or more of its various aspects and/or embodiments is thus presented to accomplish one or more objectives and advantages, such as those noted below.

A general object of the present invention is to provide a profile management system having a user interface that provides the ability for a customer to freely access and maintain their service profile data.

Another object of the invention is to provide a profile management system for AIN-based services. A further object of the invention is to provide such a system that does not rely upon the involvement of service personnel to permit a user to access and modify their AIN service profile data.

Still another object of the invention is to provide a profile management system that provides an efficient and user-friendly manner by which customers may review and revise their service profile data.

Yet another object of the invention is to provide a profile management system for more "complex" services (e.g., AIN services based on a large number of service parameters or including more complex sets or groups of service parameters), that permits a user to more effectively access and maintain their profile data for such a complex service.

Another object of the invention is to provide a profile management system that includes a user interface that permits a customer to review and update their profile data for services, such as AIN-based services, through a computer-based interface.

A profile management system is provided for accessing and maintaining profile data associated with a telecommunications service subscribed to by a user. The profile data is stored on a telecommunications network which executes the telecommunications service subscribed to by the user in accordance with the profile data. The profile management system includes a client and a server. The client hosts a user interface allowing the user to view and update the profile data. The server processes user requests from the client to view and update the profile data by obtaining the profile data from the telecommunications network and forwarding the profile data to the client. The server also processes user requests from the client to update the profile data by forwarding user updates of the profile data from the client to the telecommunications network. As a result of the profile management system, the user can access and maintain the profile data associated with the telecommunications service subscribed to by the user without involving service personnel.

In a preferred embodiment, the user interface is a graphical user interface, the telecommunications service is positive identification, and the profile data includes access codes and authorized telephone numbers. Moreover when a calling party calls the user, the calling party is only successfully connected to the user if either the calling party's telephone number is one of the authorized telephone numbers or the calling party inputs one of the access codes. If the calling party is not successfully connected to the user, the calling party hears a prerecorded message and is subsequently disconnected. A reporting system may also be provided which generates reports detailing calling parties attempting to connect to the user. The report may also indicate each calling party successfully connected to the user, and each calling party not successfully connected to the user.

According to another preferred embodiment, the profile management system also includes an access control system which only allows authorized users to access and maintain the profile data. Furthermore, the user may specify a time when

the server will forward the user updates from the client to the telecommunications network. The profile management system may also include a DTMF system for accessing and maintaining the profile data.

According to another embodiment, a profile management system is provided for accessing and maintaining profile data associated with a telecommunications service subscribed to by a user. The profile management system includes a server, a client and a telecommunications network. The client hosts a user interface allowing the user to view and update the profile data. The telecommunications network stores the profile data and executes the telecommunications service subscribed to by the user in accordance with the profile data. The server processes user requests from the client to view and update the profile data by obtaining the profile data from the telecommunications network and forwarding the profile data to the client. The server also processes user requests from the client to update the profile data by forwarding user updates of the profile data from the client to the telecommunications network. As a result of the profile management system the user can access and maintain the profile data associated with the telecommunications service subscribed to by the user without involving service personnel.

In a preferred embodiment, the user interface is a graphical user interface, the telecommunications service is positive identification, and the profile data includes access codes and authorized telephone numbers. Moreover when a calling party calls the user, the calling party is only successfully connected to the user if either the calling party's telephone number is one of the authorized telephone numbers or the calling party inputs one of the access codes. If the calling party is not successfully connected to the user, the calling party hears a prerecorded message and is subsequently disconnected.

According to another embodiment, a profile management system is provided for accessing and maintaining profile data associated with an AIN service subscribed to by a user. The profile management system includes a server, client and an AIN network. The client hosts a user interface allowing the user to view and update the profile data. The AIN network stores the profile data and executes the AIN service subscribed to by the user in accordance with the profile data. The server processes user requests from the client to view and update the profile data by obtaining the profile data from the AIN network and forwarding the profile data to the client. The server also processes user requests from the client to update the profile data by forwarding user updates of the profile data from the client to the AIN network. As a result of the profile management system the user can access and maintain the profile data associated with the AIN service subscribed to by the user without involving service personnel.

In a preferred embodiment, the user interface is a graphical user interface, the AIN service is positive identification, and the profile data includes access codes and authorized telephone numbers. Moreover when a calling party calls the user, the calling party is only successfully connected to the user if either the calling party's telephone number is one of the authorized telephone numbers or the calling party inputs one of the access codes. If the calling party is not successfully connected to the user, the calling party hears a prerecorded message and is subsequently disconnected.

According to another preferred embodiment, a profile management system is provided for accessing and maintaining profile data associated with a telecommunications service subscribed to by a user. The profile management system includes a client and a server. The client hosts a user interface allowing the user to view and update the profile data. The server stores the profile data and executes the telecommunications service subscribed to by the user in accordance with the profile data. The server processes user requests from the client to view and update the profile data by forwarding the profile data to the client. The server processes user requests from the client to update the profile data by replacing the stored profile data with user updates of the profile data received from the client. As a result of the profile management system, the user can access and maintain the profile data associated with the telecommunications service subscribed to by the user without involving service personnel.

According to another preferred embodiment, a method is provided for accessing and maintaining profile data associated with a telecommunications service subscribed to by a user. The method includes remotely logging into a server, from a client; viewing the profile data associated with the telecommunications service subscribed to by the user; and if desired, updating the profile data. As a result of the method, the user can access and maintain the profile data associated with the telecommunications service subscribed to by the user without involving service personnel.

The above-listed and other objects, features and advantages of the present invention will be more fully set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is further described in the detailed description which follows, by reference to the noted plurality of drawings by way of non-limiting examples of preferred embodiments of the present invention, in which like reference numerals represent similar parts throughout the several views of the drawings, and wherein:

FIG. **1** illustrates the components of a conventional Advanced Intelligent Network (AIN) network environment;

FIG. **2** illustrates, in block diagram form, an exemplary system architecture for implementing the various features and aspect of the present invention;

FIG. **3** illustrates, in block diagram form, another exemplary system architecture for implementing the features of the present invention;

FIG. **4** illustrates yet another exemplary system architecture and environment for implementing the present invention;

FIG. **5** illustrates a further exemplary system architecture and environment for implementing the features of the present invention;

FIG. **6** illustrates a list of Positive ID numbers and their status as displayed by an exemplary user interface according to an aspect of the present invention;

FIG. **7** illustrates an authorized telephone number table and access code table as displayed by an exemplary user interface according to an aspect of the present invention; and

FIG. **8** shows an activity log according to an aspect of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the accompanying drawings, a detailed description of preferred embodiments, features and aspects of the present invention will be provided.

The present invention relates to a profile management system having a user interface, such as a personal computer (PC) interface, for accessing and maintaining profile data of a user's subscribed telephony service. The telephony service may be a AIN-based service that includes profile data which control and/or define the service features and parameters

associated with the AIN service subscribed to by the customer. Through the user interface of the present invention, a customer may freely access, maintain and modify their service profile data without the involvement of or interaction with service personnel. The present invention also provides the ability to selectively access and maintain complex service profile data with a user-friendly and effective interface. When the interface is implemented with a PC interface, one or more display screens may be provided to display the customer's profile data, and to permit a user to build and maintain their data.

