Telecommunications Services in the Next Decade

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Invited Paper

In this paper, the authors present their views concerning what types of telecommunications services are likely to come into existence or become widespread during the next decade. The paper is organized in terms of fundamental customer needs which those services should help to satisfy. In particular, the following categories of needs are considered: i) Information Productivity, ii) Cost-Effectiveness and Control, iii) Telemarketing, iv) Media and Protocol Conversion, v) Entertainment, and vi) Telecommunications Ubiquity. Throughout the paper, the special role of ISDN (Integrated Services Digital Network) is highlighted. It is pointed out that ISDN provides generic capabilities—a standardized digital interface, wider bandwidth, and powerful, out-of-band signaling and control—which facilitate the construction of a wide variety of new services. Finally, after discussing many potential new services in detail, the authors summarize some of the major trends which seem certain to characterize the changing face of telecommunications services in the next decade. Among these are: wider bandwidth, more data and digitization, multimedia capability, services "on demand," and internationalization. The authors also briefly discuss network-based versus CPE-based services and the likely roles of public versus private networks.

I. INTRODUCTION

Mary Jones, mother of three, walks into the study of her modern, suburban home 10 mi outside of Milwaukee, WI. After pressing a button to actuate the raising of a decorative wooden panel, she sits down in front of a built-in color-graphics terminal. An electronic voice greets her with the words, "Good afternoon, Mary. Today is Tuesday, September 28th, 1994. It is 3:07 P.M., and the current temperature in Milwaukee is 62 degrees. Skies will be clear the remainder of today with an overnight low of 44 degrees. What can we do for your today?" As the voice subsides, a menu appears on the screen, offering Mary a wide choice of functions including electronic news, catalog shopping, electronic banking, and transportation and entertainment schedules. Mary presses "talk to office," and, after entering a sequence of security codes, she downloads a copy of the "sales results" database from the mainframe computer at the corporation for which she works. Then, accessing a statistical analysis package resident on a computer at the University of Wisconsin, she attempts to verify a hypothesis concerning the impact of fluctuations in interest rates on the regional sales for which she is responsible.

While Mary is working, her 17 year old son, Jimmy, sits in front of another terminal and responds to inquiries from an interactive calculus lesson. Tiring of this, he pauses briefly to call his girl friend, Cindy. Cindy is out playing basketball, but the call is automatically transferred to a portable phone which she carries when she is away from home. To the accompaniment of razzing from her friends, Cindy explains that she cannot talk right now, but that she will call back later.

While Jimmy procrastinates over his homework, his father, David, is at his office. He is involved in a three-way, multimedia teleconference call with a colleague from New York and a stock broker in London. The broker is not on live—after all it is after 10:00 P.M. in London—but his recorded talk includes what David needs; a chart showing the hour-by-hour fluctuations of the London Stock Exchange industrial average for the day. As the call nears its end, David hears two muted beep tones, indicating that someone has left him a recorded voice message. It was Mary, and she has asked David to stop at the Food Park on the way home and pick up a quart of milk. (Mary was glad David had decided to go into the office. Usually on Tuesdays he, too, works at home via his remote terminal.)

The scenario above seems futuristic, but virtually everything included in it is possible today. What separates it from reality is not a lack of technology, but rather issues of cost, availability, and compatibility with our existing telecommunications equipment base. During the next decade, these barriers will gradually melt away. Scenarios like the one above will indeed become commonplace!

In the remainder of this paper, the authors discuss some of the wide range of telecommunications services which seem likely to come into existence or become widespread during the next decade. The organization of the article is as follows. Section II discusses "drivers" of the anticipated new wave of services; that is, the fundamental customer needs which will motivate the implementation and spread

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of new telecommunications services. With that as background, Section III touches upon the special significance of ISDN (Integrated Services Digital Network) and upon its role in meeting the fundamental customer needs described in Section II. Actual new services are discussed in Sections IV–IX, with each section focusing upon services that will help satisfy a particular one of the major customer needs identified in Section II. Finally, Section X summarizes what has been said earlier, but from a somewhat different perspective. There, the authors discuss a number of significant trends which will characterize the evolution of telecommunication services in the next decade.

II. "Drivers" of New Telecommunications Services

When one thinks about "drivers" of new telecommunications services, technology has to be at or near the top of the list. Little that is dramatically new is possible without at least some new technology, and, as is ably described in the companion paper [1] by Mr. Vickers, there will be plenty of new technology to choose from in the next decade. However, for the most part, technology determines only what is possible, not necessarily what is needed or wanted. Thus in the remainder of this section, we will focus on service drivers which stem from customer needs.

