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1 Introduction

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Report No. 27
Report from the UMTS Forum

Strategic Considerations for IMS – the 3G Evolution

UMTS Forum, January 2003

This report has been produced by the UMTS Forum, an association of telecommunications operators, manufacturers and regulators who are active both in Europe and other parts of the world and who share the vision of the Universal Mobile Telecommunications System (UMTS). UMTS is a modular concept, which takes full regard of the trend of convergence of existing and future information networks, devices and services, and the potential synergies that can be derived from such convergence. UMTS will move mobile communications forward from where we are today into the Information Society of third generation (3G) services, and will deliver speech, data, pictures, graphics, video communication and other wideband information direct to people on the move. The study was carried out by the consulting company Telecompetition, Inc. under the guidance of and with contributions from the IMS Project Team of the UMTS Forum.

This report follows on from other outputs which have dealt with: a regulatory framework and spectrum and technical aspects, impact of licence cost levels, licensing conditions, minimum spectrum requirements, an extended vision, market forecasts, and other issues. Reports on these and other topics are listed in the Bibliography and can be found on the UMTS Forum Web site, www.umts-forum.org/reports.html.

Many statements in this report represent the views of the original author, Telecompetition, Inc., and have been subject to formal approval in the UMTS Forum. Thus, most operators and manufacturers within the UMTS Forum support the main conclusions and key findings in the report. The National Administrations that are members of the UMTS Forum have supported the development of the report. However, the views and conclusions expressed in this report do not necessarily represent the views of the National Administrations. Therefore, the Administrations cannot be bound by the detailed recommendations contained in the report.

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1 Introduction

The market and technological momentum for the use of the Internet is unstoppable. In addition, the Internet is entering into its second phase of development. During the first ten years after the introduction of the World Wide Web, the Internet has been dominated by non real-time, person-to-machine communications (information services). The next major development will incorporate real-time person-to-person communications, including toll quality voice and video telecommunications along with extensive use of machine-to-machine interactions to simplify and enhance the user experience.

The Internet provides network interoperability on a global scale: across company and national borders. Initially used solely to interconnect computer networks, IP-compatibility is being added to many types of devices: from set-top boxes to automotive and home electronics. The large-scale deployment of IP-based networks creates significant economies of scale thereby reducing the acquisition costs of the associated devices. The ability to deliver content and services, and to re-use application code creates significant economies of scope and scale.

The quality of Voice-over-IP (VoIP) services is constantly improving and the use of VoIP in wireline and enterprise networks is increasing, albeit slowly. In any case, IP-based networks will eventually provide the same level of ubiquity and interoperability for voice services as they do now for data services.

The UMTS Service Architecture should enable the machine-to-machine interactions that promise to handle much of the complexity involved in delivering new services. From domain names to digital rights to protocol conversion, network-based inter-machine negotiations will simplify service delivery and enhance service offerings. A key question that the mobile industry must address is to what extent mobile services will interoperate with fixed Internet services.

The IMS (IP Multimedia Subsystem) vision is to integrate mobile voice communications and Internet technologies, bringing the power and wealth of Internet services to mobile users. IMS provides for person-to-person real-time services (such as voice) over the packet-switched domain. It allows the creation and deployment of IP-based multimedia services in 3G networks.

As described in UMTS Forum Report 20, IMS could enable IP interoperability for real-time services between fixed and mobile networks and so holds the promise of seamless converged voice/data services. Service transparency and integration are key features for accelerating end-user adoption. Two aspects of IMS are of fundamental importance to deliver these features:

- IP-based transport for both real-time and non-real-time services.
- Introduction of a multimedia call model based on the Session Initiation Protocol (SIP).

Both these aspects have implications for deployment options available to operators.

The "IP Question" for Mobile Operators

This vision of seamless interoperability, however, must now be evaluated against an increasingly complex set of technology and deployment options and financial constraints.

Based upon the economies of scope derived from the fixed Internet, the clear direction from the mobile standards community, and evidence that all current development work in the fixed environment is IP-based, it would appear that an "all-IP" network is inevitable.[1] Therefore, it would seem that the

[1] A significant development in 3G mobile is the cooperation between 3GPP (GSM-focused) and 3GPP2 (CDMA2000-focused) to "harmonize" their IP Multimedia Core Networks to enable application level roaming. This includes the creation of a single IMS reference model and consistent terminology to describe common IMS functional entities. Such cooperation is a demonstration of the industry's recognition of users' needs for the capabilities that IMS offers.

critical deployment question for mobile operators is when and how to deploy IP and IMS, not whether or not it is financially justified to deploy it at all. This is a stark conclusion given the current difficult economic climate. Market forces demonstrate that IMS functionality is desirable and necessary. However, current market reality makes deciding when to deploy problematic for a number of reasons:

- Uncertainty regarding service adoption: End user adoption of new mobile data services has been slow.
- Standards: Some of the required IMS standards are still being developed or finalized.
- Investment costs: Cost of deploying IMS or upgrading an existing mobile network to IMS.
- Strategic considerations: The interoperability of IMS may be viewed as a competitive threat (e.g. third party application providers and VoIP).

Even for mobile operators committed to deployment of an IMS-based, IP network, the timing and scale of such deployment must be determined and the additional cost of IMS will have to be carefully considered. However, It should be noted that IMS is an incremental network investment and existing infrastructure can be reused to a large extent.[2]

Report Structure and Goals

The purpose of this study is to provide clarity of thinking on the critical investment questions facing mobile operators: The study approaches this as follows:

- Develop a flexible cost analysis methodology that can used to study a range of networks with different architecture, size and configuration.
- Use this methodology to assess high-level relationships between different IMS deployment strategies.
- Analyse the 3G revenues associated with IMS based on the UMTS Forum's 3G service categories and the same bounded revenue forecasting methodology used for the UMTS 3G revenue and subscriber forecasts.
- Use this methodology to assess different contributions to IMS service revenue and their timing.
- Identify scenarios that represent clear deployment choices that an operator might consider in terms of level of deployment investment and timing of market entry.
- Discuss the relative service, cost, revenue, and strategic implications for these options.

Given the unique market, regulatory, and technology issues faced by each operator, this report cannot definitively answer the IMS deployment question. Instead, it illuminates many of the critical macro factors associated with IMS deployment and provides an approach for further individual operator evaluation.

Section 2 presents a description of the scenarios, study assumptions and market context for IMS. Section 3 frames the strategic issues related to IMS addressed in this report. In Sections 4, 5 and 6 the network architecture, costs and revenues are explored. And finally, in Section 7, the scenarios are compared and the implications inherent in each are analysed in the light of a range of potential industry situations.

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[2] IMS puts no requirements on the infrastructure that transports the IP packets. An installed base using ATM transport is as capable of supporting IMS as an installed base using all IP transport. A feasible migration path for an operator is to introduce all IP when it is justified for other reasons than IMS. E.g., network expansion should be done with IP transport whilst keeping the installed ATM transport. The overall business case should decide when the ATM transport network should be replaced by all-IP.

2 Overview

IMS represents the migration of the voice telephony part of mobile networks from circuit-switched technology to IP-based multimedia networks, fully capable of interoperating with the Internet and joining the "all-IP" world. This holds promise, as well as threats. Each operator will weigh the various costs and benefits of different approaches to existing within this new environment.

In order to "frame the question", five distinct scenarios are defined that represent a cross-section of approaches to IMS. These are not intended to represent any particular operator, and indeed real operators will be a composite of the types of "personalities" represented by the different scenarios.

To define the scenarios, certain assumptions have been made as follows:

- A single IMS decision will be made by an operator
- Once a network deployment decision is made, it will be implemented quickly and completely for that operator
- Service launch will take place in the second year after network deployment.

Scenarios have been given names that convey both the type and timing of network deployment and the type of operator "personality" that would tend to make such a deployment choice.

In this report, revenue is grouped into the following components. These components are further described in Section 6.2:

- IMS Services
  - Push-to-Talk (an example of an early IMS service)
- Other Data Services
- Roaming
- Voice
- IMS Voice

2.1 Market Context: User Needs

Ultimately, the success of any new network infrastructure is solely dependent on its ability to generate increased revenues for the operator: to offer attractive new services at affordable prices. Studies and market trials are showing that end users do desire, and are willing to pay for, new services *as long as* they satisfy four key criteria:

- Service transparency
- Service integration
- Multiple-media support
- Global roaming, while not entirely available today for mobile data services, will become more important. (Users will expect the same functionality in data services as they now get in voice.)

The specific implications of these criteria vary somewhat by user segment:

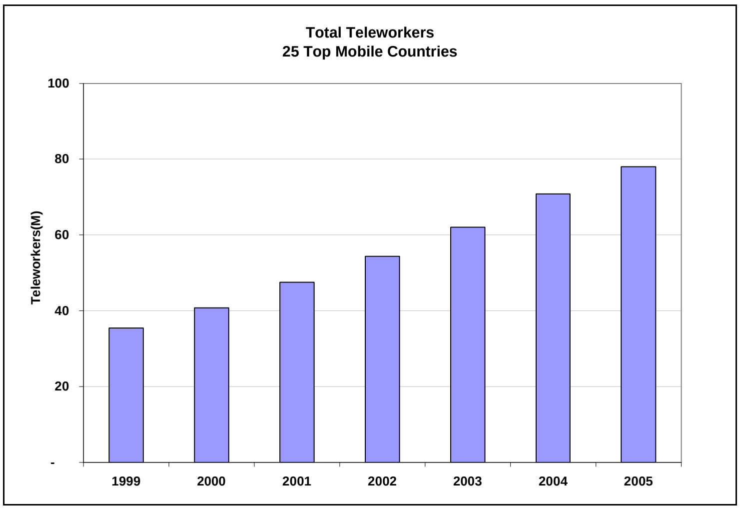
- Enterprises (integration with VPNs and other enterprise networks)
- Mobile business workers ("road warriors")
- Consumers

2.1.1 Enterprise and the Mobile Worker Needs

Workforce mobilisation has increased significantly over the last few years and this trend is expected to continue. As shown in Figure 2.1, the number of teleworkers in developed countries is expected to grow significantly over the next few years.

Figure 2.1. Growth in teleworkers.[3]

Teleworkers will increase over the next few years, increasing the demand for the capabilities offered by IMS.



Source: UMTS Forum and Telecompetition, Inc., October 2002.

The increased mobilisation of the workforce through teleworking, remote location of individual workers, and other types of mobility have placed greater demands on the enterprise to provide mobile and remote workers with comparable access to corporate information, telecommunications services, tools, and other resources

At the same time, the need to optimise workforce productivity is resulting in integration of corporate networks and information technology infrastructure, including mobile. The difficult economic climate of 2002 has increased the pressure on corporations to improve financial performance. Future enterprise technology investments will likely be more closely scrutinised for financial performance. As a result, there is an increasing tendency to make enterprise-wide decisions on mobile services and devices used by its workforce.

In the business market, mobile services providers must therefore address two distinct buyer categories with different needs:

- Enterprise IT department: Need to add mobility and to integrate the entire information infrastructure (systems, networks, applications, etc.).
- Individual mobile worker: Need to access communications, information and information resources whenever and wherever. Individual needs directly impact mobile applications, device form factors, ease-of-use, and geographic availability.

The needs of mobile workers and enterprises are further described in the Appendix (Section 9.1).

[3] The European Union study on Electronic Commerce and Telework Trends (ECaTT) defines two categories of teleworkers: Home Based: Permanent and alternating teleworkers working from home for at least one full working day per week; Other Teleworkers: self-employed teleworkers in SOHOs, mobile teleworkers using online connections when travelling, supplementary telework from home but less than one full working day per week. (ECaTT) “Population Survey”, June 2000.

2.1.2 Mobile Needs of Consumers

While mobile workers are driven by a need for mobile connectivity to Internet and enterprise information (content), consumers' desire for advanced mobile data services is more often driven by mobile connectivity to people and personalised content. Consumers are more commonly seeking content for entertainment purposes that is customised or personalised to their needs and for person-to-person communications to keep in touch with friends and family. Important consumer mobile services will include:

- Mobile access to specific infotainment content such as banking, shopping, eCommerce, news, weather, location-specific information, etc.
- General web browsing / Internet access
- Voice, messaging, picture and video communications to friends and family
- Games and other entertainment
- Content specific to mobile devices such as ring tones, logos and background pictures
- Need to integrate portable, personal electronics including mobile phones, MP3 players, PDAs, handheld games, etc.

Consumers don't have IT departments to integrate their technology or help them with service problems. Therefore, simplified interfaces and easy-to-use services are keys to a successful consumer 3G service.

2.1.3 Advantages of IMS to the End User

The service transparency and integration of IMS gives the end-user greater ease of use in multimedia enhanced mobile communications. The richer end-user experience enabled by IMS more closely emulates the natural communication flows. Users find using 3G services enjoyable instead of frustrating. This ultimately will result in greater user satisfaction and higher service adoption. For the enterprise, improved communications and workflows translate into more productivity and cost savings.

3G/UMTS with IMS will provide the needed bandwidth, coverage, service transparency, interaction and integration to provide end-user requirements for mobile access to data and multimedia resources. GPRS in connection with initial IMS functionality can also provide non-real-time and near-real-time services such as video streaming. A more detailed discussion of GPRS and IMS capabilities is contained in the Appendix 9.3. In addition, IMS allows enterprises to more easily integrate mobile networks with the remaining IP-based networks in the corporate infrastructure.

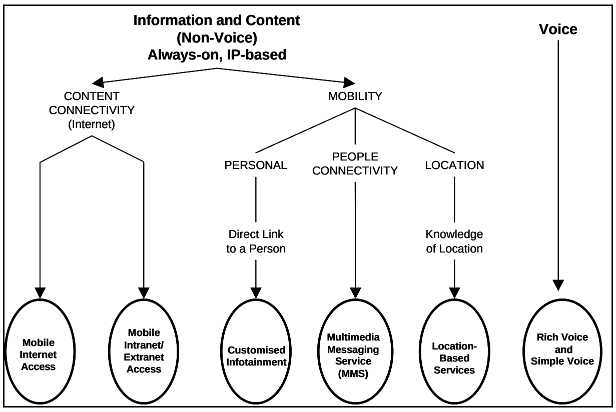
IMS will enable interoperability between fixed and mobile networks, and also between communications devices. As consumers and business users increasingly juggle PDAs, mobile phones, PCs and other personal electronic devices, the ability to seamlessly access needed information from any device or any network becomes even more important. This vision of seamless mobile access to the Internet and other fixed networks requires IMS to become a reality.

2.2 Services Enabled or Enhanced by IMS

To more fully understand how the addition of IMS can impact 3G services and better meet end-user needs, one must consider the entire range of potential 3G/UMTS services that are possible. The UMTS Forum previously developed a 3G services framework to describe the breadth of services possible and to derive market forecasts. The service framework, as shown in Figure 2.2, includes six service categories that comprise the majority of 3G service revenue. Any number of individual 3G services falls within these service categories.

Figure 2.2. 3G services framework with its six service categories.

The IMS service analysis in this report is consistent with the services framework previously developed by the UMTS Forum



Source: UMTS Forum and Telecompetition, Inc., August 2001.

IMS can provide incremental enhancements to each of the six service categories shown in the framework by adding increased service integration and interaction. In the case of Rich Voice, however, IMS is required to provide real-time voice/multimedia integration. In the appendix of this report, one can find a representative sample of service concept from each of these service categories, including a qualitative discussion of the end-user benefits derived from the addition of IMS. The service concepts and target markets included in the appendix are listed below:

The three services (also analysed in detail in UMTS Forum Report 20):

- Advanced Mobile Videophone Service (Consumer)
- IMS Multimedia Group Broadcast (Business)
- IMS Mobile Gaming (Consumer)

Some of the other services (noted in Report 20):

- Mobile VPN (Business)
- “Mixed Media” Mobile Access (Business)
- Multimedia Messaging with Presence (Consumer)
- Alert Service (Consumer)

Another service opportunity that has been identified since the publication of UMTS Forum Report 20:

- Push-to-Talk (Business and Consumer - an example of an early IMS service)

Incremental revenues related to IMS accrue to each Service Category. This relationship between the service categories, revenue components and service concepts is shown in Table 2.3:

Table 2.3. Relationship between UMTS Forum Service Categories and IMS service concepts and revenues.

Service Categories	IMS Service Concepts	Service Revenue Components
Mobile Internet		▪ IMS Services ▪ Other Data Services ▪ Roaming
Mobile Intranet/Extranet	▪ Mobile VPN ▪ “Mixed Media” Mobile Access	▪ IMS Services ▪ Other Data Services ▪ Roaming
Customised Infotainment	▪ IMS Mobile Gaming	▪ IMS Services ▪ Other Data Services ▪ Roaming
Multimedia Messaging	▪ Multimedia Messaging with Presence ▪ Alert Service	▪ IMS Services ▪ Other Data Services ▪ Roaming
Location-Based Services		▪ IMS Services ▪ Other Data Services ▪ Roaming
Voice	▪ Advanced Mobile Videophone Service ▪ IMS Multimedia Group Broadcast ▪ Push-to-Talk	▪ IMS Services ▪ Roaming ▪ Push-to-Talk (an example of an early IMS service) ▪ Voice ▪ IMS Voice

Source: UMTS Forum and Telecompetition, Inc. December 2002.

The qualitative differences in end-user experience illustrated in the appendix can make a difference in end-user adoption of individual services, and ultimately result in quantitative impacts to revenue. These qualitative and quantitative impacts are further considered in the scenario analysis in Section 7 of this report.

2.3 Scenario Descriptions

The five scenarios analysed in this report and illustrated in Figure 2.4 are:

- No IMS – Keep it Simple
- Full IMS – Technology Follower
- Closed IMS – Wildcard
- Only IMS – Market Follower
- Early IMS – Market Leader

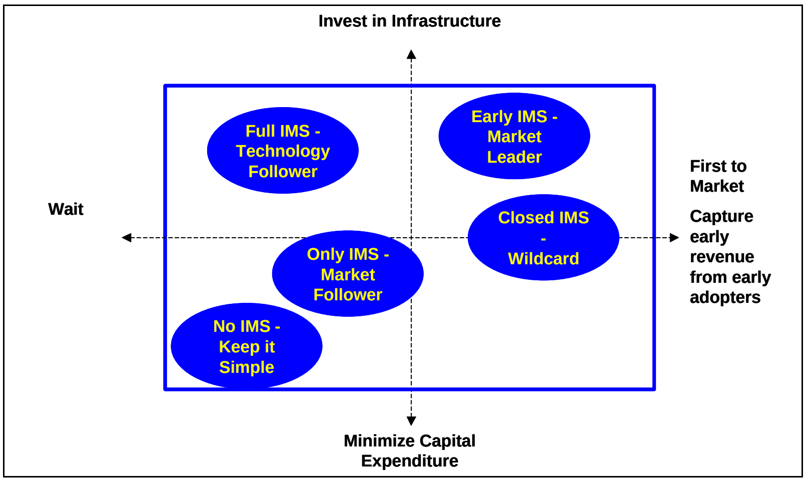
The “Full IMS” and “No IMS” scenarios illustrate the two IMS network deployment extremes, respectively, of fully deploying IMS in accordance with the 3GPP standards (when the standards are commercially developed) and not deploying IMS at all. Both these approaches suggest a conservative market entry strategy that prefers to wait rather than be first to market with new services. The “Full IMS” provides the greatest breadth of service possibilities while the “No IMS” focuses on non-real-time mobile data services.