The various features and aspects of the present invention are disclosed herein with reference to a particular AIN-based service, which is referred to as "Positive ID (PID)" or "Computer Access Restriction (CAR)" herein. Although the present disclosure describes a particular implementation of the present invention with respect to the PID service, the scope of the invention is not limited to this implementation and the various features and aspects of the invention may be adapted for other AIN-based services or telephony. Changes may be made, within the purview of the disclosure, as presently stated, without departing from the scope and spirit of the invention in its various aspects. Further, although the invention has been described herein with reference to particular means, materials and embodiments, the invention is not intended to be limited to the particulars disclosed herein; rather, the invention extends to all functionally equivalent structures, methods and uses.

As disclosed herein, PID is an AIN-based service that permits a user to control access to their telephone or private line. PID may be used to restricts phone line access to computer systems or other proprietary systems (e.g., PBXs, etc.) of a subscriber. According to one aspect of PID, a screening list of authorized calling party numbers (CPNs) is stored at an ISCP or SCP. When a call is placed to a subscriber's working telephone number (WTN) (e.g., the number of the phone line used to access the subscriber's computer system), an AIN query is launched to the SCP by the serving or originating SSP in order to determine whether the calling party is authorized to access the subscriber's system. Authorization is confirmed when the number of the calling party is located in the screening list of authorized CPNs. If the calling party is not authorized, a denial message may be played back to indicate that access has been restricted. A screening list of override access codes may also be stored in the SCP, to permit employees or other calling parties who are calling from an unauthorized phone number to override the rejection and gain access by entering one of the access codes contained in the screening list.

In accordance with an aspect of the invention, a profile management system may be provided as a tool to PID customers for building and maintaining their profile data, including their lists of authorized telephone numbers and access codes associated with their PID-equipped lines. The user interface of the invention may comprise a PC interface including client software which allows a user to access a secured server of the PID service provider, which will accept changes made by a user through the PC interface. These changes may include revisions to a customer's list that are sent to the AIN network that screens the PID customer's incoming calls. According to an aspect of the invention, the server may also automatically track log-on activity to a customer's account and provide reports so that a user can verify that only authorized individuals have accessed their WTN.

FIG. **2** illustrates in block diagram form an exemplary system architecture for implementing the present invention. The profile management system of the present invention may include a PID PC client **102** that serves as a PC interface for the PID user or subscriber. Although FIG. **2** depicts a single PID PC client **102**, a plurality of PID PC clients may be provided for each AIN-service based user and/or depending on the number of users accommodated by the profile management system of the invention. The PID PC client **102** may comprise PID client software residing on a micro-processor based system or personal computer platform such as an IBM PC or compatible, preferably operating in a Microsoft Windows environment. The PID client software may be programmed with a high level programming language, such as PowerBuilder available from Sybase, Inc. of Emeryville, Calif. and provides various display windows or screens for facilitating the building and maintenance of the user's profile data. A detailed description of the functions and operations performed by the PID client software is provided below.

The PID PC client **102** may include a modem for dialing and accessing a PID PC server **104** through a dedicated/private line or network using, for example, the TCP/IP protocol. Messaging middleware such as "DATAGATE" (which is a message based software application available from Southwestern Bell Telephone Co.) may be utilized by the PID PC client **102** to send and receive messages and information to the PID PC server **104**. Although FIG. **2** only depicts one PID PC server, depending on the number of users and system capacity, one or more PID PC servers may be provided that each serve a plurality of PID PC clients. The PID PC client **102** may communicate with the PID PC server **104** to obtain a list of the PID WTNs a user is entitled to work with, and to obtain the detailed information associated with each PID WTN, including the authorized telephone numbers and access codes for user maintenance, e.g., updating the tables.

The PID PC server **104** may comprise an application service to handle the PID client connections and communicates with a Service Management System (SMS) Server **204** to obtain profile data on behalf of subscribers and also to submit subscriber orders. The PID PC server **104** may be implemented with a UNIX-based mainframe or other type of computer, utilizing threads and software programmed in a high level programming language such as C++. The PID PC server **104** may access and interact with the SMS Server **204** via a suitable communication channel or network connections (e.g., a dedicated line, local area network (LAN) or wide area network (WAN)) using TCP/IP and messaging middleware such as "DATAGATE". The SMS Server **204** may be implemented with a UNIX-based mainframe or computer (e.g., a SPARC Center 2000 with a Solaria operating system), and sends information to and receives information from an ISCP or SCP via a service creation environment (SCE) such as SPACE. A more detailed description of the various features of the SMS Server **204** may be found in U.S. patent application Ser. No. 08/831,892 filed Apr. 3, 1997, entitled "Apparatus and Method for Facilitating Service Management of Communications Services in a Communications Network", in the names of Larry JOST et al.

As further shown in the embodiment of FIG. **2**, the profile management system of the invention may also include a PID status server **106** and PID database **110**. The PID status server **106** may comprise an application service to handle asynchronous acknowledgments of client order completion and new PID order notifications from the SMS Server **204**. The detailed profile data for each Positive ID WTN (i.e., the authorized telephone number list and access codes) may be simultaneously stored by the SMS server **204** and in the database of the ISCP or SCP. The SMS server **204** keeps a duplicate of the

profile data stored in the ISCP to facilitate update and modification of a user's profile data and to provide a backup in case of system failure or outage.

The PID database **110** may store additional data required by the profile management system of the present invention. For example, the PID database **100** stores information relating to orders for new service including the order status and may be used to check all activity on a service order, including creation and cancellation. Furthermore, the PID database **100** may store indicators showing whether a specific user has access to a positive ID number or is locked from access for a positive ID number.

The PID status server **106** may be implemented with a UNIX-based mainframe or computer, utilizing threads and software programmed with a high level programming language such as C++. The PID status server **106** may access and interact with the SMS Server **204** via suitable communication channels or network connections (e.g., a dedicated line, local area network (LAN) or wide area network (WAN)) using TCP/IP and messaging middleware such as "DATAGATE". The PID database **110** may be implemented with a suitable storage device or as part of the memory of a UNIX-based mainframe or computer system. It is also possible that several of the main components of the profile management system, including the PID PC server, the PID status server and the PID database are implemented on a single mainframe or computer system (such as a UNIX-based mainframe).

The user interface is now described with reference to FIGS. **6** and **7**. Initially, the user logs onto the PID PC server **104** from the PID PC client **102**. In a preferred embodiment, the log-in is password controlled. After the user ID and password is verified, a screen similar to that shown in FIG. **6** will appear. FIG. **6** shows all working telephone numbers associated with the user's password and user ID. Then, a user may select one of the WTNs to view, edit or delete. The screen shown in FIG. **6** also indicates a status of each WTN. If the WTN is shown as ACTIVE, the date in the second column indicates the date the current profile data was put into service to restrict calls. When a WTN is active, the view and edit button are available, whereas the delete button is unavailable. Viewing the ACTIVE status tables is particularly important when trying to establish if an authorized person's telephone number is, in fact, on the table and also whether a given access code is valid.

If the status column for a WTN indicates PENDING, then a file containing authorized telephone numbers and access codes has been created with changes in it, but those changes have not yet become effective. Pending files can be created for immediate processing or with an effective date some time in the future, which the user may select. A pending file can also be deleted, which will completely eliminate the submitted file. When a pending file is deleted, a new pending file can be created by editing an active WTN. The status of a WTN is shown as NEW from the time that the Positive ID service is ordered until the service establishment date passes.

