Integrating Communication Services

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Abstract

The need for communication services which span multiple communication technologies is growing. Communication services are being developed in three areas: in the public switched telephony networks (Intelligent Networking), on the Internet in the form of integrated multimedia, including Voice-over-Internet, and in private switched telephony networks (enterprise CTI applications). This paper shows that is plausible to create unified services which span the Internet and public switched networks and goes on to describe Nexus, an architecture and prototype for integrated communication services.

1. Introduction

Communication services are intended to facilitate personal communication. The communication services discussed in this paper are centred around voice telephony, the current mainstay of personal communications. Communication services add value to the basic communication act by dealing with many of the exceptions - the person to be contacted is unavailable, or they are talking to someone else, or they can be contacted by some other means - on another telephone, or via a pager or GSM Short Message Service, or via email. There may be services to screen outgoing and incoming calls, and services to simplify charging for the call. Taken together, they simplify the task of communicating with another party or parties.

There is a paradox in the fact that too many methods of communication and too many disjoint communication services make communication more difficult. The ‘voicemail syndrome’ is an example, where a person receives messages on a corporate voicemail system, and some on an answering machine at home, and even some voice messages via email. His GSM mobile telephone, to which he forwards calls while on the move, also has a separate voicemail system. If his employer discourages the use of corporate facilities for personal communication, he might have a subscription with a local Internet Service Provider, and an additional email account for personal mail and voice messages, and an Internet telephone application capable of receiving .... more voicemail. For further entertainment we can assume that the mobile phone he uses on business is for business use only and there is a family mobile phone which receives some calls from relatives and close friends and this also comes ... with a voicemail system.

Internet communication technologies have had a significant impact on personal communications, firstly through text-based communications such as email, newsgroups and interactive chat groups, and now through developing Voice Over Internet (VOI) technology. Communication is becoming more accessible and cheaper, and at the same time more complex. Section 2. of this paper looks at three major and partly disjoint areas where communication services are being developed and discusses the problems caused by this. Section 3. argues that the centre of gravity for communication services should be biased towards the Internet, with the WWW act-

ing as a model (or inspiration) for a communication service architecture. Section 4. discusses WebIN, a hybridisation of Internet technologies and Intelligent Networking which indicates that a unification of communication services from currently disjoint domains is plausible. Section 5. introduces Nexus, an architecture and working prototype for integrated communication services.

2. Communication Services

Communication services oriented around voice telephony are emerging in three areas: in the PSTN (and for convenience we include mobile telephony), in private switched voice networks, and on the Internet, as shown in Figure 1.

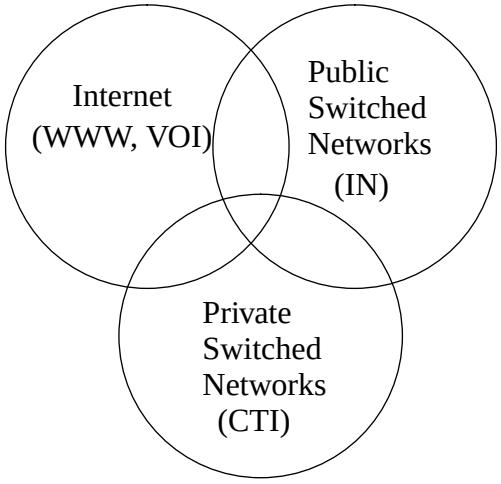

Figure 1: Communication Service Evolution

Communication services in the PSTN are provided by the technology of IN [1][2]. Services such as Freephone (800 number), Credit Card Calling, Automatic Alternate Billing, Voicemail, Virtual Private Networks and a variety of personal call redirection and call management services are widely deployed in the public networks. Continued development and standardisation of IN is proceeding through the Capability Set standards (CS01, CS02, CS03) [3] adding more powerful interfaces for switch control. In anticipation of switched broadband networks, an architecture is being developed for full multi-party, multi-media services such as distance learning, Video Dialtone, Video-on-Demand, WWW-style content provision and Home Shopping [4].

Communication services in private switched networks have centred around call centre and customer contact management applications. There are a number of proprietary variations of the ECMA CSTA standard for switch control [5], such as AT&T and Novell's Telephony Services API (TSAPI), and industry groupings such as the ECTF and Versit are continuing to refine CTI standards. CTI applications are becoming increasingly prevalent with the ubiquity of MS Windows and the availability of the Microsoft/Intel Telephony API (TAPI) interface. CTI applications are typically task-specific (e.g. personal call manager, automatic call distribution) and can have excellent integration with customer databases, screen pops, voicemail and voice messaging, email/voicemail integration, FAX and increasingly, Internet communications.