In both the “Early IMS” and “Closed IMS” approaches, the mobile operator’s primary objective is to be first to market and to capture as much early revenue as possible. However, in “Early IMS”, the mobile operator intends to comply with IMS industry standards, while the “Closed IMS” mobile operator takes a wildcard approach and deliberately chooses a closed network.

“Only IMS” represents the most conservative IMS investment strategy and minimizes a mobile operator’s infrastructure investments by waiting to build its 3G / UMTS network until the 3GPP IMS standards are commercially available and the market demand more developed.

Figure 2.4. Scenario comparison.

The five scenarios analysed in this report differ in their aggressiveness in launching new services and deploying new technology.



Source: UMTS Forum and Telecompetition, Inc., January 2003.

We have assumed that for each scenario the operator is making a rational deployment decision based upon the existing individual market conditions and strategies. The profile of a hypothetical operator and market strategy is summarised in Table 2.5. Each scenario represents a distinct deployment choice and a distinct set of market conditions and strategies. A more detailed description of each scenario can be found in Section 6.

Table 2.5. Operator profile summary – five scenarios.

	Personality	Market Strategy	Value Proposition
No IMS – Keep it Simple	▪ "Stick to the Basics" ▪ Incumbent Tier 2 Player ▪ Do what we do best ▪ Developed Countries	▪ Price Parity ▪ Narrow Product Portfolio ▪ Internet-centric Customer Base ▪ Grow Usage /Traffic	▪ High-speed Mobile Access to Fixed Internet ▪ Good Quality Voice ▪ Network Transmission Quality and Speed
Full IMS – Technology Follower	▪ "Standards come first" ▪ Incumbent Operator ▪ Conservative ▪ Leading, global player ▪ Developed Countries	▪ Competitive Price ▪ Broad Product Portfolio ▪ Sustain and build from existing customer base ▪ Meet competition as necessary	▪ Competitive prices ▪ Global ubiquity and interoperability ▪ Single Source Provider
Closed IMS – Wildcard	▪ "I'll do it my Way" ▪ Independent ▪ High Risk Taker	▪ Differentiation ▪ Unique Product Portfolio ▪ Redefine market	▪ Competitive value ▪ Unique services ▪ Regional geographic service
Only IMS – Market Follower	▪ "Wait until it's Ready" ▪ Incumbent, global Operator ▪ Conservative ▪ Developed countries plus emerging economies	▪ Price Leadership ▪ Voice-focused Product Portfolio ▪ Sustain and build from existing customer base ▪ Meet competition as necessary	▪ Value pricing ▪ "Good enough" new services ▪ Global interoperability
Early IMS – Market Leader	▪ "First to Market" ▪ Capture early adopters ▪ Moderate Risk ▪ Leading, global player ▪ Developed Countries	▪ Differentiation ▪ Segmentation-based Product Portfolio ▪ Pursue new services and niches ▪ Aggressively beat competition	▪ Competitive prices ▪ "Get it here first" ▪ Global ubiquity and interoperability

Source: UMTS Forum and Telecompetition, Inc., January 2003.

2.3.1 Service Capabilities for the Five Scenarios

The five scenarios have differing network deployment strategies, cost structures and service capabilities. These are described in detail in Section 5. These differing service capabilities support the overall market strategy, value proposition and revenue potential described for each scenario. The service capabilities for each scenario are discussed in more depth in the remainder of the report, but are briefly introduced here to aid in reader understanding.

No IMS – Keep it Simple

This is the situation whereby the operator makes a clear decision not to deploy IMS for some reason. However, in the model, it is assumed that a full 3G network is required and that it is implemented in a way that enables full interworking with other fixed and mobile networks, i.e. according to 3GPP Release '99.

In this and all the scenarios, a two year gap has been assumed between the start of network deployment and the launch of revenue generating services. This time, which in practice will vary between different operators and suppliers, is to allow for the process of implementation, deployment, tuning, optimisation and marketing. Thus, if the 3G network was deployed in 2003, then revenue-generating services would start in 2005.

The 3G/UMTS network provides conventional circuit-switched voice plus broadband packet data services. Furthermore, the incumbent operator in this scenario has a 2G network that can also deliver voice and data (2.5G). IMS services such as Rich Voice are not available.

As was pointed out in Report #20 and the Technology Enablers Annex, the long-term direction of fixed, mobile and corporate networks is to move away from ISDN based technology to all-IP implementation. This will ensure the integration of voice communications with data and information services, so enabling advanced services to be provided together with improved efficiency obtained by having only one integrated network to manage rather than two networks employing different technology. However, the No IMS example has particular value in this report, because it is the baseline against which the other scenarios are compared with regard to costs and revenues, and because it is an option that could be considered by some operators.

Full IMS – Technology Follower

In this scenario, the operator deploys both 3G and IMS. Both are implemented in a way that enables full interworking with other fixed, mobile and IP networks. Because this operator finds it most valuable to use standards-based technology IMS is deployed as soon as commercially available. The assumption has been made that the deployment is fully according to 3GPP specifications (Release 5 and 6), including IP based Radio Access Network (RAN) and that the capacity and quality of the IMS network is that it can carry a significant proportion of the voice traffic of the mobile network. From the IMS service date, the scenario allows IMS services such as Rich Voice to commence.

Closed IMS – Wildcard

In this scenario, the operator deploys both 3G and IMS. However, both are implemented in a way that discourages or even prevents full interworking with other fixed, mobile and IP networks. The operator believes that by deploying a network ahead of available standards or with features that are not included in any standard, he will be able to deliver unique services ahead of the competition that more exactly meet his target market's needs. A particular example might be an operator who would deploy a Microsoft NetMeeting server together with some of the IMS capability and other proprietary technology in order to provide a popular service to his users. Thus the Closed IMS scenario could be regarded as a competitive threat to less adventurous providers. There is no deliberate intention to prevent interworking, but the likelihood is that technological incompatibilities due to the early non-standard deployment would act to make interworking difficult.

Therefore, 3G network is deployed in a way that restricts interworking for data services as well as for IMS Services (Rich Voice). However, it is assumed that voice phone calls would interwork with other networks (particularly fixed networks) and that if a 2G network is available, then it would not be restricted in any way. While the scale and complexity of this network is projected to be similar to standard IMS deployed according to 3GPP specifications, it might use some proprietary technology or it might not include some 3GPP technology such as IP based RAN, enabling it to be deployed somewhat earlier.

Only IMS – Market Follower

In this scenario, the operator deploys both 3G and IMS, but only when IMS is commercially available. Because IMS then provides for voice as well as the more advanced data services, there is no need to deploy the Circuit Switched domain of the 3G network. However the network is implemented in a way that enables full interworking with other fixed, mobile and IP networks.

The IMS network in this scenario will be deployed exactly to 3GPP specifications (including IP RAN), which have not yet been completed, which means that deployment cannot commence until 2007, with both 3G and IMS services starting later. In the scenario we have assumed an incumbent operator and so voice and some data services will be available from the existing 2G/2.5G network in the interim period before IMS and 3G are available. This scenario provides for full quality and capacity for a substantial part of the voice traffic on IMS and interworking with other networks when available.

Early IMS – Market Leader

In this scenario, the operator fully deploys both 3G and IMS with full interworking with other fixed, mobile and IP networks. However, prior to the availability of the fully specified IMS system, the operator also deploys a small subset of the SIP/IMS network without the full features of 3GPP IMS, but with sufficient capability to allow the start of a few early innovative but limited IMS services such as the dispatch service (Push-to-Talk) described in more detail in Section 3.1.3. This network strategy is consistent with the operator's "First to Market" and intention to create competitive advantage. We have assumed that an effective SIP/IMS subset could be deployed as early as 2004, either onto an existing GPRS network. EDGE or the Release '99 3G network deployed in 2003.

It is predicted that the capability of these early limited IMS services would be progressively improved. So for example, at the start of the early deployment, the SIP/IMS Push-to-Talk service would likely be more suitable for consumer users. However at the time that a fully specified IMS is available (2007 for Rel.5/6 and IP RAN), the SIP/IMS Dispatch service should be suitable for professional users such as the emergency services etc and the IMS network would then also have the quality and capacity to carry a substantial part of the conventional voice telephony services also.

The network deployment decisions and service capabilities of each scenario are further discussed in Section 5.

3 The Strategic Issues of IMS

IMS completes the evolution of mobile networks to an IP environment. Therefore, IMS cannot be viewed as just another incremental network upgrade. IMS signifies a fundamental shift in network capability, interoperability, and end-user functionality not previously possible. The evolution to IP-based services is an important topic throughout the worlds of computing and fixed telecommunications. Its impact on mobile communications is no less important.

While the strategic implications of IP evolution, including IMS, are numerous, this report focuses on two issues of particular importance – service and technology strategies. The following service and network strategic issues provide the context for the details that follow in Sections 4 and 5.

3.1 Service Issues

IMS strategic service considerations include the ability of the technology to meet critical user needs, the timing of new service launch to meet user needs, maintain competitive position, meet financial objectives, and the balancing of launching new data services and sustaining existing voice revenue. This section discusses these three strategic service issues.

3.1.1 User Needs

As discussed in Section 2, increasingly enterprise, mobile workers and consumer needs for mobile access to information, resources, and people are growing in complexity and quantity. 3G/UMTS provides the increased bandwidth to access that information while mobile.

It is also not uncommon for mobile users to have PDAs, mobile phones, laptops, desktop computers, and other personal media devices. As a result, the desire for integrated or multi-function devices is growing. Increasingly, mobile users not only need the ability to access information while mobile, they also need the ability to access information seamlessly and securely from different sources or databases, and to integrate that content with personal communications over a number of devices. IMS, which improves service transparency and integration between networks, services, media types, and devices, provides a valuable tool for meeting that integration and transparency need.

The ability to meet these evolving user needs for integration and transparency are critical to the success of IMS, and requires successful execution of a number of complex technical and market initiatives.

3.1.2 Timing of Service Launch

The timing of service launches is critical. Network investment costs must be balanced against market and competitive demands for services. If one anticipates the market too much, then costs will be incurred sooner than revenue can be created. If investment is delayed for demand to be more fully developed, then market share may be lost to earlier competitors. Table 3.1 compares early and late market entry strategies.

Table 3.1. Advantages and disadvantages of market entry timing.

	Early Entry	**Later Entry**
Advantages	▪ Capture early adopters ▪ Obtain demand while prices higher ▪ Can define market expectations ▪ Opportunity to create entry barriers	▪ Reduce Costs ▪ Service / demand requirements better known ▪ Can learn from competitors' success and failures
Disadvantages	▪ Higher costs sooner ▪ Pioneering demand for other providers ▪ No history – trial and error service definition	▪ Prices may have dropped ▪ More competition already in the market ▪ Less market experience, competitive disadvantage

Source: UMTS Forum and Telecompetition, Inc., January 2003.

Market timing decisions should also consider the following:

- IMS provides a qualitative distinction that can be a source of competitive differentiation for mobile operators.
- IMS provides general market benefits through more rapid service creation and competitive differentiation.
- Measuring direct revenue benefits from IMS deployment is problematic. For example, if IMS only impacts 10% of users, that 10% may be the most influential early adopters, which in turn will prevent subsequent adoption by “followers”.

3.1.3 Service Options for Voice

An important consideration for operators is the evolution of voice services since these represent the largest revenue source today. Three types of voice service are analysed in this report – Simple Voice, Simple Voice delivered by IMS (IMS Voice) and Push-to-Talk. In addition to these three basic voice services, IMS enables Rich Voice services, whereby voice will be one component of multimedia communications (other media components including video, graphics, text, etc.). However, in this report, such Rich Voice services are analysed in the category “IMS Services”.

Whilst traditional voice and the future IMS Voice are transparent to the end-user and all voice ARPUs are declining, they are separated in this report due to their different cost structure and application. An additional voice service opportunity, “push-to-talk”, has been considered in this report. The term push-to-talk comes from the type of two-way radio system used by dispatchers and it provides a different type of service for different user groups than mobile telephones. The main differences are that communication is one way at a time, initiated by pressing and holding a switch rather than by dialling, and that the communication can be overheard by others in the community of interest. In addition to dispatch services, less robust push-to-talk products are now making inroads in the consumer market as well. Interviews with industry sources have suggested that push-to-talk is not a replacement for consumer mobile voice. Rather, it represents a new type of usage in closed user groups that was not previously captured by the mobile phone providers, where it is a more convenient way to quickly relay information than by making a mobile phone call. For example, a family in a shopping mall notifying family members to meet at a store.

A number of operators and manufacturers are exploring ways to utilize SIP call processing to offer push-to-talk or dispatch services via 2.5G (GPRS) and 3G mobile telephone networks today rather than wait until the completed IMS standards are commercially available. Such pre-IMS services would offer voice having the quality of service most immediately associated with Citizens Band (CB) radio and consumer walkie talkies, but without the range restriction (few km). We have considered such a service as the main service component of the “Early IMS” deployment scenario. Such an early IMS service, without the full capability of the completed IMS standards, would not be able to provide the network quality and reliability necessary for professional dispatch services such as the emergency services (fire, police and ambulance) as well as radio-controlled taxi and delivery services. Today many of these services also use push-to-talk radios, but on special networks. However, once the IMS networks have been fully built out to 3GPP standards, the network quality and reliability should then be sufficient even for emergency services and professional users.

Push-to-talk services are complex to add to an existing cellular network as every switch, base station, and terminal would need to be upgraded. However, with SIP, the service could be simply implemented in a single application server.

Table 3.2 summarises the service choices related to voice that could be available to mobile operators.

Table 3.2. Service choices for voice with a comparison of attributes.

Attribute	Voice	Push-to-Talk	IMS Voice
Technology	2G / circuit-switched	Early IMS packet-switched	IMS IP-based
Service Example	Local calling	Dispatch	Long distance
Voice Quality	High	Good enough	High
User Experience	Landline	2-Way Radio	Landline
Quality of Service (QoS)	Medium	Low (Becoming Medium for Full IMS Deployment)	Medium

Source: UMTS Forum and Telecompetition, Inc., January 2003.

There are several threats to incumbent, voice-centric mobile operators:

- Dial-around (bypass) by existing international, fixed resellers.
- Fixed line-based VoIP third party service providers.
- Service bundling by large service providers, especially for enterprise customers.
- Accelerating corporate transition to VoIP services within the enterprise

These threats exist independent of IMS, and voice revenues may be threatened before IMS is even available. So infrastructure costs and the ability to meet these threats without losing margin becomes a strategic consideration in choosing the service options and infrastructure available to operators.

3.2 Network Deployment Issues

Whilst service launch and network deployment issues are interdependent, they are often analysed separately.

Deployment costs and available capital are unique to each operator. Costs vary based on the size and configuration of the network, the relationship with infrastructure vendors, and technologies chosen. This report presents generic cost models by hypothetical deployment scenarios as the basis for structuring deployment decisions and provides some tools by which an operator can evaluate individual situations. Specifically, the following deployment cost considerations are analysed:

- Relative size of cost to deploy IMS
- Available timing of these costs

In addition to cost considerations, service launch dates, network capabilities and deployment timing are strategic considerations.

3.2.1 Network Decisions and Competitive Position

The type, timing, and scale of network deployment are strategically important to creating a market position. The functional capabilities provided by the chosen network determine the breadth of service features, the level of network quality and reliability, and how quickly services can be developed and launched. In addition, the network decision largely defines the cost structure of the mobile network operator in terms of total investment, on-going network operational expenses, and labour costs. It can also significantly contribute to the operator's ability to achieve economies of scale and obtain competitive cost of capital (e.g. debt). Thus the network decision must be evaluated in terms of the total market and business strategy and not just the network efficiencies, performance, or coverage obtainable.

3.2.2 Network Interoperability

One of the important benefits of standard implementation of IMS is the increased interoperability of IMS services both between mobile networks and between mobile and fixed IP networks.

The value of interoperability has already been demonstrated in the mobile industry with two services:

- Messaging
- Roaming

The rapid take-up of SMS services in Europe (where GSM dominates) compared to the poor adoption in the US (which has several different network technologies that cannot easily exchange SMS messages) is one such example. International roaming, whilst comprising less than 10% of mobile minutes, is a highly profitable service and an important value for business users in particular.

For mobile voice, the ability to access mobile services when outside the operating area of the provider has been fundamental to the success of the industry. If IMS mobile data (non-real-time) and Rich Voice (real-time) services could not seamlessly roam from one mobile network to another, a negative impact could be expected. Usage would logically be reduced, but more importantly, service adoption itself may be reduced if users perceive they cannot use the service when they need it the most (i.e. while travelling). The ability to terminate mobile voice traffic on other mobile networks as well on fixed voice networks is so critical to the basic concept of voice communications that it is considered fundamental to network design. In the future, the ability to terminate traffic between fixed IP (Internet traffic) and mobile IP networks should be viewed with equal significance. Such mobile to fixed IP interoperability can be expected to increase overall traffic on both networks. For example, if the rapidly growing SMS traffic in the mobile environment could be combined with the Instant Messaging traffic on the fixed Internet, traffic terminated on both networks would increase.

3.2.3 Network Capabilities

An example of a network deployment issue of strategic importance is VoIP. Until IMS is commercially available, operators will carry voice traffic on existing circuit-switched networks. Therefore until IMS is commercially available and/or for those operators that choose not to deploy IMS, dual or overlay networks will exist. This may increase the cost structure of the non-IMS operator, putting them at a cost disadvantage to a service provider able to offer VoIP.

3.2.4 Timing of Network Deployment

A variety of network deployment issues change with time and can impact a strategic analysis. The following are considered in this report:

- Equipment costs typically decrease over time as volumes increase
- Early adoption prior to standardisation can result in higher costs later to convert to standard equipment
- Standardisation timetables and associated commercialisation dates.

4 Network Considerations to Add IMS

This section looks at the changes that are necessary in order to add IMS to a UMTS network. The intention is to provide an indication to the industry of the cost needed for such an investment, which can then be balanced against the increased revenues from new IMS services. In this report, five different deployment scenarios for IMS are presented. The intention is to analyse the five scenarios in terms of a simplified, comparative cost and revenue profile.