A. Information Productivity

Today, we are all besieged by ever increasing amounts of information. At offices, schools, and laboratories, the number of memoranda and articles which cross our desks, the range and extent of databases available for our use, and the number of meetings and phone calls to which we must attend seem to grow every day. In warehouses and in factories, jobs which formerly were primarily physical are now complicated by the need to maintain real-time inventories and schedules, increasingly individualized (by customer) requirements, and computerized manufacturing instructions. And, even at home, there is little respite. Personalized records keeping grows more complicated every day, a plethora of new electronic gadgets offer us new opportunities for monitoring and controlling, and the information needs and concerns of work follow us home. Much of the ever growing volume of information is potentially useful. But its sheer magnitude threatens to swamp us, raising the possibility not of progress, but of the opposite. Thus we need to become more productive in dealing with information. We must be able to access or reject, assimilate and/or store it more effectively than we do today, and telecommunications services which help to meet that need will be in great demand.

B. Cost-Effectiveness and Control

As information movement and management (IM & M) becomes a bigger and bigger part of our lives, so too does its potential expense. Thus it will not be enough to make the people that depend on IM & M more productive. At the same time, it is important to lower the cost of providing the IM & M services which are helping them. The growing importance of IM & M also implies that customers will want increasing *control* of IM & M services. They will want immediate access to those services, when they want them, and they will want to be able to tailor those services to their particular needs. Indeed, to the extent possible, many customers will want physical control over the actual equipment and facilities which are providing the IM & M services. Cost-effectiveness and control are closely related, for control implies more than just self-reliance. Control also offers the opportunity to use telecommunications equipment and services as cost-effectively as possible. Thus great demand will exist for IM & M services that improve cost-effectiveness, increase customer control, or both.

C. Telemarketing

Telemarketing can be defined as any use of telecommunications services to promote or facilitate the sale of other goods and services. For a variety of reasons, telemarketing has become a burgeoning industry during the last decade. The rapid rise in multi-job families has decreased the time available for traditional, in-store shopping. And, as a general rule, individuals have become more and more at home with all kinds of telecommunications equipment, and (perhaps sadly) less attuned to the use of written language. Thus today, many people routinely order, by phone, products which previously they might have ordered in writing or picked up at a store. Sensing the shifting pattern in consumerism, merchants have scrambled to facilitate telephone ordering and to use telecommunications service as a means of soliciting sales and differentiating their sales services. During the next decade, we can expect new telemarketing applications to intensify these trends.

D. Media and Protocol Conversion

As technology and competition have exploded in the telecommunications industry, so, too, have the range of telecommunication products, media (voice, data, image, full-motion video), and protocols (especially data protocols). To keep the associated wide array of terminals, services, and network equipment running together (or rather to minimize the number of cases when they do not), a new need has developed for media and protocol conversion capabilities. Not all such capabilities are aimed simply at mundane translations amongst slightly differing technical parameters. In particular, advances in speech recognition and speech synthesis should dramatically lower the cost of providing many new telecommunications services.

E. Entertainment

Although few consumers would actually admit it, video games have probably been responsible for more personal computer sales than any other application. In general, people have *always* been motivated to spend money on entertainment, even during depressions. Thus entertainment applications are certainly a glowing opportunity for telecommunications service providers, and that opportunity will be vigorously exploited during the next decade.

F. Telecommunications Ubiquity

As communications continue to become more and more important in our lives, we become increasingly intolerant of

circumstances which limit our ability to communicate. This simple fact has fueled the expansion of mobile, satellite, and international communications services, and it should continue to do so in the future. We should expect a continuing cycle of innovation: New telecommunications services such as data, image, and full-motion video services will be implemented first on wired or fibered domestic networks, will spread to international use, and finally, will become available as mobile telecommunications offerings.

III. The Special Role of ISDN

For several years, ISDN (Integrated Services Digital Network) has been one of the biggest topics of conversation in the telecommunications industry [2], [3]. What is ISDN and what role will ISDN play in satisfying the needs enumerated in Section II? As discussed below, ISDN is a set of capabilities which provide the *means* to implement a wide *range* of services quickly and easily. In simplest terms, ISDN is a method for providing integrated access. The "2B + D" basic rate interface provides two 64-kbit/s Bearer (B) channels, which may be used for voice, data, or image communications, and a 16-kbit/s Data (D) channel, which will carry signaling and control information and limited customer data in packetized form. Similarly, the "23B + D" primary rate interface will provide 23B channels and a 64-kbit/s D channel.

