Chapter 1

IMS Vision: Where Do We Want to Go?

Third generation (3G) networks aim to merge two of the most successful paradigms in communications: cellular networks and the Internet. The IP (Internet Protocol) Multimedia Subsystem (IMS) is the key element in the 3G architecture that makes it possible to provide ubiquitous cellular access to all the services that the Internet provides. Picture yourself accessing your favorite web pages, reading your email, watching a movie, or taking part in a videoconference wherever you are by simply pulling a 3G hand-held device out of your pocket. This is the IMS vision.

1.1 The Internet

The Internet has experienced dramatic growth over the last few years. It has evolved from a small network linking a few research sites to a massive worldwide network. The main reason for this growth has been the ability to provide a number of extremely useful services that millions of users like. The best known examples are the World Wide Web and email, but there are many more, such as instant messaging, presence, VoIP (Voice Over IP), videoconferencing, and shared whiteboards.

The Internet is able to provide so many new services because it uses open protocols that are available on the web for any service developer. Moreover, the tools needed to create Internet services are taught at university and are described in large numbers of books.

A widespread knowledge of Internet protocols has an important implication: people who develop new services are the ones who are going to use them. Let us say that a user is interested in chess and would like to play chess over the Internet. This user will be able to program a chess application and make it work over the Internet using an existing transport protocol.

On the other hand, if the protocols were not open and there were few individuals who had access to them, the person programming the chess application would be somebody with deep knowledge of the protocol but little of chess. It is not difficult to guess who would come up with the best chess program: the chess player who understands what to expect from a chess program or the protocol expert. In fact, this is what the Internet has achieved. The number of protocol experts is so high that there is always somebody within a given community

(e.g., the chess community) who understands the requirement of the community and the protocols that need to be involved.

1.2 The Cellular World

At present, cellular telephone networks provide services to over one billion users worldwide. These services include, of course, telephone calls, but are not limited to them. Modern cellular networks provide messaging services ranging from simple text messages (e.g., SMS (Short Messaging Service)) to fancy multimedia messages that include video, audio, and text (e.g., MMS (Multimedia Messaging Service)). Cellular users are able to surf the Internet and read email using data connections, and some operators even offer location services which notify users when a friend or colleague is nearby.

Still, cellular networks did not become so attractive to users only for the services they offered. Their main strength is that users have coverage virtually *everywhere*. Within a country, users can use their terminals not only in cities, but also in the countryside. In addition, there exist international roaming agreements between operators that allow users to access cellular services when they are abroad.

Reduction in terminal size also helped the spread of cellular networks. Old brick-like terminals gave way to modern small terminals that work for several days without having their batteries recharged. This allows people to carry their terminals everywhere with little difficulty.

1.3 Why do we need the IMS?

On the one hand, we have mentioned that the idea of the IMS is to offer Internet services everywhere and at any time using cellular technologies. On the other hand, we have also said that cellular networks already provide a wide range of services, which include some of the most successful Internet services, such as instant messaging. In fact, any cellular user can access the Internet using a data connection and in this way access any services the Internet may provide. So, what do we need the IMS for?

We need to further clarify what we mean by merging the Internet and the cellular worlds and what the real advantages of doing so are. To do that, we need to introduce the different domains in 3G networks, namely the circuit-switched domain and the packet-switched domain.

The circuit-switched domain is an evolution of the technology used in second generation (2G) networks. The circuits in this domain are optimized to transport voice and video, although they can also be used to transport instant messages.

Although circuit-switched technology has been in use since the birth of the telephone, the current trend is to substitute it with more efficient packet-switched technology. Cellular networks follow this trend and, as we said earlier, 3G networks have a packet-switched domain.

The packet-switched domain provides IP access to the Internet. While 2G terminals can act as a modem to transmit IP packets over a circuit, 3G terminals use native packet-switched technology to perform data communications. This way, data transmissions are much faster and the available bandwidth for Internet access increases dramatically. Users can surf the web, read email, download videos, and do virtually everything they can do over any other Internet connection, such as ISDN (Integrated Services Digital Network) or DSL (Digital Subscriber Line). This means that any given user can install a VoIP client in their 3G terminal

and establish VoIP calls over the packet-switched domain. Such a user can take advantage of all the services that service providers on the Internet offer, such as voicemail or conferencing services.

So, again the same question: why do we need the IMS, if all the power of the Internet is already available for 3G users through the packet-switched domain? The answer is threefold: QoS (Quality of Service), charging, and integration of different services.