To select a PID WTN for editing or viewing, the user highlights a desired WTN and presses the edit or view button as shown in FIG. **6**. In a preferred embodiment, the screen shown in FIG. **7** will then appear displaying both the authorized telephone number and access code tables. The authorized telephone number table stores the authorized telephone number in the first column, and comments in the second and third columns. Typically, the second column will store the name of the person associated with the authorized telephone number. The second comment column (third column in FIG. **7**) may be used, for example, to indicate a department associated with the authorized telephone number.

According to a preferred embodiment, both tables can be sorted to provide ease in analyzing the information. By double clicking on any column heading, the data will be sorted by the information in that column in ascending order. For example, by double clicking on the column storing authorized telephone numbers, the authorized telephone number table will be sorted in ascending order by authorized telephone number. By double clicking on the comments field, the authorized telephone number table will be alphabetically sorted by the data in the comments field, e.g., by name.

In a preferred embodiment, the authorized number table stores up to 500 numbers, although any other maximum number of authorized telephone numbers can be utilized depending on available storage capacity. Preferably, the authorized telephone numbers are stored in the area code—telephone number format, which is 10 digits in length. By pressing the add button when editing the authorized telephone numbers table, the user may insert a new authorized telephone number into the table. By highlighting an authorized telephone number and pressing the remove button, the user may delete an authorized telephone number from the table.

In a preferred embodiment, the access code table is limited to 100 entries, although any other number may be used depending on available system storage. In a preferred embodiment, the access codes are 4 to 7 digits in length. As shown in FIG. **7**, the access code table contains one comment field for information, such as the department, associated with each access code. An access code can be added and deleted in the same manner as the authorized telephone number is added and deleted.

Referring back to FIG. **6**, when a PID WTN shows a NEW status, no tables exist for that WTN. However, a user may view and edit the unpopulated tables. New tables associated with the NEW WTN can be created by pushing the edit button. Pushing the edit button creates a pending version of the tables that may be submitted to the SMS server **204** when editing is completed. If the PID WTN number is shown as ACTIVE, no pending file exists for that WTN. However, a user may view the file (storing the tables) currently restricting access to the WTN and may create a new file. After the user creates a new file by completing editing of the file, the WTN will show PENDING status. If another user is editing a WTN's tables, then the tables can only be viewed (not edited), because only one pending file can exist for each PID WTN.

If a PID WTN has a PENDING status, a file has been created with changes to the table associated with that PID WTN and the file has been submitted, but the changes have not yet become effective. In a preferred embodiment each PID WTN is permitted one pending file. The pending file can be edited, but the edited version will replace the existing pending file. The pending file can also be deleted, which will completely eliminate the submitted file. When a pending file is deleted, a new pending file can be created by editing the new or active PID WTN. Moreover, when a PID WTN is PENDING, the user may elect to view either the active file, or the pending file. In other words, the user may view the file currently controlling access to the PID WTN, or the file scheduled to control access when it becomes effective.

In a preferred embodiment, when submitting files to the SMS server **204**, an effective date of the submitted file must be selected. Selecting an effective date in the future allows updates to the tables to be made in advance of when the file is actually needed. For example, if a new employee is joining a group in a week, the file could be updated and submitted, but not be made effective until the next week when the employee is part of the group.

Once the user selects a PID WTN to view or edit, the PID PC server **104** launches a query to the SMS server **204** to retrieve the tables (authorized telephone number table and access code table) associated with that PID WTN. The PID PC server **104** also locks the PID WTN, so that no other user can access the tables for editing purposes, until the initial user has completed working with the tables.

In a preferred embodiment, the authorized telephone numbers field and comments fields of the authorized telephone numbers table are stored by the SMS server **204**, but the comment fields is stripped off prior to the SMS server **204** sending the message to SPACE. Consequently, if the user only changes information in the comments field, the PID PC client **102** sends a message to the PID PC server **104** indicating that only comments have changed. The PID PC server **104** then sends only the comments field to the SMS server **204** and will mark the change as local only. The local indication tells the SMS server **204** that the update should not be sent onward to SPACE and the ISCP, but should be saved within the SMS server **204**.

A detailed description of exemplary interactions between the various main components of the profile management system (i.e., the PID PC Client, the PID PC Server, the PID Status Server, and the PID Database) is now provided. The messaging between the various components is facilitated with messaging middleware such as DATAGATE. First, the messages between the PID PC client **102** and the PID PC server **104** are described.

In a preferred embodiment, the connection between the PID PC client **102** and the PID PC server **104** is via TCP/IP using either a dial up connection or a dedicated line. Initially, the PC client may initiate a log in request by transmitting the user ID and password to the PC server. The PC server responds by accepting the log in or rejecting the log in. The PC client may also initiate a request to change a password to which the PC client responds by either accepting or rejecting the request.

Another possible transaction between the PC client and PC server is retrieving the list of PID WTNs the user has access to, along with information about all pending activities to be performed on each PID WTN. Upon receipt of the PID WTN information, the user interface on the PC client displays the information in a manner similar to that shown in FIG. **6**. For a new PID WTN not yet established, which the user has yet to submit tables for, the PC server assigns a NEW status for this PID WTN.

Another possible transaction between the PC server and PC client is retrieving the authorized telephone number table and access code table associated with a specific PID WTN. As described above, the user may view the active or pending files. The PC server's response to the PC client's requests includes a read-only data structure if another user is currently working with the PID WTN's pending file i.e., the file is locked, or if the active file is requested. Note, a user may lock a PID WTN that has a pending file, if the user is requesting the pending file. However, if the user is requesting the active view, the lock will be rejected.

Another possible transaction between the PC client and PC server is modifying the authorized telephone number table and the access code table associated with the PID WTN. The PC server responds to the request with either a success or failure indication.

Another set of possible transactions between the PC server and PC client is establishing and releasing a user's lock on a PID WTN's file. Establishing the user's lock locks the PID WTN's file from write access by other users. In other words, a lock prevents any other user from editing the tables associated with the PID WTN. When a user requests a view of a pending PID WTN file, the PC server locks the pending PID WTN's file, preventing any other user from submitting modifications to the PID WTN's file. The release lock transaction may be used to unlock the PID WTN's file. The release lock request is sent by the user interface on the PC client when a user has exited the PID edit screen.

A cancel pending request transaction is also possible between the PC client and the PC server. The cancel pending request transaction allows a user to cancel a pending request against the PID WTN. In a preferred embodiment, the user selects a specific file for canceling or a file assigned to a specific pending date. After canceling a pending request on a PID WTN, the user interface may allow the user to edit the pending view (retrieved prior to the cancellation) and resubmit the request. A user must obtain a lock on the PID WTN after performing the cancel. Cancellation of a pending file for a PID WTN that is locked is prohibited, unless the file is being canceled by the user holding the lock.

An additional PC client to PC server interaction is for status log requests a status log request transaction retrieves the status log history of a specified PID WTN, or all PID WTNs associated with a user. If a PID WTN is specified in the request, then the log for that PID WTN is returned. Otherwise, the log for all the PID WTNs associated with the user are returned. A user may also request a date which will be the cutoff time from when the log information begins. If the date is unspecified, the PC server returns all available log information for the selected PID WTNs.

