Introduction

The advent of Third Generation (3G) communication systems, with their ability to process real-time multimedia applications and their large bandwidths, is greatly enhancing the mobile multimedia and mobile application environments. Wideband Code Division Multiple Access (W-CDMA) radio technology is here today, having been introduced in Japan with the opening of NTT DoCoMo’s Freedom Of Multimedia Access (FOMA) 3G mobile service [1]. With a downlink speed of up to 384 kbit/s – 40 times faster than conventional public wireless data communications – 3G offers high quality video streaming, videoconferencing, and easy and efficient Internet access, as well as enhanced voice quality. Mobile multimedia is able to combine voice, news, video sequences, etc, in new ways that closely match users’ needs – the essence of true multimedia applications. Together with the key “always-on” and “anytime/anywhere” characteristics of 3G mobile data systems, this will lead to mobile multimedia handset devices becoming an essential part of everyday life.

In future, mobile operators will have to be active not only in network ownership and operation, but also in fostering a business model that fuels the creation of content and services. This can be done, for instance, by applying the economic model used for i-mode (the Japanese mobile Internet service) based on a high quality infrastructure and flexible billing. Alcatel is heavily involved in the application race and offers suitable tools for a successful 3G launch. Clearly, 3G services are on the verge of revolutionizing our everyday business and personal lives by making what used to be fiction a reality.

Remember 1st October 2001?

After a successful test phase, NTT DoCoMo launched its FOMA service over the world’s first commercial 3G mobile network on 1st October 2001, ushering in the era of high speed mobile communications based on W-CDMA technology. Table 1 lists the main features of the service.

3G brings mobile video and multimedia, more capacity and enhanced voice quality (thanks to the use of adaptive multi-rate coding), as well as improved mobile data performance (up to 384 kbit/s with W-CDMA frequency division duplexing). However, it requires a new 3G radio core network and easy-to-use terminals with large color displays and multimedia capabilities. Finally, the market needs compelling user services based on attractive applications.

By the end of February 2002, the FOMA service already had 54,000 subscribers. More than 4000 terminals were sold on the first day, including 1600 video terminals! Clearly there are lessons to be learned from this launch, since the Japanese mobile market is an excellent source of information and field experience for operators worldwide. Consequently, the way NTT DoCoMo deals with coverage, applications and terminals is of particular interest. Figure 1 shows the phased approach adopted by NTT DoCoMo from launch to March 2002.

Coverage

Since the introductory service was launched on 31st May 2001 in Tokyo (30 km around the city center) and parts of Yokohama and Kawasaki, NTT DoCoMo has been steadily expanding the FOMA network through-
out Japan. In the first half of 2004, 97% of the population will be covered. Clearly, coverage is a key to the success of any mobile communication network.

3G Applications and Terminals

In the Japanese model, applications are the focal point. W-CDMA broadband technology makes it possible to offer mobile multimedia content such as voice, data, high definition images and video. Careful network design minimizes signal distortion, interference and quality loss or bit errors.

Figure 2 classifies applications in terms of bandwidth requirements (from low to high data rates) and the nature of the communication (interactive, point-to-point, one-way, pull services, multipoint and broadcast). It is worth noting that most of the existing fixed and 2.5G services are already available, which increases the validity of such a segmentation: videotelephony, video on demand/mobile radio/mobile TV (i-motion), voice mail, e-mail and web surfing.

New video-based 3G applications are shown in blue, while those involving the transport of large amounts of data (e.g. web and mail applications, MP3 music, and file transfer) are in green.

Handsets are specifically designed for the operator so that they are ideally suited to the application. This is a quite different approach from trying to launch applications for terminals that are already on the market.

Taking advantage of 3G technologies and the i-mode model, DoCoMo has structured its offer around the following services (in addition to high quality voice): FOMA i-mode, videophone service, i-motion, high speed data communication and i-appli.

I-mode

FOMA i-mode handles multimedia content with download speeds of up to 384 kbit/s. Users have access to video and music content, as well as e-mail messages of up to 10 000 characters with attached image and music files. All new 3G FOMA terminals are equipped with an integral i-mode browser.

Video Communication Videophone Service

Mobile videophone technology, offering both video and audio communication, is available using 64 kbit/s circuit data channels. It is also possible to establish videophone communication with fixed Integrated Services Digital Network (ISDN) users to take advantage of the subscriber base.
I-motion
This i-mode video clip service was launched at the end of 2001.