Until recently communication services on the Internet were text-based - email, Usenet newsgroups, Internet Relay Chat and form-based communication on the WWW using the Common Gateway Interface (CGI). The recent emergence of a large number of mutually incompatible Voice-over-Internet (VOI) applications has lead to the creation of industry groups (four at the time of writing) looking at interoperability issues, and it is clear from industry white papers

(e.g. [6] [7]) that VOI technology is being positioned as the first step in the evolution of sophisticated workgroup applications combining voice, video and data.

While evolution of communication services in each of the three areas shown in Figure 1. is relatively unencumbered by evolution in the other areas, the overlaps are increasingly important and will become critical as the three technologies reach an equivalent level of maturity. For example, while is technically straightforward to bridge VOI calls through to the PSTN (and a number of commercial services exist to provide this facility) there is no corresponding unification of the service frameworks, so that a VOI contact service and an IN contact service will be disjoint. The impact on the end-user will be one of unnecessary complexity and increasing difficulty in maintaining effective communications - the 'voicemail syndrome' writ large, and covering not just voicemail but most contact services. Each technology provides useful services taken by itself, but the areas of overlap are large and when there is no integration the effect is to undermine the value of *any* communication service.

The thesis of this paper is that for communication services to be effective they must apply uniformly regardless of whether the user is working within a corporate switched network, or making use of IN services on the wireless and wireline public networks, or using VOI workgroup applications on the Internet. The goal of communication services is to facilitate communication. They cannot be oriented around a specific type of network or a specific communication technology as if no other methods of communication existed.

We[1] believe a unified communication service architecture has to take into account the following requirements:

- communication technology neutrality.
- terminal neutrality, in recognition of the integration of functions within personal appliances and an increasing diversity of appliances, so that it becomes difficult to say whether a device is a telephone, a personal assistant, a pager, a portable Internet terminal, a FAX terminal, or an offline mail reader.
- policy-driven communication negotiation - negotiating communication method, quality of service, cost and personal preferences to find a highest common factor between communicating parties.
- terminal mediation, providing adaptation between different terminal types.
- a demand for powerful and configurable single-point-of-contact services which integrate multiple communication methods - wireless and wireline telephony, VOI, email, pagers, content (WWW), document sharing etc.
- a demand for multi-party and workgroup communication services, including role-based communications.
- integration with emerging workgroup applications, and in particular Internet VOI and multimedia applications.
- emerging switched multimedia services.
- increased personal mobility and location-based services.
- the growth of novel applications as a result of an increasingly instrumented environment, such as domestic and vehicle control and security - communication with an intelligent environment is rapidly becoming as important as interpersonal communication.

A large measure of pragmatism will be needed in trying to satisfy these requirements, for the simple reason that each of the three areas in Figure 1. is well established and cannot be abolished by *fiat* - for example, there are 600 million wireline telephones in the world, and IN serv-

1. I write on behalf of the Nexus project team.

ices will remain popular for many years to come. This suggests hybridisation as a possible way forward, and later in this paper I describe WebIN, a hybrid of the WWW and IN which provides control over telephony services from within a WWW-like service environment. WebIN an indication that unified WWW/IN services are plausible and this is a useful step forward.

There are many points of correspondence between switch control in the public networks and switch control in private networks, and so the concepts in WebIN can be applied (although we do not discuss this here) to CTI applications in private switched networks.

This leaves unresolved the question of where the centre of gravity for communication services should lie. This is a contentious issue, as each of the three technical communities has a stake in extending and exploiting an existing base of commercial applications. It is our belief, which we attempt to substantiate below, that WWW content services provide an excellent model for developing an architecture for integrated communication services. This architecture we have called Nexus because it represents the intersection of the three circles of Figure 1, and a description of a prototype implementation of Nexus concludes this paper.