The main issue with using the packet-switched domain to provide real-time multimedia services is that it provides a best-effort service without QoS; that is, the network offers no guarantees about the amount of bandwidth a user gets for a particular connection or about the delay the packets experience. Consequently, the quality of a VoIP conversation can vary dramatically throughout its duration. At a certain point the voice of the person at the other end of the phone may sound perfectly clear and instants later it can become impossible to understand. Trying to maintain a conversation (or a videoconference) with poor QoS can soon become a nightmare.

So, one of the reasons for creating the IMS was to provide the QoS required for enjoying, rather than suffering, real-time multimedia sessions. The IMS takes care of synchronizing session establishment with QoS provision so that users have a predictable experience.

Another reason for creating the IMS was being able to charge multimedia sessions appropriately. A user involved in a videoconference over the packet-switched domain usually transfers a large amount of information (which consists mainly of encoded audio and video). Depending on the 3G operator, the transfer of such an amount of data may generate large expenses for the user, since operators typically charge by the number of bytes transferred. The user's operator cannot follow a different business model to charge the user because the operator is not aware of the contents of those bytes: they could belong to a VoIP session, to an instant message, to a web page, or to an email.

On the other hand, if the operator is aware of the actual service that the user is using, the operator can provide an alternative charging scheme that may be more beneficial for the user. For instance, the operator might be able to charge a fixed amount for every instant message, regardless of its size. In addition, the operator may charge for a multimedia session based on its duration, independently of the number of bytes transferred.

The IMS does not mandate any particular business model. Instead, it lets operators charge as they think most appropriate. The IMS provides information about the service being invoked by the user, and with this information the operator decides whether to use a flat rate for the service, apply traditional time-based charging, apply QoS-based charging, or perform any new type of charging. As a clarification, by service, in this charging context, we refer to any value offered to the user (e.g., a voice session, an audio/video session, a conference bridge, an instant message, or the provision of presence information about co-workers).

Providing integrated services to users is the third main reason for the existence of the IMS. Although large equipment vendors and operators will develop some multimedia services, operators do not want to restrict themselves to these services. Operators want to be able to use services developed by third parties, combine them, integrate them with services they already have, and provide the user with a completely new service. For example, an operator may have a voicemail service able to store voice messages and a third party develops a text-to-speech conversion service. If the operator buys the text-to-speech service from the third party, it can provide voice versions of incoming text messages for blind users.

The IMS defines the standard interfaces to be used by service developers. This way, operators can take advantage of a powerful multi-vendor service creation industry, avoiding sticking to a single vendor to obtain new services.

Furthermore, the aim of the IMS is not only to provide new services but to provide all the services, current and future, that the Internet provides. In addition, users have to be able to execute all their services when roaming as well as from their home networks. To achieve these goals the IMS uses Internet technologies and Internet protocols. So, a multimedia session between two IMS users, between an IMS user and a user on the Internet, and between two users on the Internet is established using exactly the same protocol. Moreover, the interfaces for service developers we mentioned above are also based on Internet protocols. This is why the IMS truly merges the Internet with the cellular world; it uses cellular technologies to provide ubiquitous access and Internet technologies to provide appealing services.

1.4 Relation between IMS and non-IMS Services

We have just explained that the IMS is needed to provide Internet services (including real-time multimedia services) with an acceptable QoS at an acceptable price. Yet many such services can be provided outside the IMS as well. Two users can establish a videoconference over the circuit-switched domain and send each other multimedia messages using MMS. At the same time they can surf the web and check email over the packet-switched domain (e.g., GPRS (General Packet Radio Service)). They can even access a presence server on the Internet to check the availability of more people who may want to join the videoconference.

Given that all the services just described can be provided with an excellent QoS with no IMS at all, then what does the IMS really provide?

First of all, the IMS provides all the services using packet-switched technology, which is generally more efficient than circuit-switched technology. Nevertheless, the real strength of the IMS when compared with the situation above is that the IMS creates a service environment where any service can access any aspect of the session. This allows service providers to create far richer services than in an environment where all the services are independent of one another.

For example, a service could insert an announcement in a conference based on an event that happens on the Internet, like the change of the presence state of a colleague from busy to available. Another service could, for instance, display on the user's screen the web page of the person who is calling every time a call is received. Moreover, the same service could automatically set the user's presence status to busy and divert incoming calls to an email address instead of to the typical voicemail.

When services in the network can access all the aspects of a session, they can perform many operations (e.g., changing the presence status of the user) without sending any data over the air to the terminal. Spare radio capacity can be used to provide a higher QoS to existing users or to accommodate more users with the same QoS.

Another important advantage of the IMS is that it does not depend on the circuit-switched domain. This way, interworking with devices with no access to this domain, such as laptops connected to the Internet using any videoconferencing software, becomes trivial. This increments dramatically the number of people IMS users are able to communicate with using all types of media.