By itself, integrated access, as embodied by these two interfaces, provides new power and efficiencies. For instance, ISDN access is digital, allowing for digital services at rates up to 64, 384, or 1536 kbits/s, well in excess of the 19.2 kbits/s achievable today with analog loops and modems. Also, the D channel may be used to access packet transport services, avoiding the necessity of tying up the users' basic lines.

In addition to providing a standardized digital interface which allows access to basic voice, data, and image services, ISDN also provides a powerful, out-of-band signaling channel (D channel) that allows tying intelligence in the network to that in the user's customer premises equipment (CPE). The D channel uses message-oriented signaling (based on the CCITT ISDN signaling protocol Q.931) to provide for: a) call signaling and supervisory information, which can be used to set up or clear any switched or private line call, b) control messages, which can determine, for example, how the B channels are used, and c) the transmission of information—usually information about one or all of the parties involved in a call—between parties or between one of the parties and the network. By themselves, these capabilities do not really constitute services. However, combined with additional software in the network and/or in CPE, these capabilities can yield a wide variety of powerful new services, some of which will be described below. The *power of ISDN is that it provides* these *generic capabilities* which allow new services to be constructed with a minimum of specialized development.

Returning to the notion of service "drivers" introduced in the previous section, we can describe the special role of ISDN in a slightly different way. ISDN is a product of technology, but it is technology particularly well suited to meeting the needs represented by all the other drivers in Section II. As we shall see, all of these other drivers are served by a handful of common technological elements—wider bandwidth, digitization, and enhanced signaling and control capabilities. These are precisely the capabilities provided by ISDN, and "ISDN services" will grow as the capabilities of what we call ISDN expand. By the mid 1990s, we should see the set of standard interfaces to have expanded well beyond the current 2B + D, 23B + D, and 30B + D versions of today. Eventually, what we now call ISDN should evolve to provide integrated access and transport over pipes with total bandwidth measuring in the tens of megabits. Users' ability to control and access this bandwidth dynamically will grow in kind, leading to realization of the goal of uniform, economic availability of voice, data, and image services in any combination—"Universal Information Services" [4], [5].

IV. Information Productivity Services

It could be argued that virtually *every* new telecommunications service improves information productivity. For our purposes, however, we will consider services in four subcategories: i) call redirection and message handling, ii) teleconferencing, iii) database and information services, and iv) information monitoring and control services.

A. Call Redirection and Message Handling Services

In this section we will consider message taking and forwarding services and services involving call redirection or other forms of call handling.

1) Message Handling Services: Basic voice telephony has been widespread for many decades, and, over time, there have been impressive improvements in its quality, cost, and degree of ubiquity. Yet, technology is just beginning to solve the single biggest inefficiency associated with this service. When the called party is busy or not there, the desired passage of information does not occur. Interestingly, this is a rare area in which small business and residence customers have set the pace of progress. In these environments, telephone answering machines have become quite common, providing an opportunity for *real* communication, even if only one way.

At large business offices, where the modest cost of answering machines is certainly not a deterrent, they are generally not used. Instead, secretaries or answering services fill the breach. While the intervention of an intelligent human being would seem to be a distinct advantage, often that does not turn out to be the case. But, in general, callers refrain from asking secretaries or answering services to do much more than take down very short messages. This may be because of a fear of errors or of compromising privileged information, or it may simply reflect the knowledge that most secretaries are just too busy to take down long messages. Whatever the cause, secretaries and human answering services often act as little more than a means for initiating the next round of telephone tag.

The frustration and inefficiency associated with incompleted calls suggests that there should be a substantial market for electronic message handling services. Such services already exist in customer-premises-based systems, and relaxations of Computer Inquiry-II should pave the way for network-based offerings as well. During the next decade, services of this type should proliferate in a variety of ways:

• *Voice mail services* will save voice messages for called parties and allow calling parties to "store" recorded messages for automatic transmission or retrieval at a later time.

• *Electronic mail service* will provide for distributing typed messages to electronic "mailboxes" from which the "addressees" can retrieve them by entering a password at their terminal. The users of this service will typically be a closed community of interest groups (such as large corporations) or individual users (such as small businessmen, professionals, or residential users) who "subscribe" to the "mailed" information.

• *Electronic data interchange service* will provide message handling service for applications that involve transmission of data or graphical material: purchase orders, order status inquiries, material orders, sales results charts, etc.