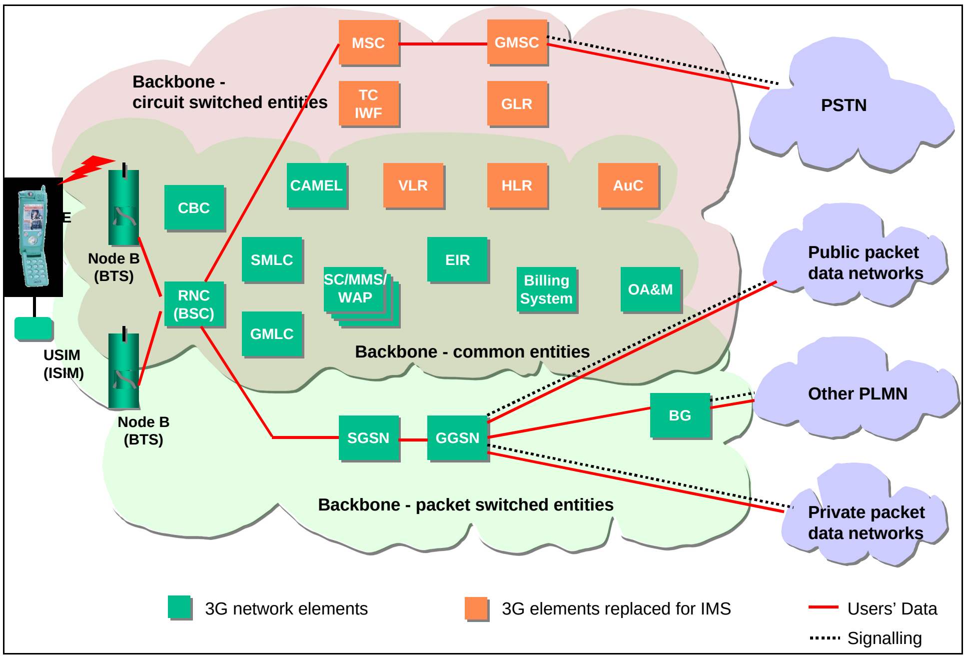
In order to estimate the investment profile for each of the five scenarios, we have first examined the two known and standardised network architectures, UMTS with and without IMS. A methodology for estimating the cost of IMS networks is then described. From the two basic networks illustrated, we have then looked at the variations in order to arrive at the profiles for the five different deployment scenarios.

The challenge has been to produce cost information for IMS at a time when the industry probably does not yet have prices and in a situation where prices for network equipment are not made public. However, the cost of deploying a UMTS network will now be familiar to operators and to an extent, the figures are approximately known to the technical press and have been published. In brief, then, the methodology is to compare the IMS platforms with the UMTS platforms on the basis of roughly equivalent complexity and then to apply this to each of the network architecture variations that result from the different deployment scenarios. One of the key differences between the five deployment scenarios is that the TIMING of the investment in both 3G and IMS platforms differs. The subsequent presentation for each deployment scenario model shows a relative cost and the timing of each tranche of investment.

4.1 UMTS Baseline Network Architecture (without IMS)

UMTS (3G) is the baseline against which IMS deployments will be compared. It happens also to correspond to one of the deployment scenarios – “No IMS”. A generic network architecture is shown in Figure 4.1. It is based on Release 1999 (Rel-99) of the UMTS standard published by 3GPP and the acronyms are explained in the appendix (Section 9.4). No attempt has been made to model a real physical deployment or to scale the relative numbers of the different network elements required. The platforms needed to provide services and content are also shown as well as the end-users’ traffic flow. However, the complex signalling data flow is only shown by the network “clouds”, apart from an initial connection between the mobile network (PLMN) and each of the external networks. It shows a fundamental feature of pre-IMS networks, namely that the signalling data follows the same path as the traffic. The call control and the service provisioning software are both integrated in the same platforms, making the development of new telephony services costly and time consuming.

Figure 4.1. 3G/UMTS Reference network architecture (Rel-99).



Source: 3GPP and Telecompetition, Inc., September 2002.

4.1.1 Network and Deployment Description

The network architecture and the following descriptions are based on the latest 3GPP specification to describe the Rel-99 implementation[4]: The pre-IMS UMTS network incorporates two domains: the Circuit Switched (CS) domain based on 2G GSM technology and the Packet Switched (PS) domain based on GPRS (2.5G). The 3G Radio Access Network (RAN) is newly introduced in UMTS. The elements, shown in Figure 4.1, which make up the cost of deploying a 3G/UMTS network, are identified in Table 4.2.

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[4] TS 23.002 version 3.5.0 and to a lesser extent on the GPRS Service Description Stage 2 in TS 23.060 version 4.5.0 (actually a Rel-4 document).

Table 4.2. Key components of a UMTS network.

Domain / Location / Function	Name	Type	Comment
Circuit Switch (CS)	MSC – Mobile Switching Centre	Large network element	
	GMSC – Gateway MSC	Large network element	
	GLR – Gateway Location Register	Network element with database	
	TC/IWF The Transcoder and Interworking Function	Plug-in cards/module	
Circuit Switched (CS) and Packet Switched (PS)	HLR – Home Location Register	Network element with database	
	VLR – Visitor Location Register	Network element with database	
	AuC – Authentification Centre	Network element with database	
	EIR – Equipment Identity Register	Network element with database	
Packet Switched (PS)	SGSN – Serving GPRS Support Node	Network element	
	GGSN – Gateway GPRS Support Node	Network element	
	BG – Border Gateway	Network element	
Radio Access Network (RAN)	BSC – Base Station Controller or RNC – Radio Network Controller	Large network element	
	BTS – Base Transceiver Station or Node B	Network element	
Mobile Station	ME – Mobile Equipment	Subscriber terminal ("handset")	Not included in cost analysis
	USIM – UMTS Subscriber Identity Module	Card in terminal	Not included in cost analysis
Messaging Services	SC/MMS/WAP – Centres and gateways for messages	Network elements	
	CBC – Cell Broadcast Centre	Network elements	
Location Data	SMLC – Serving Mobile Location Centre	Network element with database	
	GMLC – Gateway Mobile Location Centre	Network element with database	
CAMEL	CAMEL – Customized Applications for Mobile Enhanced Logic	Software	
Management Functions	OAM&P – Operations, administration, maintenance and provisioning systems / platforms	Software	Not included in cost analysis
	Billing system	Software	Not included in cost analysis
Transport	Backbone and backhaul circuits	Transport facilities – often leased from wireline operators	Not included in cost analysis
Other	GCR – Group Call Register for number portability, OSA servers, buildings, planning, network, optimisation, service development toolkits, etc.	Varies	Not included in cost analysis

Source: UMTS Forum and Telecompetition, Inc., January 2003.

4.2 UMTS Architecture (With IMS)

The architecture presented here for the main comparison with 3G assumes that the existing 3G/UMTS network is upgraded to include IMS, including multimedia call control based on the Session Initiation Protocol (SIP) from IETF and that legacy mobiles supporting circuit-switched voice are still required. It also happens to correspond to one of the five deployment scenarios “Full IMS”.

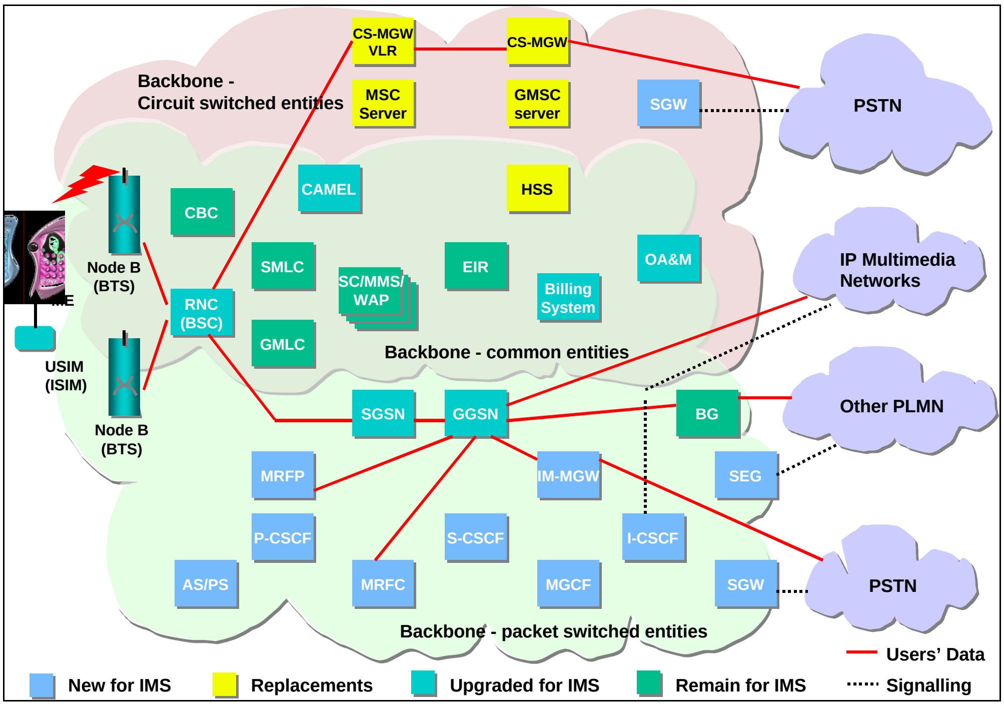
A complete generic network architecture is shown in Figure 4.3. It is based on Release 5 (Rel-5) of the UMTS standard published by 3GPP and the acronyms are explained in the appendix (Section 9.4). It shows the platforms that have been added in order to implement the IMS core network as well as the 3G platforms that require substantial upgrade in order to support it. These are mainly platforms within the Packet Switched domain.

IMS does not necessarily put additional requirements on the components of the infrastructure that transport the IP packets. An installed base using ATM transport (“IP over ATM”) is capable of supporting IMS as an alternative to one based on all-IP transport. A feasible path for an operator is to introduce all-IP transport when it is justified for other reasons in addition to IMS. For example, network expansion can be done with IP transport whilst keeping the installed ATM transport. Thus the overall business plan can decide when the ATM transport network should be replaced by all-IP. However provided, the backbone packet transport network must support the Quality of Service (QoS) requirements for IMS and upgrades may be necessary in some cases.

Also shown is a fundamental change to the circuit-switched core network that was introduced in the 3GPP Rel-4 specifications. Because IMS is concerned with moving real-time person-to-person services such as speech away from the CS domain and into the PS domain, it might be thought that upgrades to the CS domain are irrelevant. However, given that legacy mobiles still have to be supported, the Rel-4 changes are highly synergistic with one of the main principles behind the IMS architecture, namely the separation of user data and signalling. Thus an operator moving to IMS may well implement these options (and probably in his 2G network as well). In Figure 4.3, the separation of the signalling and the user data (traffic) can clearly be seen (but shown only at the interfaces to the external networks for clarity), especially when compared to Figure 4.1.

Our cost analysis methodology, presented in Section 4.4, enables other scenarios to be evaluated, such as moving from a Rel-4 network to IMS (Rel-5), or from Rel-99 to Rel-5 without implementing the Rel-4 changes to the CS domain (if that is possible without undue risk).

Figure 4.3. Reference network architecture – 3G/UMTS with IMS (Rel-5).[5]



Source: 3GPP and Telecompetition, Inc., September 2002.

4.2.1 Network Architecture and Deployment Description

The network architecture and the following descriptions are based on the latest available 3GPP specification to describe the Rel-5 implementation: TS 23.002 version 5.7.0 and to a lesser extent the IMS Stage 2 Description: TS 23.228 version 5.5.0, the Architectural Requirements: TS 23.221 version 5.5.0 and 23.207 version 5.4.0 the end-to-end QoS description. It must be pointed out that at the time of writing, the IMS standards work is not complete, particularly in areas such as the security requirements. Some Rel-5 requirements may be delayed and some essential features of IMS may not come until Rel-6. Therefore there may be additional implications to come. Further information can be found in the Annex to UMTS Forum Report 20 on Technology Enablers for IMS.

In particular note that in an IMS network the application servers are the platforms that determine the characteristics and special features of calls. Unlike conventional mobile and fixed networks, where the call processing is mainly software tied to the switches and network platforms, in IMS the Application Servers are physically separate platforms that can be owned by third parties as well as network operators and can even reside in different connected networks.

The new elements that add the IMS capability as well as the changes that must be made to the existing 3G elements in order to support the IMS environment are identified in Table 4.4.

[5] Figure 4.3 does not include all platforms for all possible services.

Table 4.4. Changes needed in order to implement IMS and SIP.

Domain /Location / Function	Change	Type	Comment
Circuit Switch (CS)	MSC Server (new platform)	Large server platform	Replaces signalling part of 3G MSC
	GMSC Server (new platform)	Large network platform	Replaces signalling part of 3G GMSC
	CS-MGW The Circuit Switched Media Gateway (new platform)	Large network platform	Replaces switching part of 3G MSC and GMSC and incorporates VLR and TC/IWF
	TC/IWF (changed out)	Plug-in cards/module	Moved into CS-MGW
(CS) and Packet Switched (PS)	HSS – Subscriber System (new platform)	Network element with database	Combines the functionality of the 3G HLR and AuC. Has new functions and interfaces for IMS
	VLR (changed out)	Network element with database	Moved into CS-MGW
	AuC (changed out)	Network element with database	Combined with HLR in new HSS element
Packet Switched (PS) and IP Multimedia Subsystem (IMS)	CSCF – Call Session Control Function (new platform)	Network element	New call control platform for IMS deployed as 3 types: P-CSCF, S-CSCF and I-CSCF
	IM-MGW The IP Multimedia Gateway (new platform)	Network Element	New bearer control platform for IMS
	MRFP – Multimedia Resource Function Processor (new platform)	Large media store and signal processing platform	New multimedia resource for IMS
	MRFC – Multimedia Resource Function Controller (new platform)	Network element	New control platform for IMS
	AS – Application Server (key new platform)	Server platform	New SIP server for telephony and value added services. May be a third party platform in another network
	PS – Presence Server (new platform)	Server platform	Specific example of an Applications Server
	MGCF – Media Gateway Control Function (new platform)	Network element	For interworking with legacy call control
	SGW – Signalling Gateway Function (new platform)	Network element	For interworking with legacy signalling transport
	SEG: The Security Gateway (new platform)	Network element	Signalling security between IP networks
	GGSN (significant upgrade)	Network element	Support of QoS management and new interfaces
	SGSN (significant upgrade)	Network element	Support of RSVP
Radio Access Network (RAN)	BSC or RNC (significant upgrade)	Large Network element	IP and QoS enhancements – RSVP support
	BTS or Node B (significant upgrade – but may be optional)	Network element	IP RAN enhancements
Mobile Station	ME – Mobile Equipment (new terminal)	Subscriber terminal (“handset”)	Not included in cost analysis but operator may subsidise
	USIM – UMTS Subscriber Identity Module (may need to be different from 3G USIM)	Card in terminal	Not included in cost analysis
CAMEL	CAMEL platform (significant upgrade)	Platform and Software	Additional element and interface
Management Functions	OAM&P (Will require upgrade to handle new IMS platforms)	Software	
	Billing system (will require upgrade to bill for IMS and third party services)	Software	
Transport	Backbone and backhaul circuits (packet networks may need to be upgraded to support MPLS and RSVP)	Transport facilities – often leased from wireline operators	Not included in cost analysis

Source: UMTS Forum and Telecompetition, Inc. August 2002.

4.2.2 All-IP RAN

The network described above is shown to include the "All-IP RAN". This is commonly understood to mean the inclusion of methods of providing for efficient transport of IP over the radio interface, such as Robust Header Compression (RoHC). Our costing methodology allows the savings obtained by not implementing IP RAN to be examined and compared to the drop in spectrum efficiency (hence reduced capacity and potential lost revenue) that would result.

4.3 Cost Factors in Deploying IMS

Any non-operator-specific discussion of costs is, by its very nature, general and high level. Operators will complete their own detailed analysis particular to their own strategy and existing network. Furthermore, each operator will decide the pace of their network transition and the network elements selection based on either *de facto* or industry approved standards. The cost profiles presented here are simply intended to provide some further insight to the industry as to the current, general direction of a standards-based evolution toward all-IP services. Our goals are:

- Contribute to the industry knowledge base related to future IP-based networks.
- Provide direction to the standards community as to the likely costs for the current direction of standards vision.
- Provide a high-level view of the cost impact of migrating to IMS services.

It is important to note the following caveats in this high-level examination:

- Only two extreme network architectures can be fully analysed – UMTS only (3GPP Release '99) and 3G incorporating a fully functioning end-to-end capable IMS deployment, which is actually beyond the current level of standardisation (Release 5). The architectures for other scenarios are based on anticipated variants to these two published architectures.
- While operators need standards-based solutions to deliver transparent services, they will only deploy technology that meets their market needs. Should 3GPP fail to deliver such solutions, other approaches will be used.
- IMS standards impact costs at all levels – from a "card-level" change to the potential replacement of an MSC with a softswitch. While all changes currently envisioned have been included in the analysis, there may be other small changes such as software upgrades that have not been detailed here. The sum total of many such small changes can certainly add up to a significant impact which is not reflected in this cost analysis.
- While, according to the 3GPP network architecture, an IMS network will use only softswitches for both conventional Circuit Switched voice and Voice over IP, in practice, operators may not discard existing MSCs and IMS could exist as an overlay. Given this fact, the network costs might reflect an overstatement of actual build out costs. This overstatement serves to offset the cost impact of the many small network changes that will need to happen to support IMS services as mentioned above.
- Only capital costs are considered in the cost analysis.
- Infrastructure costs associated with building new buildings and acquiring new cell sites are not included.

In addition, whether certain costs are incurred or not is very dependent upon the operator's existing network configuration, capabilities and capacities. In order to present a meaningful look at the order of magnitude of the IMS network upgrade costs, a number of simplifying assumptions have been made. These were noted in Table 4.4 and are listed again below to clearly highlight the limitations of this analysis. The assumptions are:

- Sufficient transport capacity in both backbone and backhaul networks is available to support the early introduction of IMS services.

- Service development costs are and will continue to be an on-going and possibly significant cost for operators for all mobile data services. No additional costs are therefore assigned to IMS for service-level development and testing.

- System and back-office platform upgrades and migration are a significant cost for operators. System costs are operator-specific and therefore not included.

- End-users of IMS services will need to purchase or upgrade their terminals/handsets. This cost cannot be estimated and, in theory is not an operator cost and is therefore excluded.

We have found that when we have discussed predicted cost figures with operators and suppliers, it is often difficult to come to a precise agreement, because costs vary based on network configuration, size, legacy components, etc. We have instead provided both a tool that the reader may use to analyse their own situation and illustrations of the relative size and timing of deployment costs. The tool is first presented, followed by high level results using the tool with hypothetical networks under the five scenarios.

4.4 Deployment Cost Methodology and Calculation Tool

The determination of future network costs is potentially complex and time consuming, as well as open to errors and interpretation. Therefore an innovative methodology has been developed which gives a reasonably accurate result and most importantly can be scaled to any operator's situation. Furthermore, the methodology is one that can be developed to give reasonably accurate results in the future, including time-variable results that take into account, for example, cost erosion.

The methodology is described below and some sample calculations are included to demonstrate its use. It has been designed as a tool for general use in calculating an estimation of the deployment cost of IMS networks and so organisations will be able to use their own data using this methodology in order to generate figures for their own situation.

The goal of this methodology is to provide a high-level estimate of the cost of deploying an IP-based infrastructure based on the current direction of the 3GPP standards work. In addition to the caveats mentioned in Section 4.3, several approaches to this analysis were studied which highlighted a number of complicating factors. These factors include:

- Pricing varies by manufacture and network architecture and is in most cases difficult to obtain.
- Some essential IMS platforms have not even been specified yet by 3GPP, let alone designed or priced.
- The capacity of each network element is needed to ascertain detailed costs.
- The impact of operator-specific discounts is difficult to consider.
- The topology of the network, especially the RAN varies between countries and operators.