High-Speed Data Communication
Using a laptop PC or mobile terminal, 384 kbit/s packet-switched data connections are available to a wide variety of content sources offering still images and video, for example, 64 kbit/s circuit-switched connections are available for the large existing subscriber base.

i-appli
Launched in January 2001, i-appli is a Java-based extension of i-mode that enables users of Java-compatible i-mode terminals to download Java applets and content from more than a hundred Web sites. They can then use the downloaded applications and content without having to re-connect to the Internet. i-appli uses the “KVM” version of Java, which runs on systems with relatively low processing power (typically handsets). A key feature of KVM is that its security functions are superior to those of standard Java.

More to Come ... Multiple Participant Videoconferencing
In March 2002, NTT DoCoMo announced a “New Mobile Video-Conferencing Platform that accepts Multiple Participants”. This system enables numerous people to participate in a mobile videoconference; a split screen shows up to four participants simultaneously.

The Killer Application is Choice
The i-mode service, which was launched as a 2G service in February 1999, now has over 28 million subscribers throughout Japan. It comprises a set of data services for mobile phones that provide entertainment, games, easy mail handling, secure banking, e-commerce, news and information, and Web browsing. The most likely reason for the spectacular success of the i-mode service is the underlying business model. The application offering and development environments are based on a subtle balance: it is a controlled, open market demand-driven system relying on a high quality pipe with a highly intelligent billing system.

Open Market Demand-driven but Controlled
As i-mode and 3G information services are based on existing Internet standards, it is easy for a small company or an individual to apply to set up a site. Initially the operator simply verifies that the candidate site complies with a number of elementary rules. The result of this open approach has been rapid growth in the number of sites. Once there are a sufficient number of successful sites, the operator can propose that these sites become Alliance Partner Sites. Such sites can participate in attractive benefit-sharing schemes and are actively promoted by the operator as part of the official offering. From the operator’s perspective, the portfolio of services grows, attracting new customers and stimulating airtime demand (at zero R&D cost!), while users can choose from a wide variety of services, with new ones being regularly introduced. This is illustrated in Figure 3.

High Quality Pipe with Intelligent Billing System
The application development scheme (controlled outsourcing) enables the operator to focus on its core business: being a pipe provider – a high quality pipe provider, needless to say – generating revenue from valued content based on a suitable revenue-sharing model. This is really the condition for being able to forget that you are a pipe provider! The success of this scheme is largely based on the maturity and flexibility of the billing system. Whatever services the user chooses, he or she only receives one bill. Charging is totally flexible: monthly charge + access to service charge + volume/time-based charging. The simple assumption is that airtime charges are retained by the operator, while the fixed and access-to-service charges are largely (91%) refunded to the information provider. Each information provider is free to decide on its own charging scheme, as shown in Figure 4.

To summarize, the operator can focus on offering a high quality pipe and an intelligent and flexible billing system. The open environment is determined by market demand, while the operator proposes an alliance to the most successful sites. Some might say that NTT DoCoMo has reinvented the old, but successful, "Minitel Story"! The larger the choice, the higher the traffic demand and revenues, leading to even more choice. Thus the killer application has been identified: it is choice. This means not only choice for the user, but also choice for the mobile operator and choice for the content providers.
In addition to the 260 Alcatel intelligent network applications that are operational in various mobile networks, there is a parallel increase in data services. The General Packet Radio Service (GPRS) has shown the importance of having market-ready applications. Consequently, Alcatel has developed a platform to benchmark applications, with the objective of ensuring that suitable applications are ready in three key areas: business, messaging and entertainment (see Figure 5).

Fig. 5 Typical communication, business and entertainment applications

I Work
Business applications are designed to create the wireless office, enabling users to connect to their office systems wherever they are, through a smartphone, personal digital assistant or other device, by accessing a mobile Virtual Private Network (VPN). Mobile office combines fast mobile access to the office (e-mail, diary, etc.) with a value-added VPN voice service.

Conferencing between fixed PCs (using H.323, for example) and mobile PCs (using H.324m, for example) is a new service that we demonstrated in Cannes. Since the speed of GPRS is similar to that of dial-up modems on fixed lines, it is difficult to use it for reading and sending mail attachments, such as Powerpoint files. This will be much easier with 3G, which should also reduce the price per kilobit.

I Keep in Touch
The new Multimedia Messaging Service (MMS) made possible by Nextenso's Internet and proxy applications will replace the popular Global System for Mobile Communication (GSM) Short Message Service (SMS). MMS is a form of mobile phone e-mail which enables a photo, video or music clip to be attached to or to replace the message text. Any digitized personal visual or music can be sent, rather than the present limited clipart library. Demonstrated in Cannes, with commercial operation scheduled for mid 2002, this service can be combined with business mail applications (e.g. Exchange, Lotus mail).