Along with the basic services enumerated above, equipment vendors and service providers will offer many options which will further extend their usefulness. Such options include:

• *Broadcast capabilities*, which will allow users to input one copy of a message which will then automatically be distributed to everyone on a user supplied mailing list.

• *Password protection and encryption*, which will be available for users who require a "secure" message handling system.

• *Message waiting systems*, which will indicate whether and what kind of messages have been left.

• *"Friendly" interfaces*, which will guide the user through the necessary steps of using a service.

With time, most of these types of capabilities should become available not just for voice, data, or graphical messages, but also for image and video messages, and for messages involving combinations of these media.

2) Call Redirection/Handling Services: Call redirection services also help get at the problem of unanswered calls. Such services do and will exist in a variety of forms. Spill-over (on nonanswer) of calls to a secretary, answering machine, or answering service are elementary, existing examples. A slightly more sophisticated example involves forwarding the identity of the called party to a centralized answering location. Thus the answering operator could say, "Mr. Smith's phone," without the expensive need for Mr. Smith's line to have a parallel appearance at the operator's position. The "call-forwarding" service shown in Fig. 1, is another example of a call redirection service. Upon leaving his normal answering location, a subscriber to this service punches a new telephone number into his station set. All incoming calls are then automatically transferred to that new number. Future enhancements to this service should include the ability to reprogram remotely the number to which calls are redirected, and the ability to redirect calls to mobile stations, as in the opening scenario.

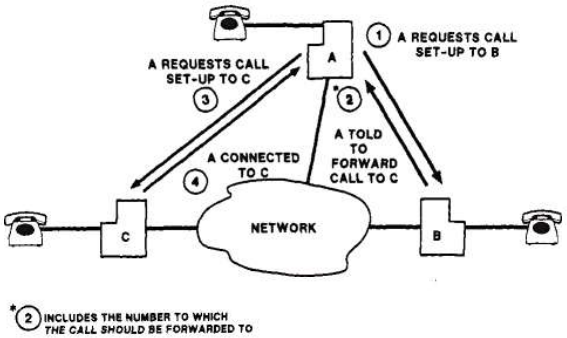

Fig. 1. Call forwarding with ISDN.

Other types of call handling involve calling party identification as illustrated in Fig. 2. Selective ringing patterns may be used to identify callers by broad categories (e.g., boss, intra-office, outside line), allowing the called party to decide whether to answer or to allow the call to overflow to a message taking service. With an appropriate display capability at the called station, forwarding of the calling party number could allow the called party to determine exactly who is trying to reach him. Retention of the calling number could also allow automatic launching of a return call when the called party becomes available.

Many types of message and call handling services are already in fairly common use, and thus their inclusion in an article about *future* services could be questioned. However, they deserve mention because they seem likely to become quite widespread during the next decade. Moreover, these services are interesting because nearly all of them will be greatly facilitated by ISDN capabilities. As ISDN capabilities spread, services now available only behind a PBX will spread to far-flung corporate networks and eventually to the full universe of telephone users. (Additional examples of call handling applications will be given in Section VI, Telemarketing.)

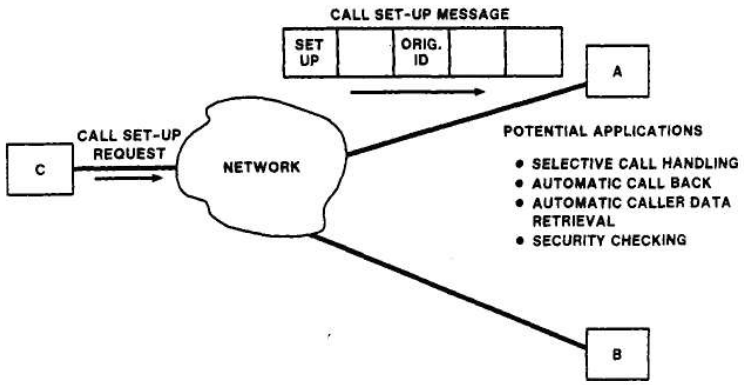

Fig. 2. Services based on station ID forwarding.

B. Teleconferencing

Teleconferencing contributes to information productivity by allowing groups of individuals to communicate without the necessity of their congregating in one location. In this section we will consider voice, video, and multimedia teleconferencing.