A comparative cost approach was selected for this study that presents key relative incremental costs of non-IMS and IMS on an element-by-element basis. The approach involves comparing each IMS network element with the nearest equivalent 3G (or GSM/GPRS) platform on the basis of either cost or technical complexity. Then from an estimate of what proportion of the total cost of a 3G network that element represents, the proportion of the total cost of a 3G network the corresponding IMS platform represents can be deduced. By completing this analysis for all the IMS network elements, we can estimate the total incremental capital cost needed to fully implement IMS as a percentage of the cost already invested in the 3G network.

Using the methodology as a tool, a reader is able to estimate actual costs for IMS using their own prices for each element and can choose the assigned proportions based on their own circumstances and also derive figures for their own custom deployment scenarios.

The analysis methodology produces a cost estimate for deploying IMS as an incremental increase over an operator's existing UMTS network cost.

The first step is to estimate the proportion of the total cost of deploying 3G that each 3G network element represents, so for example, the switches (MSCs and GMSCs) might represent 12% of the total cost of a network. The second step estimates the comparative cost of each IMS network element. We compare each of the new IMS network elements with the nearest equivalent 3G network element and estimate the cost of the IMS element as a proportion of the cost of that 3G element. Thus for example, the functions of the GSM Mobile Switching Centre (MSC) correspond broadly to the functions provided by the SIP Call Control Server, the Media Gateway Controller and the MSC Server (Softswitch) in the IMS. Therefore the cost of the MSC servers, which provide only part of the function of a full MSC and also use lower cost technology, might be say 30% of the cost of the comparable MSCs. We also perform this second step for any necessary upgrades to the 3G platforms that are necessary for them to support IMS (for example, upgrades to existing 3G base stations). The third and final step is to derive the cost of each IMS element or upgrade as a proportion of the cost for the whole 3G network and then sum the total. The proportional cost of each IMS element is the product of its comparative cost and the proportional cost of the comparable element. So for our example of an MSC server, it represents 30% of 12% that equals 3.6% of the original 3G network deployment cost. The resulting summed total is a figure for the comparative cost of the whole IMS deployment compared to the original 3G network deployment. The process is shown in Table 4.5 which incorporates fictional figures including the example described:

Table 4.5. A methodology to assessing network costs including illustrative examples of network elements.[6]

3G Network Element Type (GSM/GPRS) for Comparison	**% Each Network Element Type represents of the Total Network Cost (f)** **(Varies by operator, size of network, etc.)** **Step 1**[7]	**Replacement/New IMS Component Types**	**Cost of IMS Element Types Compared to 3G Element (g)** **Step 2**	**IMS Element as % of Total 3G Network Cost** **$h = (g \times f^l / 100)\%$** **Step 3**
MSC, GMSC...	12%	MSC Servers	30%	3.6% (h_1)
MSC	12%	SIP Application Server (AS)	10%	1.2% (h_3)
BSC/RNC	5%	IP Interface	4%	0.2% (h_4)
3G Network element #3	(f^l_3)	*IMS Network element #5*	(g_5)	(h_5)
Other 3G network elements….	(f^l…..)	*Other IMS network elements….*	(g^l…..)	(h…..)
Total % for all Network Elements	**= 100%**		**Incremental Cost Estimate: IMS/3G**	**$h_1+h_2+h_3+h_4+h_5+h....$ %**

[6] The actual structure of the table will vary depending upon the scenario under discussion.

[7] The percentage represents the total of all individual elements within the network element type. For example, all MSCs in the network would represent 12% of the total cost.

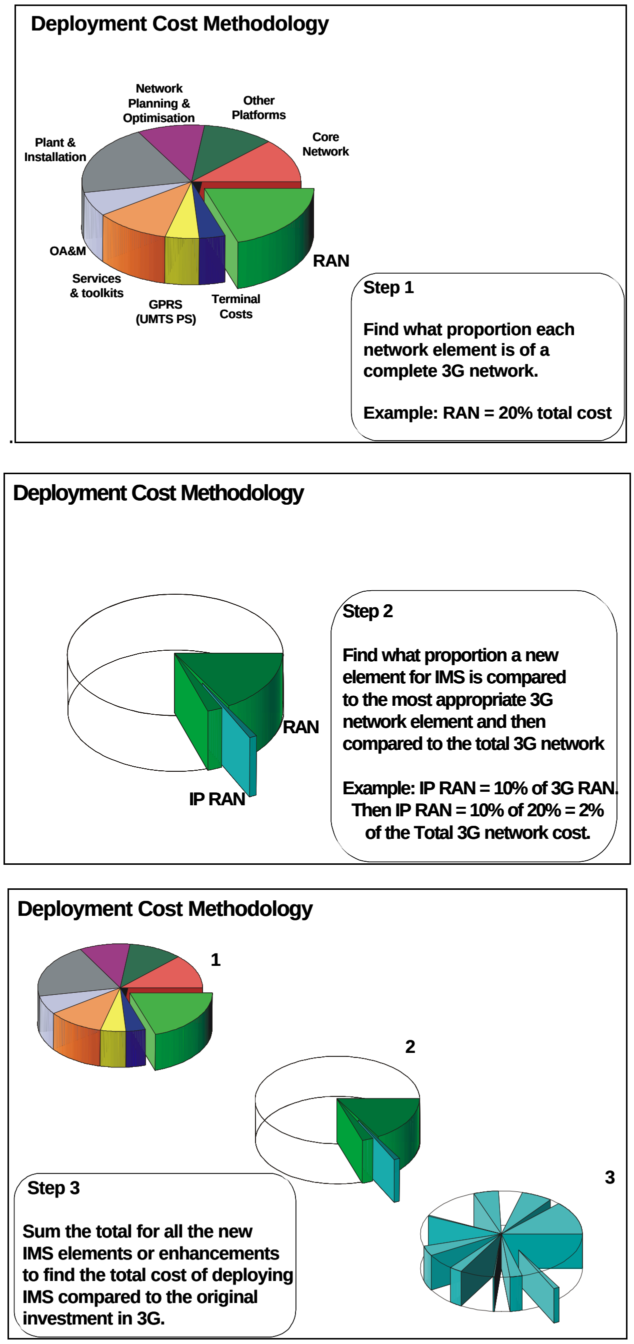
Source: UMTS Forum and Telecompetition, Inc., September 2002.

The key to the validity of this methodology is the estimate of the comparative cost of the IMS network element and the corresponding 3G network element (g). This estimate can be developed in three ways:

- Where IMS and 3G prices are available, the comparative cost can be derived from actual pricing information.
- The comparison can be made on the basis of the relative complexity of the two platforms.
- In the case of IMS platforms that have not yet been fully specified by 3GPP and therefore not designed or priced, their comparative cost can be estimated from knowledge of the expected technical complexity.

Figure 4.6 shows a pictorial summary of the steps in the overall methodology.

Figure 4.6. Deployment cost methodology, steps 1-3.



Source: UMTS Forum and Telecompetition, Inc., September 2002.

Cost Calculation Example

An example of a cost calculation using this methodology is presented in Table 4.7. A hypothetical network configuration is assumed for illustration purposes (of the scenarios analysed in this report, the example here most closely corresponds to the Early IMS deployment). The table has also been designed as a tool so that organisations can estimate the cost of their own deployment scenarios and in practice, the actual network configuration should be entered as specified in the column headings. The example shown is also based on the assumption that the upgrade to IMS is made from UMTS Rel-99 rather than Rel-4. This is because most information on 3G network investment, to which the cost of IMS will be related, probably relates to Rel-99. IP-based RAN has been included in this example, because the 3GPP specifications are driving towards its inclusion. It is an easy matter to re-calculate the effect of excluding IP RAN or the effect of upgrading from Rel-4 to IMS instead.

Table 4.7. IMS deployment cost calculation tool – Illustrative example (using Early IMS). .[8]

List all 3G network element Types you plan to deploy	Enter % each item represents of your overall network cost	Identify the replacement/new IMS Network Element Type that has approximately the same functionality	Enter your estimate of the cost of IMS Element Type Compared to 3G Element	Calculate your estimated incremental costs
MSC + VLR + G-MSC	15%	MSC Server, GMSC Server, VLR	0%	0%
		P-CSCF + S-CSCF+ I-CSCF	4%	0.6%
		MRFP + MRFC	0%	0%
		MGCF + SGW	0%	0%
		SEG	0%	0%
		AS/PS	3%	0.4%
TC/IWF	1%	CS-MGW + IM-MGW, inc. Wideband AMR codecs	0%	0%
HLR + AuC	2%	HSS	0%	0%
RNC/BSC	5%	Dual Stack & IP Interface	2%	0.1%
Node B/BTS	35%	Dual Stack & IP Interface & SIP Signalling Compression	3%	1.0%
		"IP RAN" (RoHC)	0%	0%
CAMEL	3%	IM-SSS	10%	0.3%
OA&M	6%	OA&M for IMS	14%	0.8%
		Terminal Management	7%	0.4%
Billing	3%	Billing for IMS	5%	0.2%
3G Terminal Subsidies & Testing	0%	IMS Terminal Subsidies & Testing	0%	0%
USIM	0%	USIM + ISIM (optional)	0%	0%
EIR, SC, CBC, SMLC, GMLC, MMS, WAP	4%	New software load	2%	0.1%
SGSN, GGSN, BG	4%	QoS Management functions	0%	0%
Initial 3G Services - MMS, Presence	0%	Initial IMS Services	0%	0%
3G Services Toolkits (SAT)	0%	IMS Services Toolkits	0%	0%
Internal PLMN Backbone (Capital Eqpt.)	0% 2%	Upgrade to Support QoS RSVP, MPLS	0%	0%
Inter-PLMN Links (CS, PS)	0%	QoS Enabled internets	0%	0%
3G Radio Network Optimisation & Tuning	0%	Real Time Packet Radio Optimisation	0%	0%
Buildings, Plant, Antennas, Installation	20%	Installation of IMS Platforms	0.5%	0.1%
Total % for all Network Elements	**100%**		**Total Incremental Cost: IMS/3G**	**4.0%**

Source: UMTS Forum and Telecompetition, Inc., January 2003.

This same approach has been used to calculate costs for each of the five scenarios.

[8] The figures in this table are for illustrative purposes only and have no technical or commercial significance.

5 Network Deployment Descriptions for Each Scenario

Network deployment choices are inherent in each of the five scenarios presented in this report. In addition, information about the costs associated with each scenario is needed to assess the strategic implications. The cost methodology presented above was used to estimate the size and timing of the costs associated with each scenario. Those high level results along with a further description of each scenario are presented here. It is important to note that actual costs are dependent on many factors not addressed in this report. The goal is only to provide high level, generic information to help the reader start a more detailed, realistic analysis.

5.1 No IMS – Keep it Simple (Baseline)

This is the situation whereby the operator makes a clear decision not to deploy IMS. However, in the model, it is assumed that a full 3G network is deployed according to the 3GPP Rel-99 specification and that it is implemented in a way that enables full interworking with other fixed and mobile networks. The network architecture is exactly as shown in Figure 4.1, while the network description is as described in Section 4.1.1, with the key components shown in Table 4.2. Thus they will not be repeated here.

Network Capability and Limitations

The 3G/UMTS network provides conventional circuit-switched voice (3G Simple Voice) plus broadband packet data and Internet services (3G Information Services). Furthermore, if the operator has a 2G network, then this can also deliver Simple voice and data (2.5G). IMS is not strictly needed in order to provide such Internet services as most people know them today.

The 3G information services are all non-real time, predominantly one-way at a time services. Where the pre-IMS network is limited is in its ability to handle IP multimedia services, which are defined as real-time conversational services, because of the lack of control of delay and jitter. Thus IMS Rich Voice services are not available (neither, it has been assumed, any limited IMS services such as dispatch). An example of an IP multimedia service is Microsoft NetMeeting. NetMeeting allows users of fixed terminals to share on-screen presentations, graphics and text. This aspect of NetMeeting is effectively non-real time. If a group of users were to set up a NetMeeting session on UMTS (without IMS), it is unlikely that participants would notice timing jitter or slight delays, which would affect the turning of the pages of a presentation.

NetMeeting also includes a voice conferencing facility, which is the real-time conversational part of the IP multimedia application. Now many users of broadband corporate LANs and the broadband Internet will have found that this aspect of NetMeeting works quite well because these networks have so much excess capacity and bandwidth that Quality of Service (QoS) is rarely a problem. It might even work on 3G/UMTS networks while they are lightly loaded. However, users of less well performing links will have noticed major QoS problems and such users will be faced with two serious disadvantages: poor voice quality and a cumbersome call set up process as described below.

Firstly non-IMS mobile networks are likely to have much lower bandwidth available per user and may be heavily loaded. Because such networks cannot distinguish between data packets and speech packets, clashes occur and because there is no priority information, the speech packets suffer unacceptable delays and jitter. This can cause the speech part of the service to become unintelligible or at least very annoying. Secondly, non-IMS networks do not perform media conversion to enable media to be transported efficiently over the radio interface. Therefore the use of applications such as NetMeeting relies on the application's built-in speech coding and if byte-based pricing is applied as in some GPRS services today, such users are likely to face high session charges.

Users of Microsoft NetMeeting[9] on poor quality fixed links overcome the speech quality problem by setting up a completely separate conference call via the (circuit-switched) telephone network. Now this is entirely possible on 3G/UMTS because a Class A GPRS (UMTS) terminal enables a packet-switched data session and circuit-switched voice call to be set up simultaneously! However this results in another disadvantage of non-IMS in that the setting up of an application like NetMeeting will be very cumbersome:

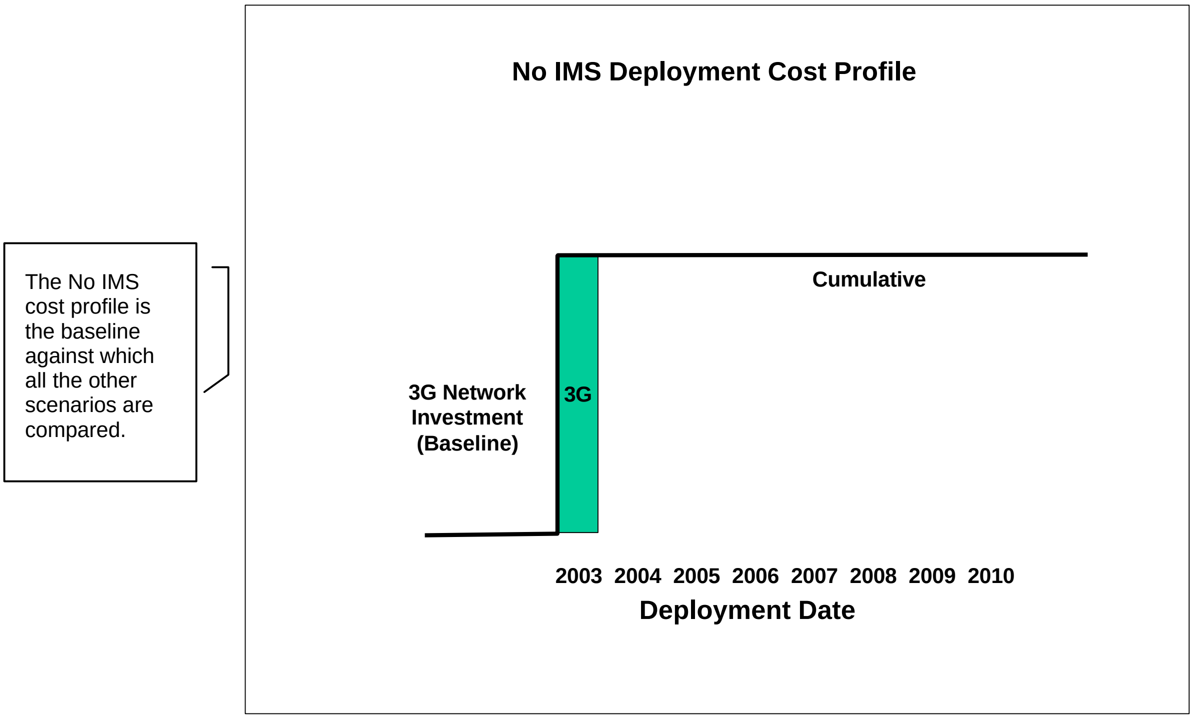
- The user has to set up a voice conference call (circuit-switched)
- The user has to set up a packet data connection to the Internet
- The user has to start NetMeeting and conference in the other participants.

We will see that IMS overcomes these shortcomings by providing the necessary QoS management to enable the real-time part of an IP multimedia service to work satisfactorily. Therefore the non-real time and real-time media can be integrated as the designer intended, providing the user with a simple one-step process for setting up the whole session.

Deployment Cost Profile (Baseline)

A simplified illustration of the cumulative cost profile for a scenario where no IMS is deployed is shown in Figure 5.1. This profile is used as the baseline against which all the other deployment scenarios are compared and the investment has been assumed to be in one stage shown as 2003. This is about the earliest that a 3G network could be deployed according to 3GPP Release'99 standards. Other Standards, such as FOMA could be deployed earlier and depending on licence arrangements, operator and supplier strategies, the deployment might be later than shown here.

Figure 5.1. No IMS (Baseline) Cost Profile.



Source: UMTS Forum and Telecompetition, Inc., January 2003.

[9] NetMeeting is based on H.323 and is no longer being supported by Microsoft. SIP is included within Windows XP as part of Microsoft Messenger.

5.2 Full IMS – Technology Follower

In this scenario, the operator deploys both 3G and IMS. The 3G network is deployed according to the 3GPP Rel-99 specification and the IMS network according to the full 3GPP specification (to be completed). Both are implemented in a way that enables full interworking with other fixed, mobile and IP networks. The 3G network architecture is exactly as shown in Figure 4.1, while the IMS network is exactly as shown in Figure 4.3 and the network description is as described in Section 4.2.1, with the key components shown in Table 4.4. Thus these figures and tables will not be repeated here.

Network Capability and Limitations

By comparison with non-IMS networks (Section 5.1), the IMS network is able to provide the necessary Quality of Service (QoS) for real time person-to-person multimedia. This means that for our previous example of Microsoft NetMeeting, the integrated speech (or video) conferencing facility will give consistent high quality results. This is what the user of telephony applications expects and it is made possible because the network now has the ability to distinguish critical data packets containing speech from low priority ones containing email or other non-real-time critical data. The network has the ability to give these critical packets the necessary priority over others and deliver them within the required jitter and packet loss requirements.

Because the real-time and non-real-time parts of an IP Multimedia application like NetMeeting can now be fully integrated as intended, the user can have just one simple point-and-click process to set up the session, instead of three. This provides a much more satisfactory and potentially richer user experience.

While the provision of all the Media Gateways has undoubtedly added complexity, it means that media can be converted to a format that is both optimally efficient for the radio interface and formatted to the display characteristics of the mobile terminal. Thus multimedia can be delivered at the least cost and most appropriate quality to the user.

Feature Set used in the Analysis

In this scenario and for the purposes of the revenue comparisons, it has been assumed that there are no restrictions placed on the interoperation of IMS services delivered to mobile users and IP multimedia services available in the fixed Internet or intranets such as web services. Thus it has been assumed that any service architecture incompatibilities between 3GPP and the fixed Internet world are resolved by means of appropriate APIs and terminal applications software etc. The cost of any such additional software or platforms has not been included in the cost analysis, however.