Possible PID PC server **104** to SMS server **204** interactions are now described. The PC server connects to the SMS server over a LAN using TCP/IP and messaging middleware, such as DATAGATE. The PC server may request the current or pending view of the authorized telephone number and access code tables associated with a PID WTN. The PC server may also request to update the PID tables and request to cancel the update of the authorized telephone number and access code tables associated with the PID WTN. In both cases, the SMS server responds with either a success or an error.

Interactions between the SMS server **204** and the PID status server **106** are now described. The SMS server connects to the status server via the LAN using TCP/IP and messaging middleware, such as DATAGATE.

When an order for Positive ID is received by the SMS (e.g., from SOAC), the SMS server sends associated information, such as the WTN and its user ID, to the status server. The status sever then inserts the new WTN into a table storing all PID WTNs. After the successful table addition, the status server sends a confirmation message back to the SMS server. An order may also be changed or deleted. If a prior version of the order exists, the status server resolves differences between the two versions. For example, if the prior version of the order creates a PID WTN not created by the latest version of the PID WTN, the status server removes the PID WTN. Alternatively if new PID WTNs are created by the newer version of the order, the status server adds the new PID WTNs. The revised order is then stored in the PID database **110**. If a cancel request is received, the old order is read in from the PID database and the initial work for the order is undone, the order status is set as CANCELED and the order is updated in the PID database.

In a preferred embodiment, the SMS server **204** sends the message indicating a pending PID WTN before the due date on the service order because the subscriber then has time to set up their lists of authorized telephone numbers and access numbers prior to the effective date of their service. Thus, the service can be activated the same day the user begins paying

for it. In cases other than Positive ID, when the SMS server receives a service order from SOAC, a field in the message received by the SMS server should be provided to indicate the type of service being ordered.

The SMS server may also send an acknowledgment that the PID tables are updated when the SMS server has processed a user requested update sent to the SMS server. In response to the acknowledgment, the status server changes the status associated with the WTN from PENDING to ACTIVE.

The SMS server may also send a cancellation acknowledgment to the status server when the SMS server has processed a user request to cancel a user generated file (storing the tables). The status server responds by updating the status of the order. The status of the order is set to CANCELED.

FIG. **3** illustrates in block diagram form another exemplary system architecture for implementing the features of the present invention. The main components of the profile management system (i.e., the PID PC client **102**, the PID PC server **104**, the PID status server **106**, and the PID database **110**) may be configured similarly to the system described with reference to FIG. **2**. The SMS server **204** may also be configured similarly to SMS server in FIG. **2**, or it may be implemented with two main interfaces (e.g., a SMS query server and a SMS O.S.S. server) as shown in FIG. **3**. The SMS query server comprises an interface for the PID PC server **104** and sends queries to the ISCP or SCP database via SPACE to obtain a customer's profile data for subsequent viewing at the PC client **102**. The service profile data obtained by the SMS query server (based on a request from the PC server **104**) may be sent back to the PC client **102** via the PC server **104**. As noted above, the SMS server **204** may also comprise a database (not shown) for storing a copy of the profile data of all PID customer's stored in the ISCP or SCP. The redundancy may be provided to protect against outages or system defaults at SPACE or the ISCP/SCP, and the data stored at the SMS may be updated with the ISCP/SCP profile data on a periodic basis (e.g., once a day, etc.) to maintain accuracy. When a copy of the customer's profile data is provided at the SMS server **204**, the SMS query server may query the SMS database to obtain a customer's profile data for viewing. In addition, a SMS O.S.S. server (see FIG. **3**) may be provided as part of the SMS server **204** to handle updates to a customer's profile data (received from the PC client **102** via the PID PC server **104**). The SMS O.S.S. server may also initiate and process a customer's service order (e.g., to populate or change a user profile) and acknowledge the status of the customer's order (in the form of a feedback message to the PID status server **106**).

Various methods and procedures may be provided for service initialization and activation. For example, in the embodiment of FIG. **3**, a user wishing to subscribe to PID may contact service personnel (e.g., by telephone, the internet or e-mail) and request that a service order be placed. When placing the service order, a client may provide contact information to the service personnel. After collecting all of the pertinent information, the client order will be entered by the service personnel (e.g., at a SOAC system terminal) and will flow to SMS for provisioning. The SMS server **204** will then send an acknowledgment message (e.g., via the SMS O.S.S. Server) to the PC status server **106** to confirm, for example, receipt of the customer's order and that the processing of the order has been initiated. The PID database **110** may include a SOAC order table to list a new client's order that has been received and confirmed by the SMS.

Support personnel may access and view the SOAC order table of the PID database **110** via a PID administration tool **130** (which may comprise a computer based interface for accessing and storing information with the PID database). When a support person sees that a new order is present in the SOAC order table, the support person may contact the customer or client based on the contact information that was provided. From the new customer or client, the service person may gather various information to provision the PID PC interface feature of the invention. For example, the service personnel may obtain and setup a user ID and password for the user of the PID PC client software, and determine the client's system specifications. The service person may also confirm the user's address and send the PC client software to the user for installation.

The user ID and password may be provisioned and stored in an access database **120** by the support person, to provide a security feature for limiting access to the PID PC server **104** and access to the customer's profile data. The access database **120** may be implemented with "Graceland", which is an access and security management tool available from Southwestern Bell Telephone, and the database may be queried and searched by the PID PC server **104** to verify a user's password and user ID before granting access to a client at PID PC client **102**. Of course any other access and security management tool can be substituted for "Graceland".

According to another preferred embodiment, a user may choose to retrieve an activity log either in its entirety or by selecting a specific WTN and/or date after which all entries should be displayed. The activity log displays transactions related to each Positive ID WTN associated with the user ID. An example of an activity log is illustrated in FIG. **8**. The first column indicates the user associated with the activity being, logged. In the log file shown in FIG. **8**, three different users all had activities logged. The second column indicates the WTN associated with the activity. The third column displays the activity. Possible activities for a WTN are: ACCESSED indicating a Positive ID WTN table was reviewed; and SUBMITTED indicating a Positive ID WTN table was changed and sent to the SMS server **204**. Thus, a modified table will show two log entries, one for accessed and one for submitted. Additional activities are: CANCEL SEND indicating a pending file was canceled before it became active and REPLACED indicating the pending file was edited and resubmitted to the SMS server **204**. Thus, a replaced table will show two log entries, one for ACCESSED and one for REPLACED.

The Date/Time column shows the date and time when the activity occurred. The effective date column, shows the date that a pending file is to be made active or the date when another activity is made effective. In the status column, the status value can be PENDING, CANCELED, COMPLETED, IN PROCESS and FAILED. PENDING indicates that files have been submitted but have not become active yet. If the pending file was submitted for a future effective date, it will remain in PENDING status until edited or the effective date passes. If the effective date field is today's date, the file was sent for immediate processing and will show all IN PROCESS status until confirmation is received from the AIN network that the changes have become active. The COMPLETED status indicates the file that was submitted is now effectively restricting access to the PID WTN. The FAILED status indicates the submitted file failed. A CANCELED status indicates the pending file was deleted before it was made active. Any authorized user may delete a pending file, not only the user who created the pending file. The Status Date/Time column indicates the date and time the status changed to the status shown in the Status column. Thus, the activity log provides the user information for tracking changes.