MMS can also enhance access to the existing GSM voice mail system by displaying the author and time of a message, and enabling messages to be accessed in any order. This is much more convenient for users.

Instant messaging is another application that can be delivered through the mobile portal developed by Nextenso. It can be combined with SMS/MMS or used as a standalone application.

I Have Fun
Entertainment applications include games, images and music streaming. Since 55% of i-mode use is for entertainment, this category of applications has enormous potential. In order to offer games that can run on current terminals, the operator can cooperate with the developers of real-time and virtual reality on-line and off-line games.

One possible driving force behind 2.5G applications is location-based services, which will provide information based on the user's location. Such a service might, for example, provide directions to the cash machine or Chinese restaurant nearest to the user. M-commerce will also be offered in the form of an "electronic wallet" for small transactions or payment using third-party certification. Alcatel Nextenso provides proxies and a complete development environment for such applications.

Open Environment
Two main platforms serve as brokers for added value, which can be provided by either internal or third-party applications:

- Nextenso Internet user and proxy applications enable operators and service providers to create or enrich their portals and generate revenue from content delivery. The operator portal can implement an array of applications, including:
  - Internet user applications: HomePage, universal messaging, personal information manager (addresses, diary, to do lists), community information management, etc.
  - Proxy applications: Wireless Application Protocol (WAP), SMS and MMS applications, voice eXtensible Markup Language (XML) browser, profile management, notification, location, syndication, etc.
  - User-defined customization.

With these applications, once a user has registered, he or she has access to all his or her communication and information services – anytime, anywhere and on any device. The user can personalize the mobile web infor-
mation environment using a PC access to speed up the retrieval of information. He or she is notified immediately and at the requested intervals of information tailored according to the user profile. This information can be sent as a short message in adapted WAP format, or in another mobile device format.

In addition, the user can customize the network to its needs (profiling, location-based services, etc) using the Nextenso proxies [2].

- Network applications utilizing the Alcatel Open Services Platform (OSP), the new generation of its successful intelligent network platform which is deployed by operators worldwide. The OSP hosts an array of value-added voice, data and multimedia services, including:
  - payment solutions: prepaid service, e-content charging, payment server;
  - 800/900: freephone, call centers;
  - mobile VPN;
  - complementary services to universal messaging and eContact centers.

It also hosts enabling functions, such as location, service creation and personalization. The Alcatel OSP provides the intelligence required to deploy global services in dedicated network nodes that can be accessed from anywhere in the network. The platform is flexible, enabling new services to be introduced rapidly.

Alcatel Positioning in the 3G Application Race

Alcatel's Universal Mobile Telecommunications System (UMTS) solutions are based on the company's experience with GSM, GPRS, the Internet Protocol (IP) and Asynchronous Transfer Mode (ATM) technology, as well as on its strategic joint venture with Fujitsu, known as Evolium SAS. Fujitsu is the leading supplier of 3G mobile to NTT DoCoMo, which runs the world's first commercial UMTS network. Evolium brings together the powerful R&D capabilities of both Alcatel and Fujitsu, and is taking advantage of the Japanese experience to accelerate development of the UMTS market.

In October 2001, Alcatel conducted the world’s first voice, data and video calls on Orange [3], France’s pre-commercial UMTS network in Paris. This included, in full compliance with the 3GPP standard, a complete Evolium UMTS Terrestrial Radio Access Network (UTRAN) with 12 Node Bs on air, core network, application servers and the icTerm user terminal. Tests included high quality voice calls and high speed video image transfers, as well as web browsing and video streaming at speeds of up to 350 kbit/s for the user.

The 3GSM World Congress 2002 in Cannes has been used as a live laboratory for Alcatel’s UMTS expertise, with the installation of an end-to-end commercial configuration. Alcatel demonstrated an array of mobile data applications based on its live UMTS network (see Figure 6). These services included 64 kbit/s circuit-switched videotelephony, MPEG-4 video streaming and downloading, and content provisioning at 350 kbit/s (close to the air interface bearer of 384 kbit/s). The services feature major partners, such as Mitsubishi, Thomson Multimedia and RAI Italian television. The Cannes network provided live coverage to partners such as Orange and Mitsubishi.

Alcatel has been conducting 17 extensive UMTS field trials throughout Europe and Asia, including Australia, China, France, Germany, Italy, Malaysia, Poland, Portugal, Romania, Russia, Spain and Sweden. These trials, which are running on commercial equipment, include radio and core systems, terminals and applications. In full 3GPP compliance, the tests feature end-to-end circuit and packet connections, soft and softer handover.