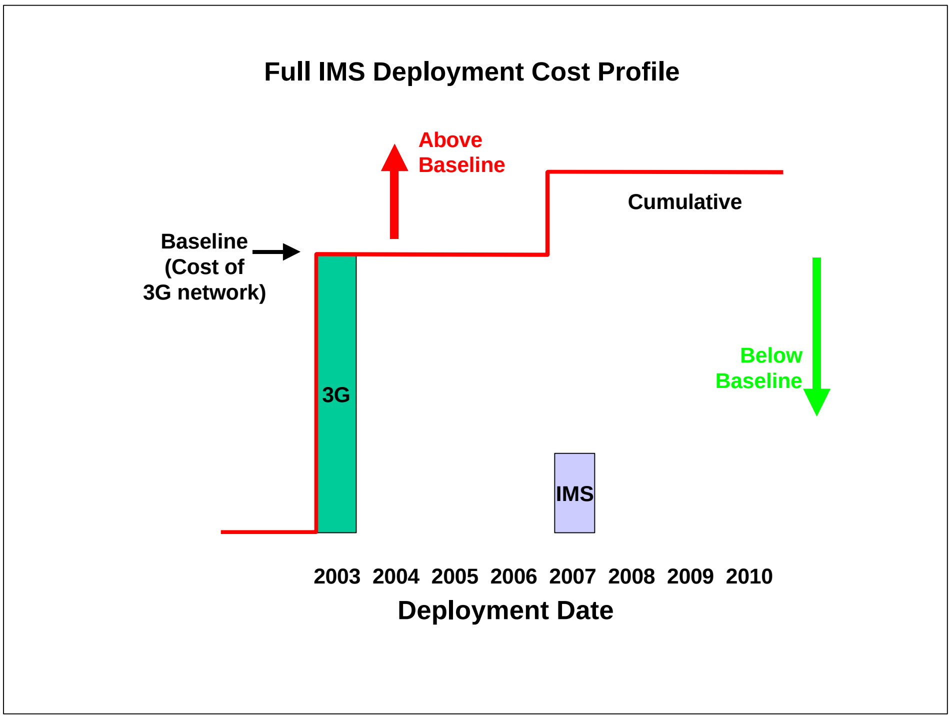
It has been assumed that the IMS network example has been deployed to the full extent of the 3GPP network architecture, as it is understood today, incorporating all the features. The scale of the IMS network model is assumed to be such that it can carry a significant proportion of the real-time traffic. Thus the scale of the IMS platforms is intended to be similar to the scale of the circuit-switched domain platforms in terms of subscriber, traffic and call processing capacity and the IMS network model does NOT represent an initial start-up situation, but a full scale commercial situation.

Deployment Cost Profile – Full IMS

A simplified illustration of the cumulative cost profile for a scenario where no IMS is deployed is shown in Figure 5.2. In this example, it has been assumed that the 3G network was deployed in 2005 with its revenue generating services starting somewhat later to allow for the process of implementation, deployment, tuning, optimisation and marketing. Because the IMS network in this scenario will be deployed exactly to 3GPP specifications (Release 5/6, including IP RAN), which have not yet been completed, the deployment is shown as taking place four years later than 3G, in 2007. Full IMS services will also be critically dependent on the availability of SIP based terminals with the capability to handle the all IP air interface. It should not be implied, however that there is a fixed time relationship between 3G and IMS. 3G or IMS or both might be deployed later according to licence conditions, operator or supplier strategies. The scenario does not allow for any limited IMS services such as dispatch to start early.

Figure 5.2. Full IMS (Technology Follower) cost profile.

Deployment of 3G and IMS is to full 3GPP specifications. It is not implied that there is necessarily any fixed time relationship between 3G and IMS



Source: UMTS Forum and Telecompetition, Inc., January 2003.

5.3 Closed IMS – Wildcard

In this scenario, the operator deploys both 3G and IMS. However, both are implemented in a way that discourages or even prevents full interworking with other fixed, mobile and IP networks. There are two potential motivations that might persuade an operator to follow this route. Firstly, an operator might consider that by deploying a network ahead of available standards or with features that are not included in any standard, he may be able to deliver unique services ahead of the competition. There is no deliberate intention to prevent interworking, but the likelihood is that technological incompatibilities due to the early non-standard deployment would act to make interworking difficult. The second motivation is that some operators might consider that it would be advantageous if they could retain and control all the service revenues for themselves rather than allow external ISPs or other mobile operators to deliver services and charge for them. In this case, the network could be deployed to 3GPP standards, but other actions would be taken to restrict or prevent interworking.

We have no exact knowledge of the technology that might be employed for a Closed IMS deployment, but for the purposes of this analysis, we have assumed that it would be broadly similar to the architecture of the 3GPP standards. Thus the 3G and IMS network architectures would be similar to that shown in Figures 4.1 and 4.3 and the network description is as described in Section 4.2.1, with the key components shown in Table 4.4, but with one exception:

In this example, the 3G network is deployed in a way that restricts interworking for advanced 3G information services as well as for IMS Services (Rich Voice). However, it is assumed that 3G Simple Voice (basic phone calls) would interwork with other networks (particularly fixed networks) and that if a 2G network is available, then it would not be restricted in any way. Therefore it has been assumed that the platforms associated with IMS interworking with external networks could be deleted. Those are the IM MGW, SGW and SEG.

<u>Network Capability and Limitations</u>

By comparison with non-IMS networks (Section 5.1), the Closed IMS network is able to provide the necessary Quality of Service (QoS) for real time person-to-person multimedia, but only within the mobile operator's domain. Because some form of basic access would undoubtedly be provided for data services, it means that our previous example of Microsoft NetMeeting could be set up, but it would fail to give consistent high quality results except to mobile users within the same network. Media sourced from outside the network would not be available.

Although no standard exists for a Closed IMS deployment we anticipate that the platforms shown in Table 5.3 need not be deployed.

Table 5.3. Key components of an IMS network not needed under the Closed IMS scenario.

Domain / Location / Function	***Name***	***Type***	***Comment***
Packet Switched (PS) and IP Multimedia Subsystem (IMS)	IM-MGW The IP Multimedia Gateway (new platform)	Network Element	Not required when there is no interworking.
	SGW – Signalling Gateway Function (new platform)	Network element	Not required when there is no interworking.
	SEG: The Security Gateway (new platform)	Network element	Not required when there is no interworking.

Source: UMTS Forum and Telecompetition, Inc., January 2003.

Because we expect that at least basic speech and data services that interwork with external networks will be provided, we have not anticipated any changes to the initial 3G network deployment, despite the fact that we have speculated that advanced 3G information services would not interwork with external networks. However, we have assumed that proprietary technology or the postponement of certain features, such as IP RAN, might allow the IMS solution to be deployed somewhat earlier than IMS deployed to full 3GPP standards.

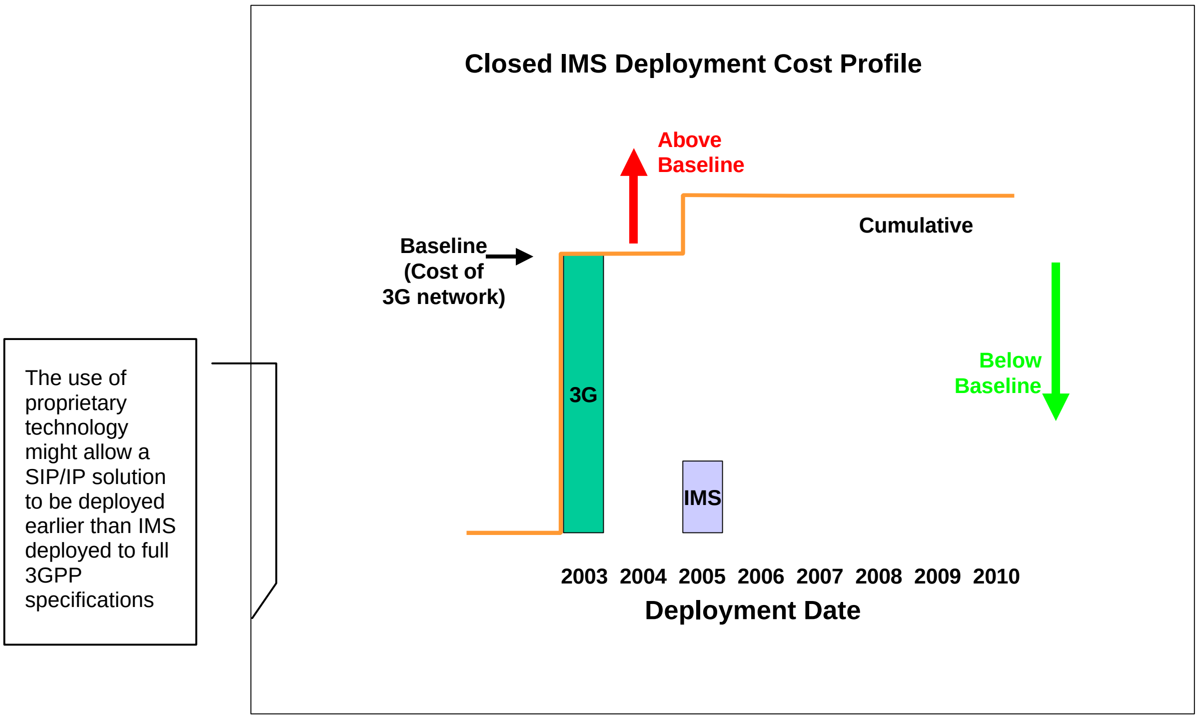
Feature Set used in the Analysis

It has been assumed that the Closed or Restricted IMS network example will be deployed to an equivalent extent to a standard 3GPP network architecture incorporating similar features. The scale of the Closed IMS network model is assumed to be such that it can carry a significant proportion of the real-time traffic within the network. Thus the scale of the IMS platforms is projected to be similar in terms of subscriber, traffic and call processing capacity and the Closed IMS network model will evolve to a full-scale commercial situation.

Cost Profile for Closed IMS Deployment

A simplified cost profile is shown in Figure 5.4. The eventual cumulative cost is slightly below that of a full IMS deployment because of the deletion of the platforms noted above.

Figure 5.4. Closed IMS (Wildcard) cost profile.



Source: UMTS Forum and Telecompetition, Inc., January 2003.

Figure 5.4 indicates that deployment of the Closed IMS network starts no earlier than the Full IMS solution shown in Figure 5.2. This is because although this scenario is not necessarily dependent on the availability of 3GPP specifications, we have assumed that it would take equally as long to develop and deploy the closed technology for the sophisticated IMS services. However, it is possible that the proprietary IMS deployment could allow some limited IMS services such as dispatch services to start early and although it has not been shown in this example, it would be a simple matter for the reader to derive the effect from the information provided in the sections on Early IMS.

5.4 Only IMS – Market Follower

In this scenario, the operator deploys both 3G and IMS, but only when IMS is available. Because IMS then provides for Simple Voice services as well as the more advanced services, there is no need to deploy the circuit-switched domain of the 3G network, either as Rel-99 or as an upgrade to Rel-4. The 3G Switched Domain and the IMS network are deployed according to the full 3GPP specification (to be completed for IMS). Both are implemented in a way that enables full interworking with other fixed, mobile and IP networks.

The dependency on 3GPP IMS specifications (Release 5/6), which have not yet been completed, means that deployment cannot commence until some years after initial 3G to release '99 specifications is first available. In addition, because in this scenario the basic 3G network is not deployed until the same time that IMS is available, shown here as 2007,the revenue for 3G voice and information services also cannot be earned until much later than the other scenarios. Full IMS services will also be critically dependent on the availability of SIP based terminals with the capability to handle the all IP air interface. However, if the operator has a 2G/2.5G network, then virtually all the Simple Voice revenues can be earned from his existing network in the interim period, as well as those information services that can be delivered via GPRS. We have assumed that this scenario does not allow for any limited IMS services such as dispatch to start early.

<u>Network Capability and Limitations</u>

Once it has been deployed, the IMS Only network is able to provide the necessary Quality of Service (QoS) for real time person-to-person multimedia, including full interworking with other networks, both

IMS and legacy non-IMS. This is made possible by virtue of the Media Gateways and Signalling Gateways. The only exception may be some of the less popular ISDN supplementary services, which may never be replicated for IMS. Prior to IMS services being available, our previous example of Microsoft NetMeeting could be set up on 2.5G GPRS, but it would mostly give poor results on the speech channel. Most users would probably set up a parallel speech conference using the 2G GSM circuit-switched network.

We anticipate that the 3G platforms shown in Table 5.5 will not be needed for an IMS Only deployment.

Table 5.5. Key IMS components not needed for the Only IMS scenario.

Domain / Location / Function	***Name***	***Type***	***Comment***
Circuit Switched (CS) Rel-99	MSC – Mobile Switching Centre	Large network element	Circuit Switched elements not deployed in this scenario – function performed by IMS
	GMSC – Gateway MSC	Large network element	See above
	GLR – Gateway Location Register	Network element with database	See above
	TC/IWF The Transcoder and Interworking Function	Plug-in cards/module	See above
Circuit Switched (CS) and Packet Switched (PS)	HLR – Home Location Register	Network element with database	Not deployed – HSS deployed instead
	AuC – Authentification Centre	Network element with database	Incorporated in HSS
Circuit Switched (CS) Rel-4	MSC Server (new platform)	Large server platform	Circuit Switched elements not deployed in this scenario – function performed by IMS
	GMSC Server (new platform)	Large network platform	See above
	CS-MGW The Circuit Switched Media Gateway (new platform)	Large network platform	See above
	SGW – Signalling Gateway Function (new platform)	Network element	The SGW associated with the Circuit Switched Domain is not needed. The one associated with PS/IMS is still deployed.

Source: UMTS Forum and Telecompetition, Inc., January 2003.

Feature Set used in this Analysis

As with the full IMS deployment, for the purposes of the revenue calculations, it has been assumed that there are no restrictions placed on the interoperation of IMS services delivered to mobile users and IP multimedia services available in the fixed Internet or intranets such as web services.

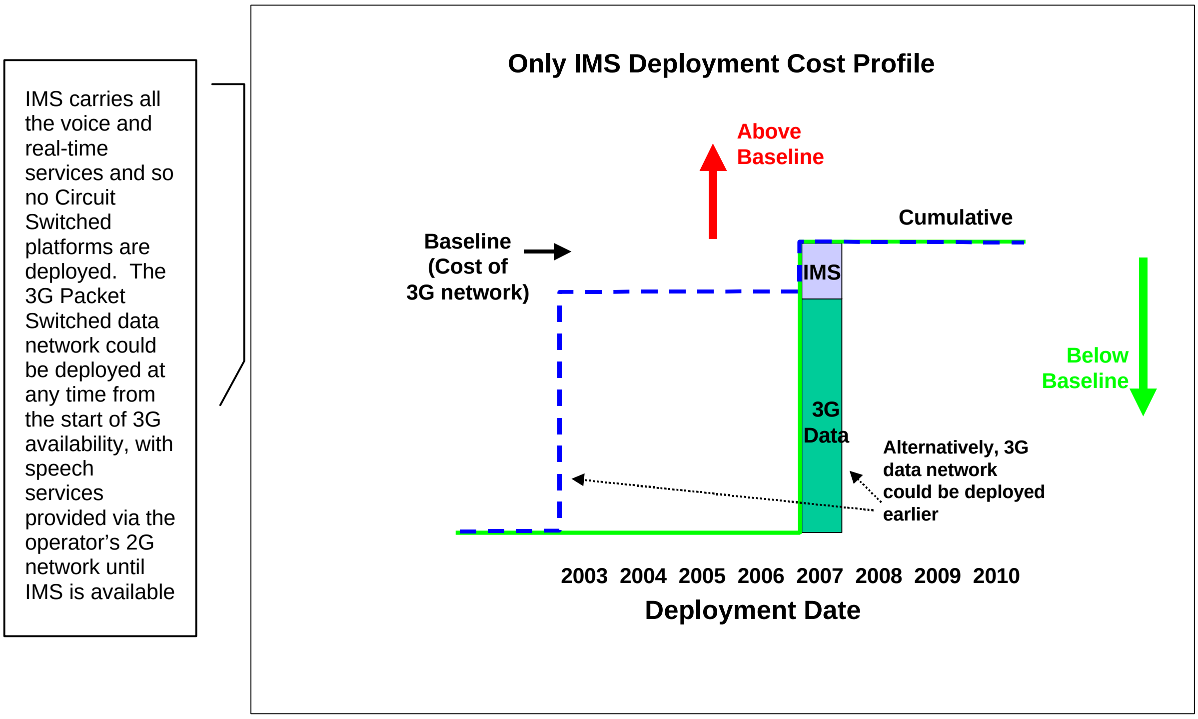
It has also been assumed here that the IMS network example has been deployed to the full extent of the 3GPP network architecture, as it is understood today, incorporating all the features. The scale of the IMS network model is assumed to be such that it can carry all the real-time traffic in a full commercial situation.

The only limitation with this deployment scenario is that legacy non-IMS terminals that do not incorporate a GSM dual mode cannot be used to make voice calls. The only case where this limitation would apply, is for Japanese and Korean users of FOMA pre-IMS 3G terminals that roam into Europe and other areas where the 2G technology is GSM, and then only if all the networks in that particular area have been deployed according to the Only IMS model. European, American and other Far Eastern users will have 3G terminals (pre-IMS) that all have GSM dual mode and so roamers from these regions will be able to receive a satisfactory Simple Voice service in an Only IMS network deployment.

Cost Profile for Scenario Where Only IMS is Deployed

A simplified cost profile is shown in Figure 5.6. The investment starts significantly later than for a conventional 3G plus IMS deployment and the final cumulative cost including IMS is only marginally greater than for a conventional 3G (CS plus PS) network only. Furthermore, because 3G is deployed at a later date and to a more mature version of the standard, there could be some further cost erosion. This factor has not been included in the scenario, but readers should be able to apply their own historical data to the figures.

Figure 5.6. Only IMS – Market Follower cost profile.



Source: UMTS Forum and Telecompetition, Inc., January 2003.

A variant of the above scenario is worth further examination. This would involve deploying the Packet Domain of 3G as soon as practicable (i.e. not waiting until IMS is available) but without ever deploying the 3G CS domain. IMS is added when it is commercially available and provides for the delivery of 3G Simple Voice as well as IMS services.

The IMS network would be deployed exactly to 3GPP specifications at the same time as for the other scenarios. The main difference for this variant is that the 3G packet-switched network part of UMTS is deployed any time after 2003 rather than necessarily waiting until 2007 and so revenue for 3G information services can be earned much earlier. These information services such as the UMTS Forum categories Internet Access, Intranet/Extranet Access, Customised Infotainment, Multimedia Messaging and Location Services are the main sources of incremental revenue for 3G. Only the service category 3G Simple Voice cannot be delivered until IMS is deployed as was the case with Scenario 4. However, if the operator likewise has a 2G network, then virtually all the Simple Voice revenues can be earned from it this way in the interim period, until Simple Voice and Rich Voice is then delivered via IMS.

5.5 Early IMS – Market Leader

In this scenario, the operator fully deploys both 3G and IMS with full interworking with other fixed, mobile and IP networks. However, prior to the availability of the fully specified IMS system, the operator also deploys a small subset of SIP and IMS without the full features of IMS, but with sufficient capability to allow the start of a few early innovative but limited IMS services.