According to a preferred embodiment, when the PID PC client **102** is connected with the PID PC server **104**, a time out may occur. The time out requires a password to be re-entered after a period of inactivity. In a preferred embodiment, the period is 15 minutes. Therefore, after 15 minutes with no keystrokes, the user's keyboard would lock, relative to the profile management application, until the password is re-entered.

In addition to accessing the profile data with the PID PC client software, an interactive voice response (IVR) system i.e., DTMF, may also be employed according to another embodiment. The IVR system allows the user to add, delete and verify authorized telephone numbers and access codes from any location using a touch tone phone. Once the initial authorized telephone number and access tables have been created and transmitted via the PC interface, the IVR may be used to update the profile data. By calling the IVR and following touch tone commands, updates can be made which become effective immediately. The IVR can also be used at any time to audibly review the tables of authorized telephone numbers and access codes. To use the IVR, the user must enter a password and the PID WTN enabling the user to access the information. The combination of the PID WTN and the password will authenticate users.

While the invention has been described with reference to several exemplary embodiments, it is understood that the words which have been used herein are words of description and illustration, rather than words of limitations. Changes may be made, within the purview of the disclosure, as presently stated and as amended, without departing from the scope and spirit of the invention in its aspects. Further, although the invention has been described herein with reference to particular means, materials and embodiments, the invention is not intended to be limited to the particulars disclosed herein; rather, the invention extends to all functionally equivalent structures, methods and uses.

For example, FIGS. **4** and **5** illustrate, in general block diagram form, other exemplary system architectures and environments for implementing the invention. FIG. **4** illustrates a system environment in which the invention may be implemented, with the PC server **104** and the PID status server **106** residing on the same platform or entity. Although not shown in FIG. **4**, the PID database **110** may also be provided on the same platform or system entity of the PID PC server and PID status server. In addition, FIG. **5** illustrates an exemplary WAN-based architecture for implementing the invention. A description of the various components depicted in FIGS. **4** and **5** may be found in the U.S. patent application Ser. No. 08/831,892 filed Apr. 3, 1997, entitled "Apparatus and Method for Facilitating Service Management of Communications Services in a Communications Network", in the names of Larry JOST et al., the disclosure of which is expressly incorporated herein by reference in its entirety.

Although the present invention has been described in considerable detail with reference to certain preferred embodiments, other embodiments are possible. Therefore, the scope and spirit of the appended claims should not be limited to the description of the preferred embodiments contained herein.

What is claim is:

1. A method for managing, by a profile management system, subscriber profile data associated with a communications service subscribed to by a subscriber, the subscriber profile data being stored on a communications network which executes the communications service in accordance with the subscriber profile data, the method comprising:

receiving a subscriber request to view the subscriber profile data from a client which hosts a user interface configured to allow the subscriber to view and update the subscriber profile data;

retrieving the subscriber profile data from the communications network based upon receiving the subscriber request to view the subscriber profile data from the client;

forwarding the subscriber profile data to the client;

receiving a subscriber request to update the subscriber profile data from the client, and

forwarding an update for the subscriber profile data to the communications network based upon receiving the subscriber request to update the subscriber profile data from the client.

2. The method for managing subscriber profile data of claim **1**,

wherein the subscriber profile data is retrieved from the communications network via at least one intermediate system.

3. The method for managing subscriber profile data of claim **1**,

wherein the update for the subscriber profile data is forwarded to the communications network via at least one intermediate system.

4. The method for managing subscriber profile data of claim **1**,

wherein the profile management system comprises a server.

5. The method for managing subscriber profile data of claim **1**,

wherein the user interface is a graphical user interface.

6. The method for managing subscriber profile data of claim **1**,

wherein the communications service comprises positive identification.

7. The method for managing subscriber profile data of claim **6**,

wherein the communications network comprises a telecommunications network.

8. The method for managing subscriber profile data of claim **7**,

wherein the subscriber profile data comprises access codes and authorized telephone numbers.

9. The method for managing subscriber profile data of claim **8**,

wherein, when a calling party calls the subscriber, the calling party is only successfully connected to the subscriber when either the calling party's telephone number is an authorized telephone number or when the calling party inputs one of the access codes.

10. The method for managing subscriber profile data of claim **9**,

wherein a reporting system generates reports comprising calling parties attempting to connect to the subscriber, indicating each calling party successfully connected to the subscriber and each calling party not successfully connected to the subscriber.

11. The method for managing subscriber profile data of claim **1**, further comprising:

controlling access to the subscriber profile data, using an access control system, to only allow authorized subscribers to view and request updates to the subscriber profile data.

12. The method for managing subscriber profile data of claim **1**, further comprising:

receiving, from the client, a time specified by the subscriber as to when the requested update for the subscriber profile data should be forwarded to the communications network.

13. A method for managing subscriber profile data associated with a communications service subscribed to by a subscriber, the subscriber profile data being stored on a communications network which executes the communications service in accordance with the subscriber profile data, the method comprising:

receiving, from a profile management system, a subscriber request to view the subscriber profile data, the subscriber request to view the subscriber profile data being received from the profile management system based upon the profile management system receiving the subscriber request to view the subscriber profile data from a client which hosts a user interface configured to allow the subscriber to view and update the subscriber profile data;

forwarding the subscriber profile data to the profile management system based upon receiving the subscriber request to view the subscriber profile data from the profile management system, the profile management system being configured to forward the subscriber profile data to the client when the profile management system receives the subscriber profile data;

receiving an update for the subscriber profile data from the profile management system, the update for the subscriber profile data being received from the profile management system based upon the profile management system receiving a subscriber request to update the subscriber profile data from the client,

wherein the communications network executes the communications service in accordance with the updated subscriber profile data.

14. The method for managing subscriber profile data of claim 13,

wherein the subscriber profile data is forwarded to the profile management system via at least one intermediate system.

15. The method for managing subscriber profile data of claim 13,

wherein the update for the subscriber profile data is received from the profile management system via at least one intermediate system.

16. The method for managing subscriber profile data of claim 13,

wherein the communications service comprises positive identification.

17. The method for managing subscriber profile data of claim 16,

wherein the communications network comprises a telecommunications network.

18. The method for managing subscriber profile data of claim 17,

wherein the subscriber profile data comprises access codes and authorized telephone numbers.

19. The method for managing subscriber profile data of claim 18,

wherein, when a calling party calls the subscriber, the calling party is only successfully connected to the subscriber when either the calling party's telephone number is one of the authorized telephone numbers or the calling party inputs one of the access codes.

20. The method for managing subscriber profile data of claim 14,

wherein the intermediate system comprises a service management system (SMS) server.

21. The method for managing subscriber profile data of claim 14,

wherein the intermediate system further comprises SPACE.

22. The method for managing subscriber profile data of claim 13,

wherein the profile management system communicates with the client using TCP/IP.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO.	: 7,907,714 B2
APPLICATION NO.	: 11/459121
DATED	: March 15, 2011
INVENTOR(S)	: P. Baniak et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title page Item (56) References Cited, U. S. Patent Documents, page 2 of the printed patent, please change "2003/0076941 A1 4/2003 Books et al" to --2003/0076941 A1 4/2003 Tiliks et al--.