3. The World Wide Web

The WWW is an architecture for providing information content services. The following characteristics of the architecture have played a part in its success:

- an open service architecture - anyone can contribute new content services.
- uniform resource location - service resources can be accessed from anywhere.
- an hierarchical, scalable name translation service (the Domain Name Service).
- scalable resource location (currently > 30 million Uniform Resource Locators (URL)).
- client/server protocols based on the Hypertext Transfer Protocol (HTTP) and Common Gateway Interface (CGI).
- uniform and ubiquitous access via TCP/IP.
- an evolving homogeneous application programming environment layered over inhomogeneous physical platforms (for example, the JAVA language and class libraries combined with client browser integration).
- an evolving Distributed Programming Environment (DPE) based on CORBA and the CORBA Internet Inter-Operability Protocol (IIOP), combined with widely endorsed proprietary protocols such as SUN's Remote Method Invocation (RMI) libraries for JAVA and Microsoft's Common Object Model (COM).
- service compositionality - anyone can compose new services based on existing services (such as directory services, search engines, digests, topic-based information services).

The openness has been critical in fostering service competition and a rapid pace of evolution. Survival of the fittest ensures that poor services are quickly ignored when superseded by better services. Excellent services (judged by level of use) can be created with a low level of capitalisation.

Service creation in IN is the dual of the WWW in that it is closed and the cost of entry is high and limited to a relatively small number of highly capitalised corporations. The SS7 signalling network has a global span but its use in the routine operation of the PSTN means that new applications have to be carefully resourced and closely vetted - IN is not open. There is often a low level of integration between different services; for example, the GSM standard for mobile telephony has a closed set of services which do not integrate with wireline IN services, a leading cause of the 'voicemail syndrome' in the UK.

The TINA-C consortium is reworking IN for the next generation of multi-media services, but a technical reworking in terms of object orientation, distributed programming and open switch-

ing may not alter the business model - anecdotal evidence suggests that while the TINA architecture represents a large increase in potential openness, the model for service provision is that of a small number of highly capitalised partner organisations providing network and communication services rather than the devolved model of the WWW, where private individuals are able to create their own personal content services at low cost.

The situation in the CTI marketplace is more promising than that in IN because there is more competition in the marketplace and more scope for rapid innovation. A personal computer application which interacts with a corporate PBX over a private LAN is a safer and simpler proposition than a similar application running in the SS7 network. Integration with the Internet is well advanced, and VOI integration is beginning to appear. The question mark in this area is whether CTI applications will present an open and extensible service framework, where the user can readily extend services and incorporate new services, or whether each application is sold as a closed (but steadily expanding) set of services. If the latter, then there will continue to be problems in providing a consistent and coherent set of services when IN services and VOI services are taken into account.

Service openness and compositionality is one of the most powerful aspects of the WWW, and although CTI applications evolve more rapidly than IN services, a closed application cannot match the evolutionary pace we now observe on the WWW.

4. WebIN

The concept of WebIN was introduced in [9] and [10] and refers to the service architecture of the WWW taken together with the public telephony control architecture of IN. The aim is to make it possible to create personal communication services involving the PSTN in the same lightweight, low cost way as content services are created on the WWW.

Many individuals and enterprises are using WWW sites as contact services; it is common to find that an organisational URL such as **www.anenterprise.com** is an indirection pointing to several kinds of contact information, such as a telephone number, a FAX number, an email address, and an HTML form interface. In an informal sense the organisational URL has become a medium-independent contact address and provides a useful contact service. Some of the information presented is operational in that a suitable browser can use it to perform communication acts (e.g. email, HTTP forms) and some information is non-operational - clicking on a telephone number does not normally initiate a PSTN telephone call.

The WebIN physical architecture, shown in Figure 2, retains the conceptual structure of IN's Distributed Functional Plane [8] but locates much of the key functionality outside of the SS7 signalling network. The Service Data Function (SDF), the repository of communication service subscriber and subscription information, is removed from the closed SS7 network and relocated and physically distributed on the open WWW, where it becomes identical with a WWW site. In practice, a person can be identified both within the telephone network and on the WWW by a URL or URN. A kernel part of the Service Control Function (SCF) remains inside the SS7 network and interfaces with Service Switching Points (SSPs) in the normal way (e.g. via the IN Application Protocol). The partitioning of the control function between the (closed) SS7 network and the (open) public network or service provider intranet is an engineering and business issue, and several possibilities have emerged.

A conservative position is to permit SDF provisioning via an Internet-enabled Service Management Function which permits IN subscribers to configure service parameters using the WWW. This does not expose the SCF and associated service logic. The Nexus prototype (described below) moves most of the service logic out of the SS7 network and leaves a kernel of service independent interface functions (Service Independent Building Blocks in IN termi-

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