The main feature that would probably not be available for an early deployment would be Quality of Service management and some of the media features. A service that fits in with this capability and yet still has significant advantages as a SIP/IMS implementation is the Dispatch Service described in detail elsewhere.

Note that when the limited IMS services are first deployed early on, there is no interworking with other networks expected. There is no deliberate intention to prevent interworking, but the likelihood is that technological incompatibilities due to the early non-standard deployment would act to make interworking difficult. In the interim period it is predicted that the capability of these early limited IMS services would be progressively improved. So for example, at the start of the early deployment, the SIP/IMS dispatch service would only be suitable for consumer users. However at the time that a fully specified IMS is available, the SIP/IMS dispatch service should be suitable for professional users such as the emergency services.

Network Capability and Limitations

We have no exact knowledge of the technology that might be employed for an early IMS deployment, but for the purposes of this analysis, we have assumed that it would be broadly similar to the architecture of the 3GPP standards. Thus the 3G and IMS network architectures would finally be similar to that shown in Figures 4.1 and 4.3 and the network description is as described in Section 4.4.1, with the key components shown in Table 4.4.

However, at the start of the early deployment, a number of IMS platforms probably need not be installed, particularly those associated with QoS management and advanced multimedia. Furthermore, because the limited Early IMS services would have a small subscriber base, the IMS network would in effect be a small subset of an IMS network. As a result, the IMS platforms could be substantially reduced in terms of capacity, performance and size compared to the Full IMS deployment. A number of experts have stated that for such an IMS start-up, the numerous IMS functions shown in Figure 4.3 could be reduced to "a few cards in a server". In fact an early SIP/IMS feature of this type could probably be implemented in 2.5G GPRS networks.

This situation has been reflected in Table 5.7 that shows the platforms not required in the Early IMS initial deployment, or substantially reduced in scale. The Dispatch Service in our analysis has been included in the Applications Server (AS) element rather than as a separate Dispatch Server (as is likely to be the case for a mature SIP/IMS realisation). Also, it has to be repeated that the full 3G network is initially deployed for this scenario as well as the full IMS network at a later date, in addition to the Early IMS network subset of the table below,

Table 5.7. Key components not needed or substantially reduced for the Early IMS Market Leader scenario.

Domain /Location / Function	***Name***	***Type***	***Comment***
Circuit Switched (CS)	MSC Server (new platform)	Large server platform	Does not replace MSC until full IMS deployed
	GMSC Server (new platform)	Large network platform	Does not replace GMSC until full IMS deployed
	CS-MGW The Circuit Switched Media Gateway (new platform)	Large network platform	Not deployed for early network. Only when full IMS deployed
	TC/IWF (changed out)	Plug-in cards/module	Not changed out until full IMS deployed
(CS) and Packet Switched (PS)	HSS – Subscriber System (new platform)	Network element with database	Does not replace HLR until full IMS deployed
	VLR (changed out)	Network element with database	Not moved until full IMS deployed
	AuC (changed out)	Network element with database	Not changed out until full IMS deployed
Packet Switched (PS) and IP Multimedia Subsystem (IMS)	CSCF – Call Session Control Function (new platform) deployed as 3 types: P-CSCF, S-CSCF and I-CSCF	Network element	Substantially reduced in scale for early network
	IM-MGW The IP Multimedia Gateway (new platform)	Network Element	Not installed until full IMS deployed
	MRFP – Multimedia Resource Function Processor (new platform)	Large media store and signal processing platform	Not installed until full IMS deployed
	MRFC – Multimedia Resource Function Controller (new platform)	Network element	Not installed until full IMS deployed
	AS – Application Server (key new platform)	Server platform	Deployed on reduced scale in early network. Incorporates Dispatch server
	PS – Presence Server (new platform)	Server platform	Deployed on reduced scale e.g. for early IMS MMS services
	MGCF – Media Gateway Control Function (new platform)	Network element	Not installed until full IMS deployed
	SGW – Signalling Gateway Function (new platform)	Network element	Not installed until full IMS deployed
	SEG: The Security Gateway (new platform)	Network element	Not installed until full IMS deployed
	GGSN (significant upgrade)	Network element	Minimal support for IP added. No support for QoS until full IMS deployed
	SGSN (significant upgrade)	Network element	Minimal support for IP added. No support for RSVP until full IMS deployed
Radio Access Network (RAN)	BSC or RNC (significant upgrade)	Large Network element	Minimal support for IP added. No support for QoS or RSVP until full IMS deployed
	BTS or Node B (significant upgrade – but may be optional)	Network element	IP RAN enhancements not installed until full IMS deployment
Management Functions	OAM&P (Will require upgrade to handle new IMS platforms)	Software	Substantially reduced OA&M enhancements and Terminal Management for early network
	Billing system (will require upgrade to bill for IMS and third party services)	Software	Reduced scale Billing System upgrade for IMS early network

Source: UMTS Forum and Telecompetition, Inc., January 2003.

Feature Set used in this Analysis

Full 3G is assumed to be deployed with all the features and services associated with it (3GPP Release '99). An initial start-up IMS network will then be deployed, able to deliver limited early SIP/IMS services that are not critical with regard to QoS management. One such service that has been identified is a dispatch service, which offers one-way-at-a-time push-to-talk group calls. Another could be SIP-based multimedia messaging. The Early IMS deployment will have negligible impact on the NetMeeting user, because QoS is not supported.

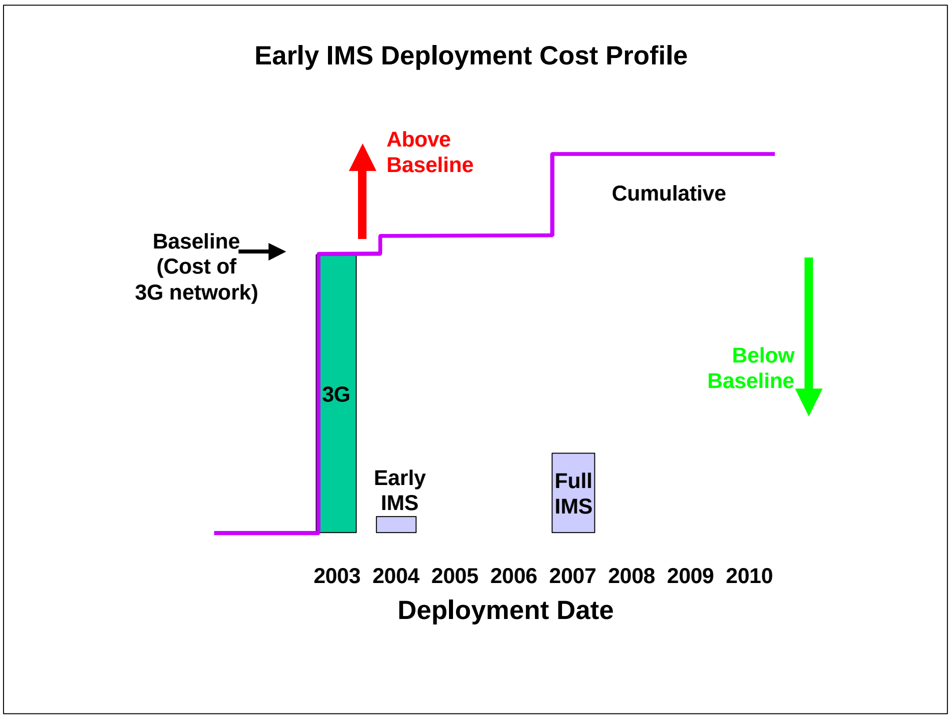
Finally, a full IMS network example will be deployed incorporating all features and this will provide the consistency, quality and reliability for real-time services that users expect. The scale of the IMS network in its final form is assumed to be such that it can carry a significant proportion of the real-time traffic within the network. Thus the scale of the IMS platforms is eventually projected to be similar in terms of subscriber, traffic and call processing capacity to the 3G circuit-switched platforms and it will evolve to a full-scale commercial situation.

Cost Profile for Early IMS Scenario

A simplified cost profile is shown in Figure 5.8. The investment steps are now in three stages, shown here as 2003 and 2007 for 3G and the Full IMS networks respectively and 2004 for the Early IMS network subset.

Figure 5.8. Early IMS – Market Leader cost profile.

The figure shows the likely earliest dates that the three deployments could be made. It is not implied that there is any fixed time relationship between them. It could depend on licensing conditions, operator or supplier strategies.

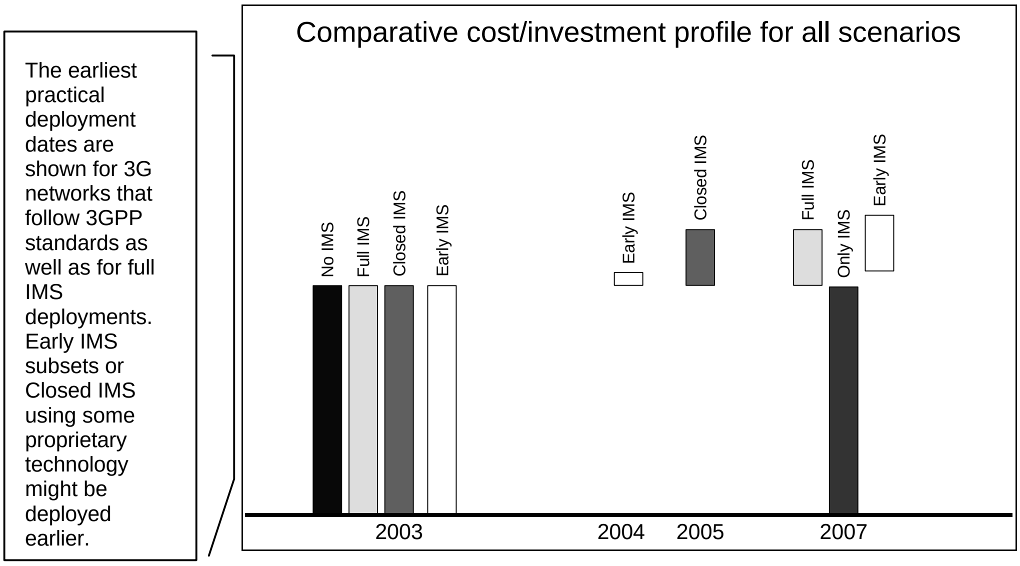


Source: UMTS Forum and Telecompetition, Inc., January 2003.

5.6 Comparison of Scenarios

In this section, we compare the cost and revenue profiles for each of the scenarios described above. In the results to follow, the cost of deploying a 3G network without IMS is used as a baseline against which the other scenarios are compared. Using the methodology, we obtain the results shown in Figure 5.9 below:

Figure 5.9. Comparative cost/investment profile for all scenarios.



Source: UMTS Forum and Telecompetition, Inc., January 2003.

Note that in the cases of the Only IMS scenario (Scenario 4), the cost of deploying the 3G network is below the baseline cost because the circuit-switched platforms are not deployed. The cost of the additional IMS network in this scenario is also reduced compared to the Full IMS scenario, because the 3GPP Rel-4 circuit-switched platforms such as the MSC Server are not deployed. The result is that for the Only IMS scenario, the eventual cumulative cost of deploying both 3G data and IMS is only marginally above that of conventionally deploying a 3G network only (the baseline).

The initial deployment cost for the early IMS platforms is shown to be only a small proportion of the investment in 3G. This is because of both the restricted service capability and the small-scale capacity of the early network. It has been assumed that the cost of the early IMS platforms cannot be recovered and are not included as part of the fully functional network deployed later. This is because there is likely to be a significant difference in the performance, capacity and reliability of the early deployment compared to what would be required in the long term.

This figure can also be used to easily work out the cost implications of adding an early IMS deployment to any of the other scenarios. The reader simply has to superimpose the Early IMS step and add it to the cumulative figure. For example, including an Early IMS deployment in the Closed IMS scenario would increase the cumulative investment but enable some IMS services to start a few years earlier.

6 Service and Revenue Descriptions for Each Scenario

Network operators make technology deployment decisions based upon their individual market and economic circumstances and their individual business strategies. This section combines the services, and end-user benefits with the 3G and IMS network requirements to describe five distinct scenarios that include services offered, market dynamics, market strategy, and a likely deployment decision based upon those circumstances.

6.1 Revenue Implications of IMS

As discussed earlier and in the Appendix, IMS enables a qualitatively better end-user experience due to the increased service integration and interaction. Without IMS, similar services may still be possible, but will lack the ease-of-use that IMS can provide. Qualitative differences in end-user experience do make a difference in buying decisions and therefore result in quantitative differences in revenue.

Using the service category framework in Figure 2.2, quantitative impacts can be attributed to the deployment of IMS in a 3G network. These impacts include:

Services that are made possible by IMS Rich Voice services, which by definition are the integration of real-time voice with multimedia, will be impossible without IMS. Therefore IMS is wholly responsible for the revenues generated from the Rich Voice services category.

Services that are enhanced with IMS capability IMS (largely through SIP and presence) provides increased service integration and interaction in all service categories. In addition, the ability to integrate non-real-time services (such as MMS) with real-time (Rich Voice) services in a single device improves ease-of-use and enhances the end-user experience. Therefore, it is reasonable to expect that the deployment of IMS will have some positive impact on service adoption in all other service categories. For example,

- *Consumer and Business MMS*: As a person-to-person messaging service, the ability to easily integrate other person-to-person communications (i.e. voice) can be expected to positively increase take up and usage of MMS. (See "Teenage MMS" in the Appendix.)
- *Mobile Intranet / Extranet Access*: Enterprise adoption of mobile data services (which already face some substitution threat with public WLAN) will be enhanced with IMS as mobile professionals will more easily integrate their voice and data remote access needs. (See Mobile VPN in the Appendix.)
- *Location-Based Services and Customised Infotainment*: Services based on personalised access to content would see slight increase in service adoption due to the increased ability to engage interactively with other users while viewing content (such as gaming, navigation data, and advertising information) and conducting transactions. (See Consumer Mobile Gaming in the Appendix.)

6.2 Revenue Components

There are a number of different services that can be implemented within the service categories just described. For purposes of this report's analysis, we will not attempt to itemise or describe all the individual services that the operators in each scenario might offer. Rather, we have grouped revenue potential into the components that are either considered a strategic issue or are specifically enabled by the network deployment assumed in each scenario.

- **IMS Services** – includes revenue from real-time Rich Voice services plus incremental IMS benefits to other 3G services including streaming and non real-time SIP-based services.
  - Push-to-Talk – an example of an early IMS service, two-way voice service over 2G, 2.5G or 3G networks.

- **Other Data Services** – includes non-real-time 2.5G and 3G service revenue from five service categories: Customised Infotainment, Mobile Intranet / Extranet Access, Mobile Internet Access, Location-Based Services, Multimedia Messaging Service.

- **Roaming** – in the most general sense, includes international and domestic interoperability between networks for mobile voice, data and messaging.

- **Voice** – traditional voice using circuit-switched networks.

- **IMS Voice** – traditional voice over the Internet or other IP-based network.[10]

The following sections describe the operator profile, market strategy, customer profile, and service portfolio of each of the five scenarios. The revenue component figures within each scenario description illustrate the revenue components offered in that scenario both before and after commercial availability of IMS. The "before IMS" portion of each figure assumes the same start date for each scenario. These figures illustrate a relative proportion of the overall revenue attributable to each revenue component for a hypothetical operator in that scenario. However, the columns in the figure are not drawn to exact scale. The fundamental analysis is based upon average revenue per 3G subscriber of the operator in that scenario, not on total market share or operator total revenue.

6.3 No IMS – Keep it Simple

In this scenario, the mobile operator is a regional service provider with limited resources compared with the large global operators. Therefore, the focus is on the core competencies of the company and limiting the complexity of the network, market activities, and operational support systems. While this operator will take moderate market and investment risks within the scope of a relatively narrow product portfolio, in general it sticks to the basics and investing in what the company does best – efficient network operations. Network costs are kept low while still providing adequate capacity, speed and fast download. The company follows an "access focused" business model, maximizing network traffic while minimizing costs.

Market Strategy

In line with the philosophy of simplicity, the business has made a strategic decision to pursue competitively priced mobile access, i.e. high quality basic voice services plus high-speed mobile data services, with no provision for integration of more complex real-time or transaction-based services. High-speed mobile data access and good quality voice transmission are the most important components of the value proposition. Mobile data access is the flagship product, with voice as a necessary convenience to customers and to increase revenue. The services are positioned as complementary to fixed Internet access as well as other remote access services and devices. For example, services include access through PDAs and laptops.

The market objective is to develop relationships and services that maximize traffic. Third party channels, MVNOs and other service providers are used extensively. For example, because this operator focuses on users of high-speed mobile data access, there is competition from substitute services such as public wireless LAN (802.11 – "WiFi"). The strategy is to position the services as complementary to PWLAN. There are few if any branded portal services. Third parties also provide most of the mobile content and advanced services such as location-based services.

Prices are kept at parity with the competition. Price margins are slim, and therefore costs must be kept low and traffic volume high.

[10] This is functionally the same as voice provided over the circuit switched network. IMS Voice does not include the previously defined " IMS services", such as multimedia enhanced "Rich" voice.

Customer Profile

The primary target segments are third-party MVNOs and other service providers, enterprise customers, and technically competent consumers or individual mobile workers. The most important needs of the end users in this customer base include:

- Integration with corporate information technology infrastructure,
- Synchronisation and integration of mobile and fixed devices especially for messaging, calendars, and address books,
- Security, reliability and performance,
- Remote access to Internet and corporate information resources.

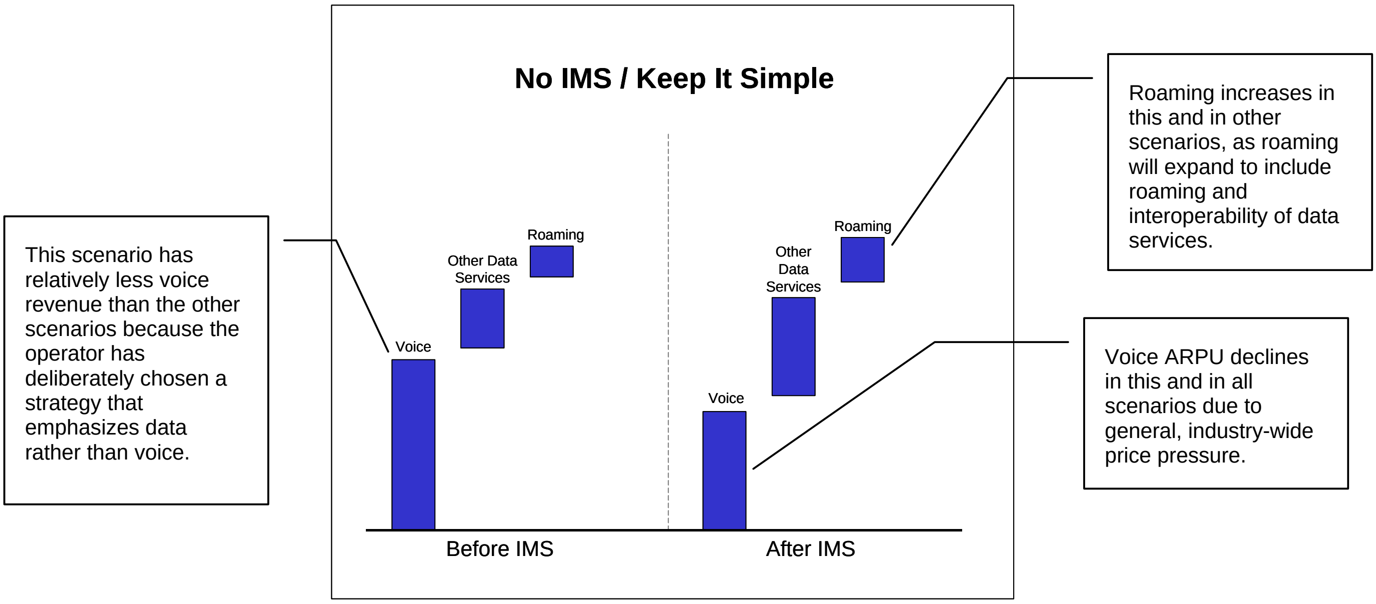
The enterprise base is exploring VoIP alternatives in its corporate network and infrastructure, but so far has limited its requirements to fixed international long distance calls and its legacy PBX with a new IP-based system.