Signed and Sealed this
Sixteenth Day of August, 2011

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

THE IMS

IP MULTIMEDIA CONCEPTS AND SERVICES, THIRD EDITION

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1

Introduction

1.1 What is the Internet Protocol Multimedia Subsystem (IMS)?

Fixed and mobile networks have gone through a major transition in the past 20 years. In the mobile world, first-generation (1G) systems were introduced in the mid-1980s. These networks offered basic services for users. The main emphasis was on speech and speech-related services. Second-generation (2G) systems in the 1990s brought some data services and more sophisticated supplementary services to the users. The third generation (3G and 3.5G) and its evolution (LTE) is now enabling faster data rates and various multimedia services. In the fixed side, traditional Public Switched Telephone Network (PSTN) and Integrated Services Digital Network (ISDN) networks have dominated traditional voice and video communication. In recent years the usage of the Internet has exploded and more and more users are taking advantage of faster and cheaper Internet connection such as Asymmetric Digital Subscriber Line (ADSL). These types of Internet connections enable always-on connectivity, which is a necessity for people to start using real-time communication means – e.g., chatting applications, online gaming, Voice over IP (VoIP).

At the moment we are experiencing the fast convergence of fixed and mobile worlds as the penetration of mobile devices is increasing on a yearly basis. These mobile devices have large, high-precision displays, they have built-in cameras and a lot of resources for applications. They are always-on always-connected application devices. This redefines applications. Applications are no longer isolated entities exchanging information only with the user interface. The next generation of more exciting applications are peer-to-peer entities, which facilitate sharing: shared browsing, shared whiteboard, shared game experience, shared two-way radio session (i.e., Push to Talk Over Cellular). The concept of being connected will be redefined. Dialling a number and talking will soon be seen as a narrow subset of networking. The ability to establish a peer-to-peer connection between the new Internet Protocol (IP) enabled devices is the key required ingredient. This new paradigm of communications reaches far beyond the capabilities of the Plain Old Telephone Service (POTS).

In order to communicate, IP-based applications must have a mechanism to reach the correspondent. The telephone network currently provides this critical task of establishing a connection. By dialling the peer, the network can establish an ad hoc connection

The IMS: IP Multimedia Concepts and Services, Third Edition Miikka Poikselkä and Georg Mayer

between any two terminals over the IP network. This critical IP connectivity capability is offered only in isolated and single-service provider environments in the Internet; closed systems compete on user base, where user lock-in is key and interworking between service providers is an unwelcome feature. Therefore, we need a global system – the IP Multimedia Subsystem (IMS). It allows applications in IP-enabled devices to establish peer-to-peer and peer-to-content connections easily and securely. Our definition for the IMS is:

> **IMS is a global, access-independent and standard-based IP connectivity and service control architecture that enables various types of multimedia services to end-users using common Internet-based protocols.**

True integration of voice and data services increases productivity and overall effectiveness, while the development of innovative applications integrating voice, data and multimedia will create demands for new services, such as presence, multimedia chat, push to talk and conferencing. The skill to combine mobility and the IP network will be crucial to service success in the future.

Figure 1.1 shows a converged communication network for the fixed mobile environment. It is the IMS which introduces multimedia session control in the packet-switched domain and at the same time brings circuit-switched functionality in the packet-switched domain. The IMS is a key technology for such network consolidation.

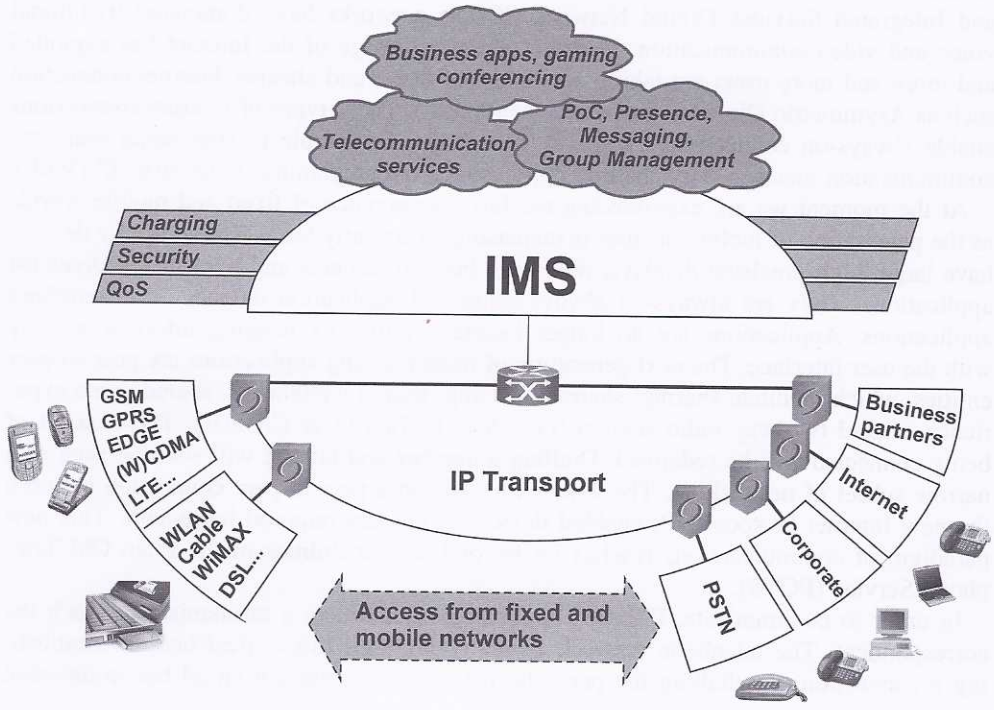

Figure 1.1 IMS in converged networks

1.2 Fixed and Mobile Convergence

Since the IMS architecture integrates both wireless and wireline networks, the IMS becomes an inexpensive medium for Fixed to Mobile Convergence (FMC). It is currently one of the crucial strategic issues in the telecommunications industry. Trends in different regions and countries are different, but on a global level operators are facing increasing competition and declining prices for voice traffic, fixed lines and fixed minutes. At the same time, mobile voice traffic is growing rapidly and substituting that of voice traffic over fixed lines. End users now expect high quality with reliable mobility and are using the Internet more as the penetration of broadband grows rapidly. Now, Voice over IP (VoIP) is starting to substitute PSTN. Meanwhile, key enabling technologies, such as smart phones, wireline and wireless broadband and IMS for seamless service over different access types are readily available. Combined, this means that operators are looking for long-term evolutionary strategies towards converged, access-agnostic networks, with service integration and interoperability across domains and devices. From the end user's perspective this delivers seamless end user experience across multiple locations, devices and services. Convergence can be viewed from three separate angles:

- convergence of networks
- convergence of services
- convergence of devices

Convergence of Networks

Network convergence simplifies the end user experience and dissolves the barriers and complexities that separate today's network islands. The same services are available across all networks and, in an ideal world, appear and perform in exactly the same way, making usage easy, transparent and intuitive.

From an operator's perspective, the goal of network convergence is to migrate today's separate PSTN, PLMN, backbone and IP networks to a fully converged network that supports any access technology. The full evolution includes a cost effective migration to an All-IP network using IMS as the unifying platform, allowing all new services to be accessed in a standard and consistent manner as shown in Figure 1.2 manner. Advancing in this evolution will be the key to an operator's ability to reduce OPEX and CAPEX, and increasing competitiveness and profitability.