Application Development within Alcatel

Given its position as world leader in Asymmetric Digital Subscriber Line (ADSL) technology, Alcatel is heavily involved in the development of applications and Application Programming Interfaces (API) for broadband. Alcatel’s strong position in intelligent network solutions (e.g. prepaid, Camel phases II and III) is also a key driver for application development. Lastly, Alcatel is investing in future multimedia IP solutions based on the 3GPP Release 5 standards. The IP standards for the IP multimedia domain were derived from fixed networks by the ITU with H.323/H.324m, and by the Internet Engineering Task Force (IETF) with the Session Initiation Protocol (SIP). An additional objective was to build a complete service architecture. Alcatel develops all the bricks for the IP multimedia subsystem – Home Subscriber Server (HSS), Personal Service Environment (PSE), MultiMedia Call Server (MMCS) and MultiMedia Application Server (MMAS) based on the OSP. This implementation facilitates the delivery of unified services in the multimedia domain with support for high-quality voice over packet and, more generally, the federation of all kinds of voice and real-time multimedia services over a unified IP infrastructure (see Figure 7).

Multimedia services will vary widely.
I Work and Keep in Touch with 3G
If there is a leading application for corporate mobility, it is certainly “read mail on the move, including applications”. Only 3G can provide sufficient bandwidth cost-effectively. For a new 3G operator, it may be the best application to attract corporate customers.

The “always on” feature of UMTS can be exploited by applications that require to continuously exchange information (e.g. e-mail, synchronization of personal organizers). Bandwidth and real-time capabilities open the door to multimedia conferencing and combined audio/video/data sessions.

Inexpensive mobile terminals are available for the 3G videotelephony market. While some still doubt that videotelephony will take off, most users who have played with the FOMA videotelephones would buy one. For remote parents and grandparents, it is a perfect vehicle for providing security and loving contact.

I Have Fun with 3G

Downloading MP3 files is an excellent example of an application that is not easy in 2.5G; any user trying to download MP3 files using a dial-up modem knows how long it takes, even if the connection is not broken. In contrast, 3G with its ADSL-like bandwidth and its always-on service is the perfect tool for music streaming on the move.

MPEG-4 video streaming is comparable to the i-motion service. In our Cannes demonstration, a video trailer was encoded at various bit rates ranging from 34 to 350 kbit/s. The videos were accessed in packet mode through a UMTS network; they were either streamed directly from the server for viewing on a standard PC, or played back after downloading to the PC. All visitors requested the quality provided by streaming at either 150 or 350 kbit/s. This commercial application is targeted at film previews and commercials sent to sales agents on the move.

Web cast is another segment. In our Cannes demonstration, a webcam acquired live footage which was forwarded to a video server where it was encoded. The video was then accessed in packet mode (video streaming) over a UMTS network (RAN + core packet network). Content was encoded at 350 kbit/s. This is a low cost replacement for a live studio on the move and watching on the move, which typically use satellite links today. The service will be introduced in May 2002 during the World Cup to broadcast goals.

3G Open Environment

Evolium 3G laboratories have already conducted interoperability tests with several terminal vendors (e.g. Mitsubishi, Fujitsu, Samsung) and network vendors. In addition, ten 3G platforms have been organized to demonstrate openness, readiness and know-how: the Alcatel 3G reality centers. They remain open to the content and service providers, and application developers, offering a complete 3G open environment (radio, circuit and packet core, OSP and Nextenso Internet and proxy applications).

The Evolium 3G laboratories are at the center of a group of partners and a community of start-up companies that are providing a rich, open variety of 3G services. Together we are building a smooth path towards a mobile multimedia future.

Alcatel believes that this is the right business model to foster a rapid uptake of services, and therefore generate revenue for mobile operators in the short term.

Fig. 7 Simplified full IP multimedia architecture
Conclusion

The magic wand of multimedia is now touching the mobile world. The advent of third-generation communication systems, with their ability to process real-time multimedia applications and their large bandwidths, is bringing genuine benefits to mobile users. Three main enabling factors are key elements in the overall success of this evolution to attractive and useful services:

- High quality infrastructure allied to flexible billing schemes.
- Stimulating and open application creation environment (under the operator’s control).
- Flexible service creation environment.

The new mobile multimedia story is pushing forward the convergence of the IT and telecom worlds in terms of transport and software engineering technology. Welcome to the mobile multimedia world! ■

References

1. http://www.nttdocomo.com/home.html; NTT DoCoMo is Japan’s largest mobile service provider, with more than 40.7 million subscribers (estimate as of March 2002).


3. http://www.orange.com; Orange is the Europe’s second largest mobile operator with operations in 20 countries across Europe and beyond.

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