Service Portfolio

The implementation of IMS to provide real-time services with voice is not important in the market strategy or to the target segment. Therefore, there is no advantage to deploying IMS in the network. The deployment approach and market strategy will provide revenues from voice services, other data services, and roaming. Even when IMS is commercially available, it is not deployed and therefore, there is no VoIP or IMS-related service revenue. Voice revenue in this and all other scenarios will decline due to price pressure. This scenario has relatively less voice revenue than the other scenarios because the operator has deliberately chosen a strategy that emphasizes data rather than voice.

This particular operator has chosen not to deploy any early IMS services, as it is not consistent with the market strategy, to minimize capital investment. As a result, there are relatively fewer new service capabilities in the "after IMS" portion of the figure. The revenue components and timing for the No IMS – Keep it Simple scenario are illustrated in Figure 6.1.

Figure 6.1. Revenue components: No IMS – Keep it Simple.



Source: UMTS Forum and Telecompetition, Inc., January 2003.

6.4 Full IMS – Technology Follower

The operator in this scenario is a large, global player mobile maintaining multi-technology networks in many countries. This is an incumbent operator, with a large market share, currently obtaining most of the revenues from voice services. Because of the scale and complexity of operations, this operator takes few infrastructure investment risks. Consequently, standard implementation is used whenever possible. The operator is willing to forego early adopter market revenues rather than risk damage to its market position through providing an unproven service.

Market Strategy

Historically this operator has built the customer base by selling mobile voice service only, largely in developed countries. Mobile penetration in most markets is near the maximum and other mobile operators in the serving areas are increasing competitive activities in order to capture market share.

The mobile operator in this scenario is focused on keeping and developing the existing large customer base, maintaining voice revenues while increasing ARPU through new services such as mobile data. To sustain the large customer base, it maintains a broad product portfolio at a competitive price. The development strategy also includes expanding into new value-added areas of the value chain, including mobile portal services, content, advertising, and transaction-based services.

The company is positioned as a single source provider, with vertical integration from retail mobile handset sales to portal content management. Global ubiquity and interoperability are also key components of the value proposition. This operator takes a conservative approach to new service development, launching new services as deemed financially prudent, but not attempting to be first in the market.

Customer Profile

This operator now has a very broad customer base consisting of both consumer and individual mobile business users, with distribution among age, income, and occupation demographic slightly skewed towards higher income, middle age, and professional occupations.

Consumers are looking for easy ways to access relevant information while keeping devices easy-to use. Important needs of this consumer segment include:

- Mobile access to specific infotainment content
- Messaging
- Entertainment

Newer growth in the consumer segment has come from youth, particularly in the area of messaging services (SMS).

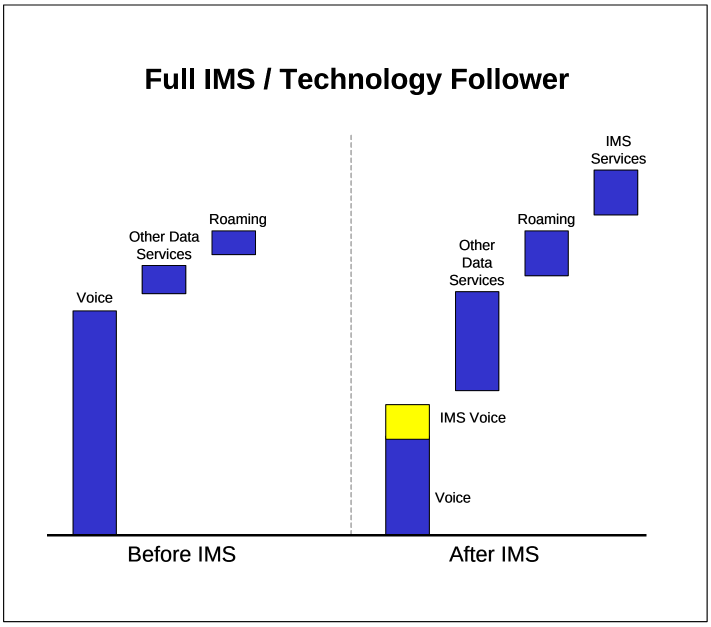
High volume business users are often mobile executives that require global roaming and global access. These users typically have a number of portable devices including laptops, PDAs, and mobile phones. Increasingly, these users are requiring more integration of messaging and synchronisation of data. Their corporations are demanding higher levels of productivity, increased security of portable devices, and easier support for a wide range of devices. Decreasing high mobile voice charges, in particular for roaming, are an important objective.

Service Portfolio

The mobile operator in this scenario initially receives revenue from voice, other data services, and roaming. Because the network is complex, launch of IMS services is delayed until IMS is fully developed and commercially available. Once IMS is available, however, IMS services plus IMS Voice is added to the portfolio. Simple Voice revenue overall will decline due to price pressure. The existing voice subscribers on the circuit-switched network will be slowly migrated to the new IMS network, but in the interim, circuit-switched Simple Voice, IMS Voice and Rich Voice are offered. There is no desire to experiment with non-standard services or even "early IMS" services as they introduce network complexity that becomes costly to manage over time. Figure 6.2 illustrates these revenue components.

Figure 6.2. Revenue components: Full IMS – Technology Follower.

In this scenario, the operator deploys IMS when the standards are commercially available, and is then able to offer IMS services.



Source: UMTS Forum and Telecompetition, Inc., January 2003.

6.5 Closed IMS – Wildcard

This operator owns a single technology network in a regional or local geographic area. The operator is independent and a high-risk taker. A non-traditional approach is taken that focuses on adding value through innovative service and content combinations rather than mobile network transmission. The serving area is a developed country that already includes several large, global incumbent mobile operators. The operator intends to redefine the market, capturing new types of mobile demand from previously untapped segments.

This operator prefers to adapt standards and technology in ways that accommodate its particular market requirements. This operator creates a proprietary version of IP services, adapting standards to meet needs as necessary. The company deliberately maintains a proprietary network to maintain a differentiation edge and sustain market position. Voice is provided either over packet or circuit switched, depending upon the load balancing required. Vertical integration with the network creates a stable cost structure and provides the flexibility needed to deliver the unique services. Data services are not interoperable with other mobile or IP networks, but this is not a significant concern to the local client base. Following industry standards and enabling interoperability with other mobile or fixed networks is not important to the business strategy

Market Strategy

The market strategy is based on differentiation, providing unique value for services. Price strategy is intended to be competitive, but as the services are so unique, subscribers don't typically directly compare the services to other mobile operators' price plans. The value proposition emphasizes differentiation, providing unique, interesting, high value services.

Profitability (high ARPU) rather than market share is the dominant market objective. The operator recognizes that the unique approach does not provide a mainstream "mass market" service. The long-term objective is to obtain a sizeable niche (10-20% share) that is highly profitable.

We do not speculate on the exact type of services such an operator might create. However, the flagship products are centred on a data component, rather than voice. Location information and transaction processing applications are used. Traditional mobile voice is included as a convenience to subscribers, but is not the primary focus of marketing activity.

Customer Profile

The customer base consists of vertical market niches of business and consumer users. Typically, new subscribers already have a mobile service provider, but also subscribe to this service due to its unique value. The services are also sold "wholesale" through a third party application service provider.

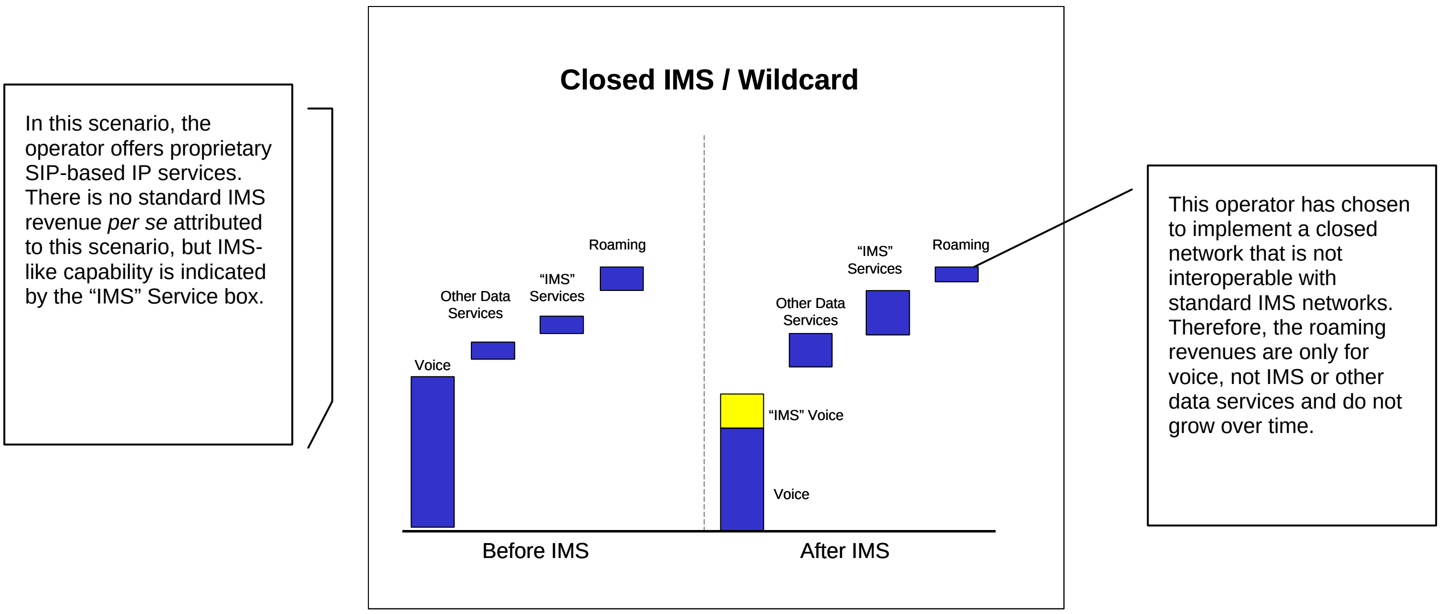
The important user needs of the customer base are:

- Local or regional remote location integration with corporate Information technology infrastructure
- Customisation of mobile services and applications to integrate with proprietary user interfaces designed for a specific vertical application
- Security, reliability and performance
- Customisation of mobile services to work with proprietary or specialized terminal / handset.

Service Portfolio

In this scenario, the mobile service provider offers proprietary IP services including voice and other data. The voice component can be circuit-switched Simple Voice, IMS Voice or Rich Voice. The services are not interoperable with other mobile networks, but this is not important to the way these services are used. There is no IMS revenue *per se* attributed to this scenario, but IMS-like capability is likely included within the proprietary IP services provided. As this operator has deliberately chosen a proprietary network, interoperability between standard IMS networks is not available, and therefore, there are no roaming revenues obtained other than for voice services. Figure 6.3 illustrates these revenue components.

Figure 6.3. Revenue components: Closed IMS – Wildcard.



Source: UMTS Forum and Telecompetition, Inc., January 2003.

6.6 Only IMS – Market Follower

This mobile operator is also an incumbent global operator, but with a large portion of properties located in areas with only moderate levels of mobile penetration. Consequently network build out for basic voice is consuming significant capital. This operator has a low tolerance for investment risk, preferring to defer new technology investment until demand is sufficient to ensure a shorter payback. Capital investment in new technology and services is minimized. While standard implementation is used when possible (as this is generally more economic), there is no urgent need to develop more advanced service capabilities. Price competition in its market areas is relatively low as there is still sufficient unmet demand for basic mobile communications service.

This mobile operator has no immediate need to deploy 3G at all, but can instead wait until demand builds, IMS standards are commercially available, and the extra capacity is needed for voice as well as data.

Market Strategy

This operator has a growth strategy to add new subscribers for voice plus a few simple data services. The product portfolio emphasises voice services. Price competition is relatively low, with the other mobile players competing primarily on the basis on service coverage and network quality. Prices are kept just below the market leader, meeting price competition when necessary through special promotions.

The value proposition emphasizes lower price, good geographic coverage for basic voice and messaging services. No other competitors are offering any mobile data services other than text messaging, so there is currently no competitive pressure to launch more advanced mobile data services in the market.

Customer Profile

The customer base consists mostly of higher income, slightly older consumers and professional business users. New growth, however, is coming from younger, middle-income consumers and a wide range of occupational categories. It is not unusual in this market for the mobile phone to be the primary communication line (rather than fixed service). Internet penetration is relatively low in this area, so mobile messaging services are very popular.

Important needs of this customer base are:

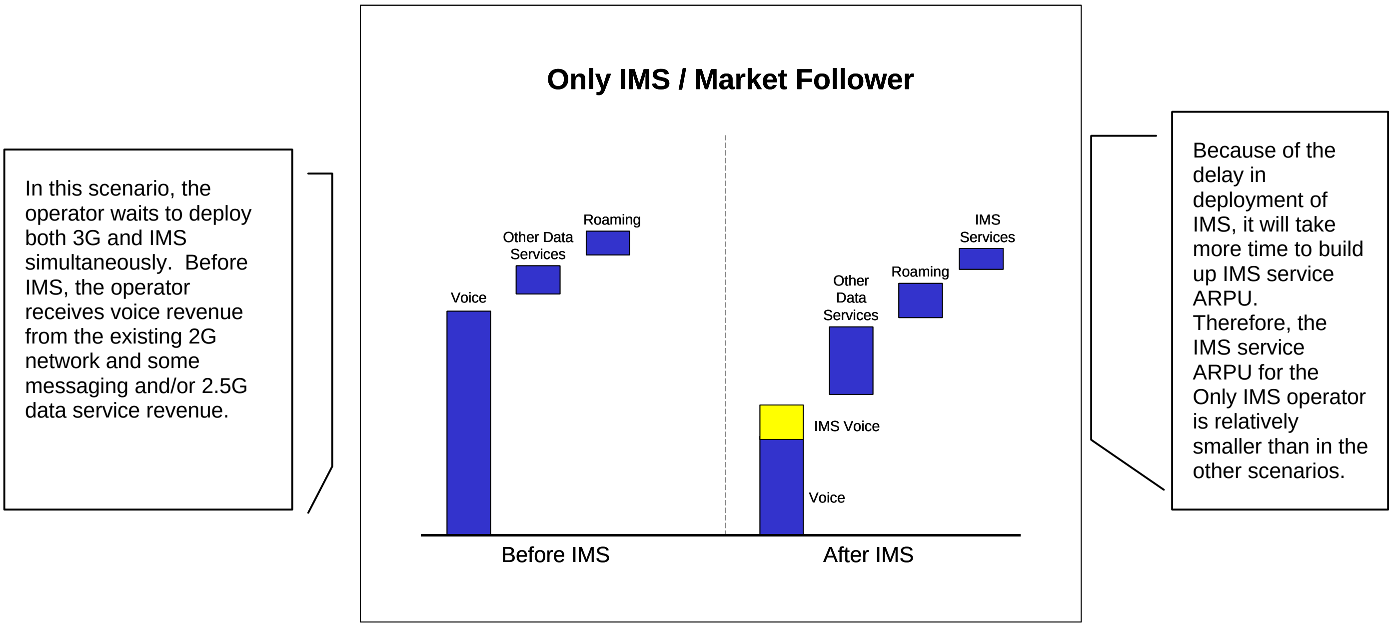
- Simple, easy-to-use interface for voice and messaging
- Pricing scheme that is competitive with fixed line alternatives
- Broad coverage for messaging services

Service Portfolio

Because this operator waits to deploy both 3G and IMS simultaneously, it only receives primarily voice revenue and some messaging and/or 2.5G data services in the interim. Consequently, the contribution from data is smaller than in other scenarios. Once deployed, the full range of IMS and other more advanced mobile data services will be offered. Because of the delayed start in offering the more advanced mobile data services, there is some ramp-up time in gaining subscriber adoption. Therefore the relative contribution from other data after IMS availability is smaller than in other scenarios. Voice revenue overall will decline due to price pressure. The mobile operator will also be able to offer IMS Voice service, and will slowly migrate existing voice subscribers from the circuit-switched network to packet switched as necessary.

Figure 6.4 illustrates the revenue components available before and after investment in 3G and IMS.

Figure 6.4. Revenue components: Only IMS – Market Follower.



Source: UMTS Forum and Telecompetition, Inc., January 2003.

6.7 Early IMS – Market Leader

This mobile operator is also an incumbent global operator. However, this operator has less variation of technology in worldwide networks and finds implementation of new capabilities to be more feasible. It is willing to take more risk in new technology investment than most counterparts. The operator is a market leader, often being the first to offer new types of services.

Standards will be adopted when available, but there is a willingness to invest in interim technology solutions to maintain competitive edge and a leadership position.

Market Strategy

This operator pursues a differentiation strategy, offering innovative services that are targeted to specific customer segments. The mobile operator has made a strategic decision to create competitive advantage by being first to market with new and interesting services. It does not compete on price, but instead aggressively pursues new services and niches, beating the competition by getting there first.

Customer Profile

The customer base consists of early adopters and technologically sophisticated business and residential users. Young adults and youth are also strong segments. The users are typically higher income, well educated, and own a number of personal electronic and mobile devices including PCs, PDAs, mobile phones, and laptops.