1) Voice Teleconferencing: It has long been possible to arrange multiparty, voice telephone conferences by making arrangements through an operator. Similarly, PBX and key-telephone users, and, more recently, subscribers to "Three-Way-Calling" service, have been able to add third parties (or, behind some modern PBXs, as many as four additional parties) to calls already in progress. Both of these capabilities have limitations—in the first case, the bother and expense of working through an operator; in the second case, the restriction of adding only one, or behind PBXs, at most a few, additional parties. Very recently, it has become possible for voice telephone users to dial-up conference calls with tens of participants. And "bridging" capabilities allow service vendors to provide "gab lines"—telephone numbers which random individuals can call to join pre-scheduled conversations on selected topics. These existing services should become widespread and routine in the next decade.

2) Video Teleconferencing: In the late 1960s and early 1970s, there were many who believed that video phones were the wave of the future. Video phones were envisioned on every corporate desk and possibly in many residences. But it did not happen.

What went wrong? For the residential market, issues of privacy aside, the service was just too expensive. For the business market, video teleconferencing was the wrong solution for the wrong problem. In theory, the service was meant to replace face-to-face meetings and save traveling expenses. Unfortunately, because high-bandwidth transport capacity was still very expensive, substantial processing was required to encode images in a format requiring 1.5-Mbit/s or less transmission capacity. This in turn made the video conference rooms very expensive, limiting their use to "exhibition" type applications or to users willing to assemble at public rooms in large cities. Moreover, because of the high cost of the transmission capacity, and/or because of the need to use public rooms, the service had to be used primarily on a reservation basis. Most important, it turned out that business people still like to meet in person, even if it means traveling.

Despite the past experience, industry watchers are again predicting a boom in video conferencing. What has changed to justify this renewed optimism? Primarily it is a matter of cost. As costs go down, video conferencing no longer needs to displace long-distance travel to be justified. It can serve close-in communities of interest, e.g., at companies with multiple locations in a small area or at universities with multiple campuses. Such users typically meet regularly, so face-to-face contact is not as critical as it is for first-time meetings. Indeed, as costs become low enough, video teleconferencing can become an *enhanced alternative* to today's ubiquitous voice-only telephone calls. Video can increase the effectiveness of these communications by adding the dimension of sight.

These new objectives of video teleconferencing are made possible by many technological advances that have been occurring in recent years. Fiber optics have driven down the cost of transmission, making even 45- and 90-Mbit/s transmissions economically viable over short enough distances. At the same time, VLSI technology and advances in coding techniques are driving down the cost and bandwidth requirements of video coders. This makes it likely that large corporations will be able to afford multiple video rooms at all their major locations worldwide. Even mobile video conferencing carts or desk top systems are a real possibility. These same video encoding technologies will give users the ability to select the technology that is most suitable for specific applications, e.g., 56-kbit/s slow-motion or freeze-frame systems for applications involving little motion, all the way up to high-resolution, full-motion systems requiring 45 Mbits/s or more of transmission bandwidth.

Finally, and perhaps most importantly, direct user control of the teleconferences via ordinary telephones and terminals, and on-demand availability of high-bandwidth transmission paths, will make video conferencing more convenient and more attractive. Together, these advances mean that video conferencing can be both reasonably economical and convenient, ensuring a significant role for such services in the next ten years.

3) Multimedia Teleconferencing Services: In addition to pure voice or pure video conferencing, today's telecommunication users also have access to facsimile and graphics transmission capabilities, and to "electronic blackboard" service. During the next decade, we can expect that all these types of capabilities will become increasingly integrated. Users should be able to shift easily from one type of medium to another, and even to mix different types of media on different legs of a conference call. For example, in the scenario of Section I, David in Milwaukee, his colleague in New York, and the broker's "database" in London were engaged in a three-way, multimedia teleconference that involved video and voice communications between the first two parties, and image (in the form of graphics) communications with the third party. David was able to set up the teleconference on demand, and to retrieve information from London interactively. He chose to obtain a graphical representation of the information he needed. However, under less urgent circumstances, the same information could have been transferred to David via facsimile or through a computer file transfer.

Why are multimedia teleconferencing services likely to be important in the future? The answer again lies in the notion of information productivity. The plethora of information with which we are all confronted exists largely in the form of text or data. But, as human beings, we learn most effectively when information is presented to us in a variety of media—voice, image and data, and various combinations of these. This is the situation which exists in face-to-face meetings and in classrooms, and this is why such forums are so important in our lives. Multimedia communications services will expand the boundaries of high "information productivity" by allowing participants in non-face-to-face meetings and learning situations to enjoy the benefits of multimedia voice, data, and image communications.

Multimedia telecommunications will show up in many guises (see Section IV-A1, Message Handling Services, as well as many of the sections ahead). The two scenarios

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