Many locations, such as homes, enterprises and public places already have access networks available (xDSL, WLAN, cable etc.). When operators launch new services such as video streaming or hosted email they can take advantage of these existing networks, extending service access to more potential subscribers. In turn this will mean launching services to new market segments for new revenue opportunities. With multiple access networks operators can attract existing and new customers with an enhanced convergence service portfolio using unified billing.

A converged core network is the key enabler for converged networks. Multi-access to a common, converged core network enables cost optimization for both mobile and hybrid operators. Re-use of existing access network infrastructure and integration with the service infrastructure results in both OPEX and CAPEX savings. And multi-access enables operators to introduce end-to-end quadruple-play services (voice, data, video/TV and mobility), to new customers.

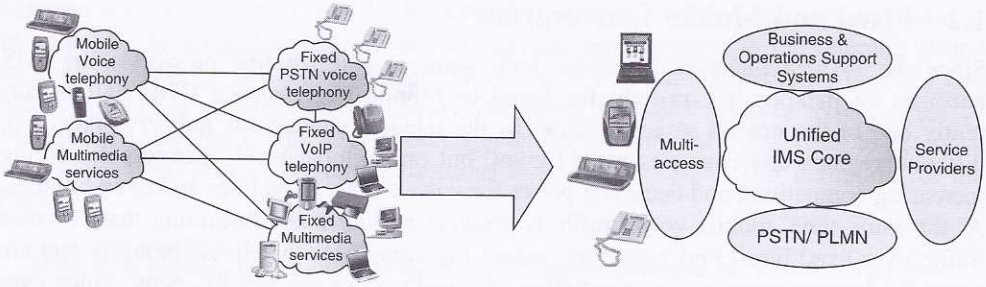

Figure 1.2 Convergence of networks

IP-based access connection using the SIP protocol between the device and the converged core network – so called 'Native IP access' – allows voice, video and other multimedia applications over any access network. Native IP access supports a wide variety of applications in different devices, including mobile handsets, PC clients and SIP desktop phones. POTS phones too, can also be supported, via a connection to an SIP-capable DSLAM or analog terminal adapter (ATA). Native IP access architecture allows the introduction of new rich IP multimedia services through IMS functionality, such as presence, media push, multimedia telephony, games and various other SIP enabled applications, furthering revenue streams for operators.

Device Convergence

Typically, a device is only used – in the main – for a single purpose and the support for its other functions is limited. PSTN phones, low end mobile phones and set-top boxes are good examples. Consumers use these devices for a single purpose. When they change tasks they change device and access network. This means service islands, which lead to mis-matched user experiences from different public and private networks. What's needed are unifying devices that can access services in a similar and easy way.

Smart phones are serious contenders for voice-plus multimedia services in a truly mobile environment. Multiple radio interfaces provide access over circuit and packet-switched networks (cellular, WLAN etc) and IMS allows services and applications to traverse different IP networks. Mobile phone development has been rapid in the last decade and new models take increasing advantage of new technologies. They incorporate the enhanced colour displays and high quality imaging features needed to support service consumption and the creation of own content. Plus the exponential growth of memory capacity and processing power means that smart phones can now replicate the applications currently employed in notebook PCs and PDAs.

Consumers want the quality of fixed services with the flexibility of mobile and convergence lets this happen, by allowing service access through the most suitable access network, and by letting consumers choose the best device for the service. In many cases that device will be a smart phone, but it could just as easily be a PC or laptop with VoIP software or converged fixed clients who can share IM, presence etc with mobile devices, a fixed VoIP phone or even a TV with a set-top box.

Service Convergence

The mobility model has become 'me-centric', with my phone book, my contact information, my agenda, my messages, my availability and preferred communication method, my Internet, my pictures and video clips (received and shared), my personal and business email, my wall-paper, my music and so on. Multimedia services, such as Presence, Push-to-talk, messaging, interactive applications, data or video sharing plus streaming, browsing and downloading, are being delivered over fixed and mobile packet networks. To launch new services and applications quickly, operators can use IMS to eliminate the complexity of different service platforms in the network. Standards based Service Delivery Framework (SDF) provides comprehensive lifecycle management, making the launch of new services and applications quicker and easier to integrate and operate; delivering solutions more speedily to market and reducing the total cost of ownership. In effect the operator can provision – and the end-user quickly and conveniently self-provision – the new services.

VoIP and Instant Messaging are two developments that helped kick-start service convergence. VoIP has had a seismic impact on telephony within enterprises and, as the penetration of broadband access increases, so does the availability of this transport mechanism within the home. Users also benefit from personalized VoIP, including same number, same contacts and the same supplementary services like call barring, call waiting, ring back tones, one voice mail, option for one postpaid bill or prepaid account, etc through any access network. IP DSLAMs are letting operators offer both DSL access and traditional two-wire POTS connections using a SIP client in the DSLAM. This development and others like fixed VoIP phones, Analog Telephony Adapters (ATA) and fixed soft switches place fixed line operators in an excellent position. They can offer multimedia services via DSL and attractive tariffs for analog POTS connected to an IP network, thereby maintaining existing services where required and evolving the core network to an IP-based solution. Smart phones, on the other hand, have WLAN interfaces so they can access fixed broadband networks. This allows the mobile phone to be used as an IP phone and users to continue employing their personalized services at home, or via WLANs, connected to DSL, in hot spots or offices. Convergence in this case enables a practical combination of cellular and fixed broadband access. The user experience doesn't change: the same voice and multimedia services are used in the same way. Fixed to Mobile Substitution and fixed VoIP are gradually replacing PSTN voice telephony. Multimedia services are being delivered over fixed and mobile packet networks. Operators must now decide on the kinds of services they wish to provide by themselves or by partners, to whom and in which regions. And what they might offer is no longer limited to traditional telecom services only, but perhaps entry into new businesses.

1.3 Example of IMS Services

Switching on my Internet Protocol Multimedia Subsystem (IMS) enabled device, it will automatically register to the IMS network using information in the identity module (such as USIM). During registration both device and network are authenticated and my device will get my user identities from the network. After this single registration, all my services will be available, including push to talk, presence, voice and video sessions, messaging

and multiplayer games. Moreover, my availability information is updated at the presence server as being "online" and listing my current applications.

When I need to contact my friend Bob, I select Bob from my device's phone book and, based on his presence information, I see immediately that he is available. After pressing the 'green button' on my device it will place an 'ordinary' call to him. The IMS network will take care of finding and setting up a Session Initiation Protocol (SIP) session between our devices, even though Bob is currently abroad. When my call reaches Bob's terminal he will see that the call is coming from me and, additionally, he sees a text string inserted by me ('Free tickets to movie next Wednesday'). Bob answers, but tells me that he's not sure whether he is able to come. We decide to check the issue again on Sunday. Before hanging up, Bob says to me, 'You won't believe what I saw today but just wait a second, I'll show you.' Bob starts streaming a video clip to me, and while I'm watching the video, Bob keeps explaining what happened in the zoo earlier that day.

Mike realizes that today is the birthday of his good friend Jill. Although he's travelling and can't meet her today, he wants to send Jill a personal birthday message. While Mike is sitting in a local coffee shop enjoying coffee and reading the latest news from the Internet using his brand-new Wireless Local Area Network (WLAN) device, he decides to send her a video clip as a birthday greeting. Jill is having a bath when she hears her phone ringing. She sees that she has received a message and checks it. She saves the video clip and decides to send something in return. Knowing that Mike knows her weird sense of humour, she sends a picture of herself taking a bath (Figure 1.3).

Peter Simpson is a Londoner and a die-hard Arsenal fan. With sheer luck he has managed to get tickets to an Arsenal–Tottenham derby and sets off to see the game. There he is, sitting at the stadium during the match, when suddenly he gets an irresistible urge to make his friend envious. He gets his mobile phone and makes a call to his friend John Clark, a Tottenham supporter. John is sitting at his desk and receives an incoming call pop-up on his PC screen, informing him that Peter is calling. He answers and they start to talk. Peter can't contain himself and starts the video-sharing application while zooming onto the field. John receives an incoming video request and accepts the stream. The PC client starts to show the game, and with a pang of jealousy and disappointment John watches Arsenal score. 'Nice goal, huh?' asks Peter. 'It ain't over yet,' says John, gritting his teeth, and ends the video stream. They continue to argue good-naturedly about the game and their teams over the phone.

Figure 1.3 Multimedia messaging

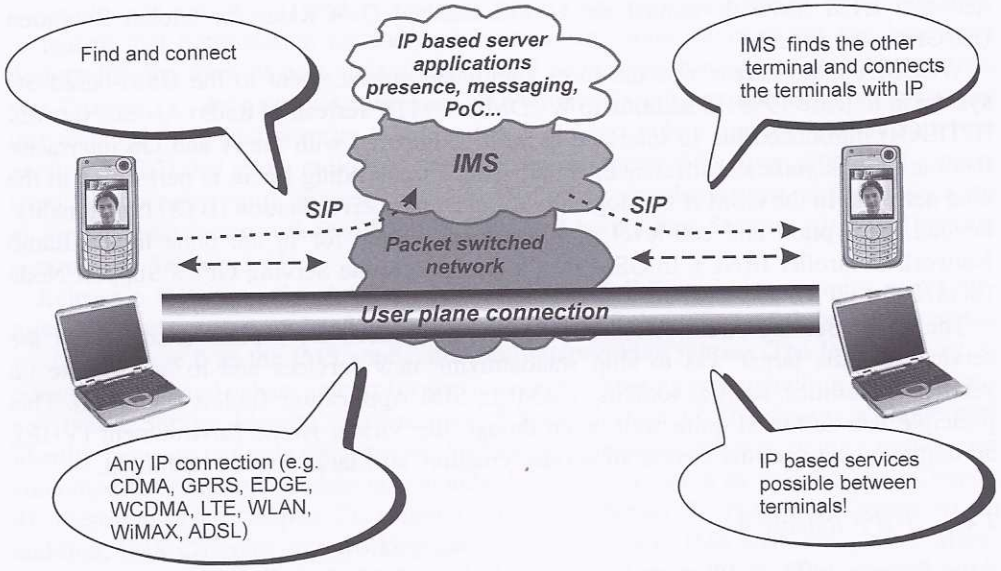

Figure 1.4 The role of the IMS in the packet switched networks

All the required communication takes place using the IP connectivity provided by the IMS as shown in Figure 1.4. The IMS offers the capability to select the best and most suitable communication media, to change the media during the session spontaneously, and use the preferred (SIP-capable) communication device over any IP access.

1.4 Where did it come from?

The European Telecommunications Standards Institute (ETSI) was the standardization organization that defined the Global System for Mobile Communications (GSM) during the late 1980s and 1990s. ETSI also defined the General Packet Radio Service (GPRS) network architecture. The last GSM-only standard was produced in 1998, and in the same year the 3GPP was founded by standardization bodies from Europe, Japan, South Korea, the USA and China to specify a 3G mobile system comprising Wideband Code Division Multiple Access (WCDMA) and Time Division/Code Division Multiple Access (TD-CDMA) radio access and an evolved GSM core network (www.3gpp.org/About/3gppagre.pdf). Most of the work and cornerstone specifications were inherited from the ETSI Special Mobile Group (SMG). The 3GPP originally decided to prepare specifications on a yearly basis, the first specification release being Release 99.

1.4.1 3GPP Release 99 (3GPP R99)

It took barely a year to produce the first release – Release 1999. The functionality of the release was frozen in December 1999 although some base specifications were frozen afterward – in March 2001. Fast completion was possible because the actual work was divided between two organizations: 3GPP and ETSI SMG. 3GPP developed the services, system architecture, WCDMA and TD-CDMA radio accesses, and the common core

network. ETSI SMG developed the GSM/Enhanced Data Rates for Global Evolution (EDGE) radio access.

WCDMA radio access was the most significant enhancement to the GSM-based 3G system in Release 1999. In addition to WCDMA, UMTS Terrestrial Radio Access Network (UTRAN) introduced the Iu interface as well. Compared with the A and Gb interfaces, there are two significant differences. First, speech transcoding for Iu is performed in the core network. In the GSM it was logically a Base Transceiver Station (BTS) functionality. Second, encryption and cell-level mobility management for Iu are done in the Radio Network Controller (RNC). In GSM they were done in the Serving GPRS Support Node (SGSN) for GPRS services.

The Open Service Architecture (OSA) was introduced for service creation. On the service side the target was to stop standardizing new services and to concentrate on service capabilities, such as toolkits (CAMEL, SIM Application Toolkit and OSA). This principle was followed quite well, even though the Virtual Home Environment (VHE), an umbrella concept that covers all service creation, still lacks a good definition.

1.4.2 3GPP Release 4

After Release 1999, 3GPP started to specify Release 2000, including the so-called All-IP that was later renamed as the IMS. During 2000 it was realized that the development of IMS could not be completed during the year. Therefore, Release 2000 was split into Release 4 and Release 5.

It was decided that Release 4 would be completed without the IMS. The most significant new functionalities in 3GPP Release 4 were: the Mobile Switching Centre (MSC) Server–Media Gateway (MGW) concept, IP transport of core network protocols, Location Services (LCS) enhancements for UTRAN and multimedia messaging and IP transport for the Gb user plane.

3GPP Release 4 was functionally frozen and officially completed in March 2001. The backward compatibility requirement for changes, essential for the radio interface, was enforced as late as September 2002.

1.4.3 3GPP Releases 5 and 6

Release 5 finally introduced the IMS as part of 3GPP specifications. The IMS is supposed to be a standardized access-independent IP-based architecture that interworks with existing voice and data networks for both fixed (e.g., PSTN, ISDN, Internet) and mobile users (e.g., GSM, CDMA). The IMS architecture makes it possible to establish peer-to-peer IP communications with all types of clients with the requisite quality of services. In addition to session management, the IMS architecture also addresses functionalities that are necessary for complete service delivery (e.g., registration, security, charging, bearer control, roaming). All in all, the IMS will form the heart of the IP core network.

The content of Release 5 was heavily discussed and, finally, the functional content of 3GPP Release 5 was frozen in March 2002. The consequence of this decision was that many features were postponed to the next release – Release 6. After freezing the content, the work continued and reached stability at the beginning of 2004. The Release 5 defines a finite architecture for SIP-based IP multimedia service machinery. It contains a functionality of logical elements, a description of how elements are connected, selected