Important needs of this customer base are:

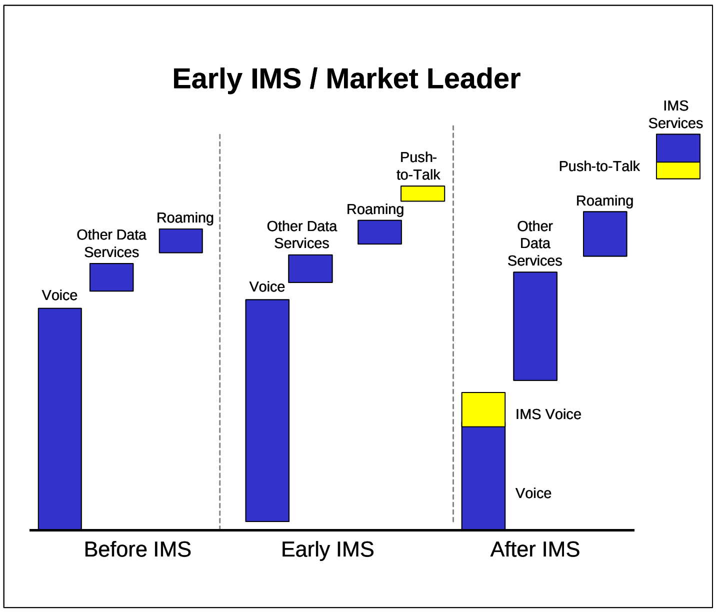
- Ability to integrate and synchronise multiple devices and applications
- Attractive, personalized handsets and service features
- Well trained technical support

Service Portfolio

In this scenario, the mobile operator initially receives revenue from Voice, IMS Services, other data services, roaming, and push-to-talk services. When the IMS standards are commercially available, the push-to-talk revenue will have growth and IMS services and VoIP will be added into the portfolio. This is illustrated in Figure 6.5.

Figure 6.5. Revenue components: Early IMS – Market Leader.

In this scenario, the operator deploys an early version of IMS in order to to offer early IMS services such as push to talk



Source: UMTS Forum and Telecompetition, Inc., January 2003.

Section 7 analyses these scenarios and compares their relative strengths and weaknesses in the current and future environment.

7 Scenario Analysis

This section analyses the five scenarios in light of the most likely market dynamics, assuming the market strategy and network deployment decisions of each scenario previously described in Sections 5 and 6. While relative relationships are discussed, total industry revenue or individual scenario revenue is not calculated. The terms “market attractiveness” and “competitive advantage” are used in this section as a framework to discuss the changes in market dynamics and the impact upon the relative market position of the operators in each scenario.

To further assess the implications of different operator scenarios, “what if” situational case analysis was completed and the relative impact on each operator scenario evaluated. In each case, the scenarios are evaluated in terms of the relative impact on ARPU *after IMS is commercially available*, and the changes in the competitive position of the hypothetical operator under each scenario. The scenarios analysed are those presented earlier in Section 6 using the network deployment assumptions presented in Section 5.

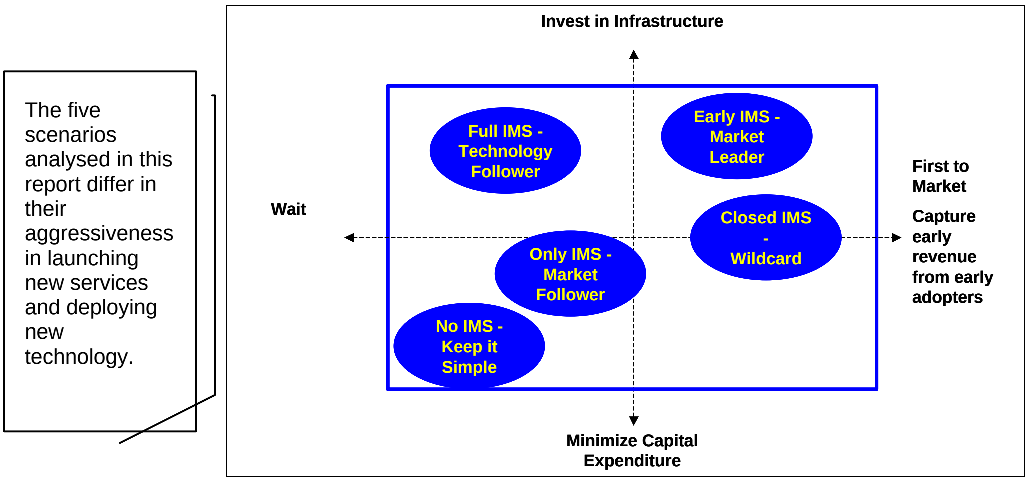
- No IMS – Keep it Simple
- Full IMS – Technology Follower
- Closed IMS – Wildcard
- Only IMS – Market Follower
- Early IMS – Market Leader

For the most likely case and for each “what-if” situation, a discussion on relative ARPU for each scenario and the changes in competitive position follows. Relative ARPU is an indication of the revenue potential per subscriber. Relative ARPU does not indicate how much total revenue (or market size) can be expected. Thus a higher relative ARPU does not necessarily mean that total revenue is higher.

The changes in competitive advantage figures illustrate competitive advantage and give an indication of the expected market share (or size). The competitive advantage figures that follow in this section show the relative strength of the scenarios against the two major sources of competitive advantage – cost structure and product differentiation. Thus this matrix takes into consideration both the functional capabilities enabled and the timing and costs incurred by the network deployment decision inherent in each scenario. Those scenarios plotted in the upper right quadrant represent the most advantaged competitors both in cost structure and product differentiation – these would therefore be expected to have the highest market share. The figures also show the position before IMS availability (grey ovals) and after IMS availability (blue ovals).

Recall from section 2.3, the scenarios were defined by their differences in market and investment strategies, specifically in the willingness to invest in new infrastructure and the desire to be first to market. Figure 7.2, illustrates those differences.

Figure 7.1. Scenario comparison of market and investment strategies.



Source: UMTS Forum and Telecompetition, Inc., January 2003.

7.1 "Most Likely" Case – General Industry Acceptance of IMS

The most likely case represents a conservative view of what is likely to happen in the industry, given the current industry dynamics, economic situation, technology development, and end-user adoption. It represents the continuation of a series of UMTS Forum market studies over the last two years on 3G market opportunity (UMTS Forum Reports 9, 13, and 17), impacts of WLAN, and IMS service visions. A few of the underlying assumptions are worth noting:

- Both fixed and mobile networks will continue to migrate to an IP-based architecture.
- 3G/UMTS networks will be widely deployed by most operators in the developed world by the end of the decade – albeit at a slower pace than was expected a few years ago.
- IMS standards will be completed within the near term.
- IMS technology and services will gain general market and industry acceptance. IMS-based Rich Voice services will contribute modest revenue. As illustrated in the end-user experiences described in the appendix (Section 9.2), all 3G services will have some revenue benefits from the increased service interaction and transparency provided via IMS.
- 3G and SIP-enabled handsets will be available in sufficient quantity to meet service demand.

The most likely case will next be discussed in terms of the expected shifts in market dynamics, and the relative ARPU and competitive position of each scenario given those expected market changes.

7.1.1 Future IMS Market Outlook

The transition to an IP network for voice and data has significant implications for the mobile industry. Not only does an all-IP network introduce the possibility of interoperability with fixed IP networks, it also facilitates market entry by non-traditional competitors. Cost structure, product portfolios, partnership arrangements, and industry structure can be impacted. Some of the potential changes may provide incumbent mobile network operators with renewed growth and profitability. Other changes will increase the intensity of market competition. Expected changes in market attractiveness indicators based on the migration to IP-based services are:

Barriers to market entry will be lowered partly due to the decreased infrastructure costs of an all-IP network. More importantly, the decoupled service creation functions will allow application and other service providers to capture a greater portion of the mobile value chain. For the incumbent mobile network operator, the market is less attractive because more and different types of competitors can enter.

Barriers to market exit will be lowered since services are less tightly integrated to network elements and new services can be tested and launched more quickly and at lower cost. Unsuccessful services can also be withdrawn more quickly. This is a benefit to the incumbent mobile network operator and increases market attractiveness.

Customer power will increase. Customers will have more service provider choices and more options of how to access mobile and fixed services. This decreases the market attractiveness for the incumbent mobile network operator.

The nature of competition will change. Voice will become even more price competitive, but this will be offset by increased differentiation possibilities of value-added mobile IMS / data services. This is positive for the incumbent mobile network operator and increases market attractiveness.

Overall market growth will increase. Market growth in developed countries has been slow, but will increase as mobile IMS services increase ARPU and attract new applications and subscribers. This is positive and will increase the market attractiveness.

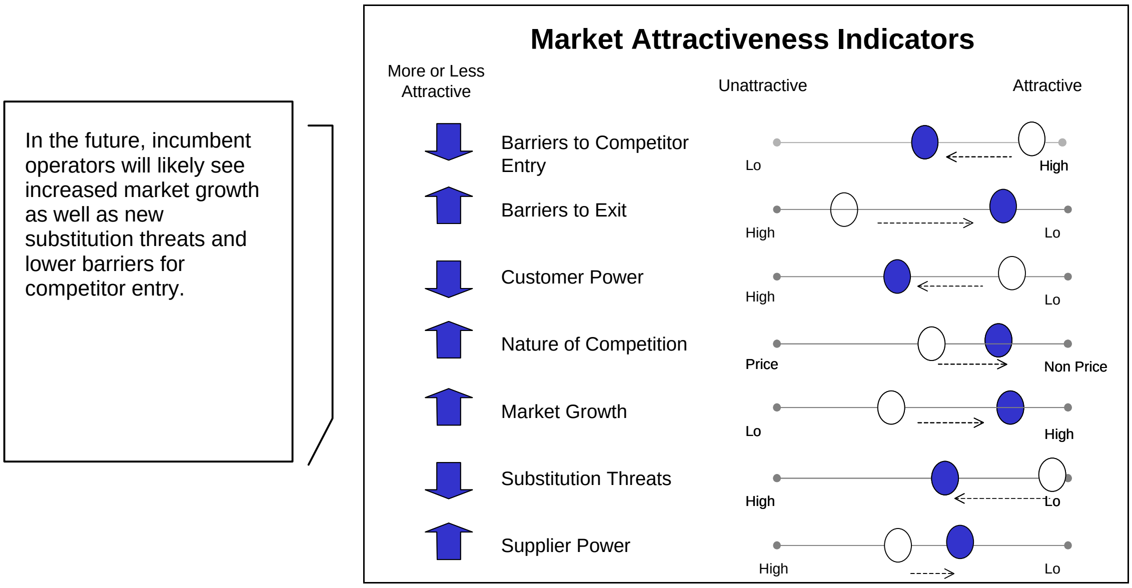
Substitution threats will increase. There are an increasing number of substitutes for mobile IP services such as public WLAN. There will also be more types of devices from which to access the mobile network. Also the technology and price distinctions between mobile and fixed networks and services are diminishing. Users are more able to substitute one service for the other. This decreases the market attractiveness for the incumbent mobile network operator.

Supplier power will decrease. Network operators will be less dependent upon specific network infrastructure providers. The wider supplier choice increases the market attractiveness for the incumbent mobile network operators.

Figure 7.1 illustrates these changes showing the expected movement in each market attractiveness indicator starting from the open circle (present) and moving towards the solid circle (future). The arrows on the left indicate whether the movement is positive (up arrow) or negative (down arrow) from the perspective of the incumbent network operator or service provider.[11]

[11] The significance of Figure 7.1 is in the directional trend for each item. The exact position of the circle on the grid could be subject to much datable and difference opinion within the industry.

Figure 7.2. Trends in market attractiveness indicators – most likely case



Source: UMTS Forum and Telecompetition, Inc., January 2003.

Despite the increased competition and substitution threats, the market will most likely become more attractive with the migration to IP networks and the addition of IMS services.

7.1.2 Competitive Position by Scenario

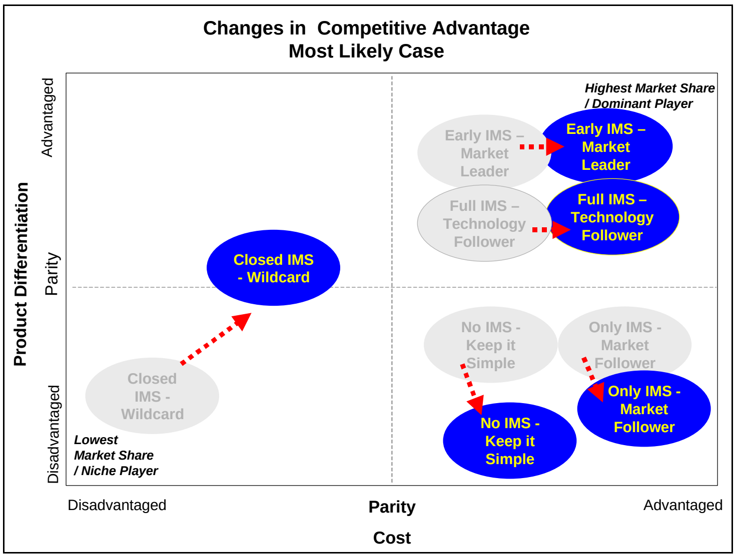
Within the foreseeable future, the industry structure will most likely remain basically the same – large players remaining large with smaller players gaining some share. There are no significant shifts in market demand or industry structure. IMS-based services gain moderate market acceptance by end-users and therefore add revenue benefits to those that have implemented IMS. This is a relatively stable situation, fairly conservative, with no major disruptive forces.

The changes in competitive position before and after IMS availability are illustrated in Figures 7.2. The Closed IMS operator (assuming success), will gain some market share, but still be a small, niche player. Those operators not offering IMS or offering it later, will lose some competitive differentiation advantage, but may gain some cost advantage due to lower infrastructure investment and possibly lower cost of debt.

Figure 7.3 Changes in competitive advantage – before and after IMS.

Each scenario has a different “starting” competitive position based on its defined differentiation and cost strategy

In the future, incumbent operators that choose to deploy IMS will likely see incremental improvements to competitive position.



Source: UMTS Forum and Telecompetition, Inc., January 2003.

The Early IMS/Market Leader operator maintains the highest ARPU through investing in new service capability early. The Closed IMS/ Wildcard operator also has high ARPU due to the strategic choice of a smaller, higher value customer base. The No IMS – Keep it Simple provider would have the lowest ARPU, but this operator also made less network investment, so profitability may potentially be higher.

"What if" Analysis

However, what if other more dramatic changes take place in the industry? Two "what if" situations are presented below representing higher and lower industry acceptance of IMS. In these two "what if" situations, it is assumed that the total size of the 3G / UMTS market remains the same as in the Most Likely Case, but that the proportion of that revenue that is attributable to IMS changes.

7.1.3 "What if" #1 – High Industry Acceptance of Standard IMS

What if IMS services really take off? In this situation, the functionality and interoperability of standards-based IMS becomes of high significance in buyer decisions for mobile services. Adoption of IMS services is at least twice as much as in the most likely case. Consequently, mobile operators offering mobile data services without standard IMS capability are much more disadvantaged.

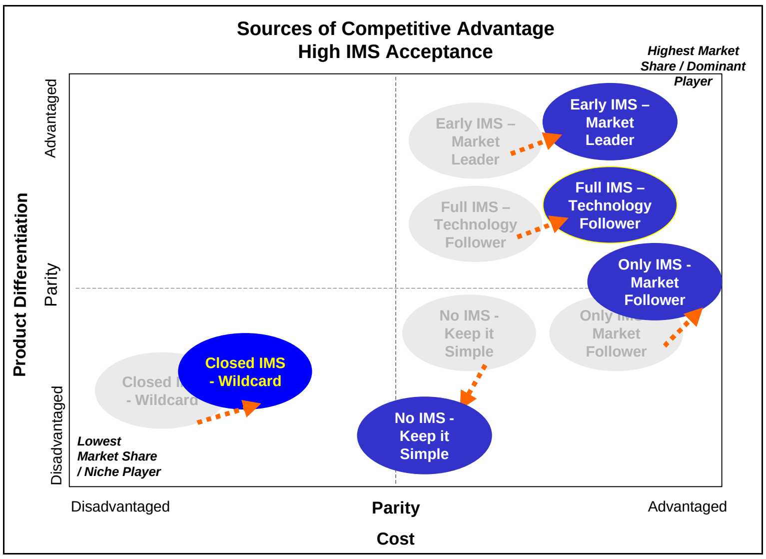
Operators without IMS (No IMS – Keep it Simple and Closed IMS – Wildcard) experience lower ARPU relative to the other operators and loss of competitive advantage. The Full IMS, Early IMS, and Only IMS scenarios benefit from this situation.

In this situation, the Early IMS/Market Leader scenario maintains the highest ARPU because it not only offers the highly popular IMS services, but has also developed additional revenue from early IMS capabilities. The Only IMS scenario operator would also be disadvantaged, at first, but able to recover as IMS was already in his network plans. All others will be negatively impacted until they can implement IMS.

Figure 7.3 shows that the operator in the No IMS – Keep it Simple scenario loses competitive position due to the inability of the network to provide the enhanced IMS services. The No IMS – Keep it Simple operator will also lose cost advantage due to the lack of scale economies of the network that is not all IP. The Closed IMS – Wildcard operator gains little market acceptance and either remains very small or may be absorbed by a larger player.

Figure 7.4. Sources of competitive advantage – high IMS acceptance.

If IMS is highly successful, incumbent operators that choose to deploy IMS will see even improvements to competitive position. The No IMS and Closed IMS operators will loose ground and/or never get their services to take off.



Source: UMTS Forum and Telecompetition, Inc., January 2003.

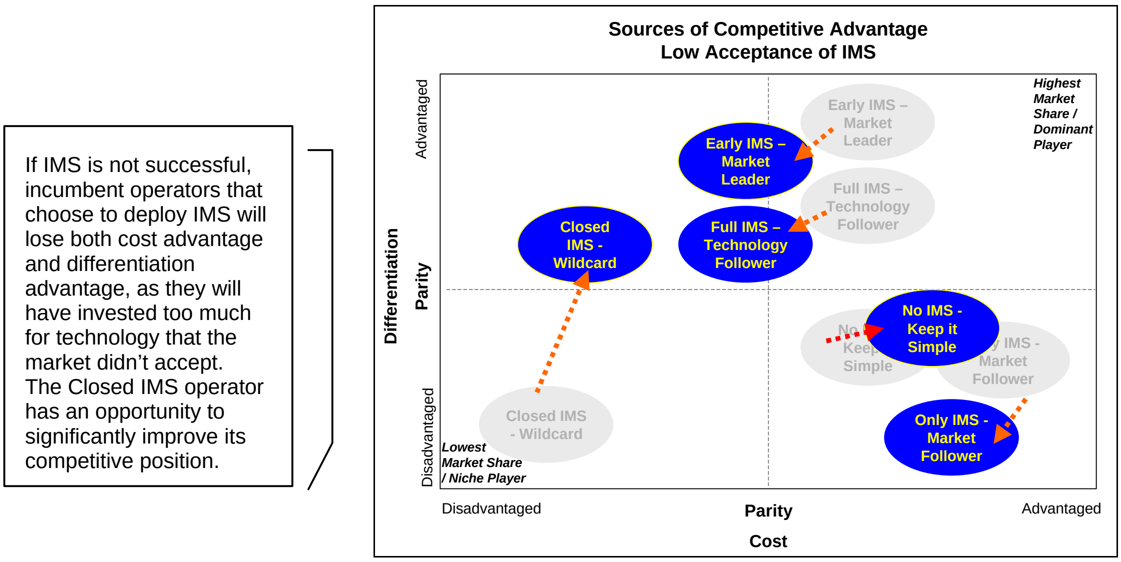
7.1.4 "What if" #2 - Low Industry Acceptance of IMS

What if IMS is not generally accepted? This could be because handsets are not available or inadequate, not enough players decide to invest in the technology, or end-users simply don't find the increased functionality to be valuable. Proprietary solutions may be deployed instead of standard IMS. Rich Voice services are not generally adopted, and the increased benefits of IMS to other 3G services are just not perceived as valuable. As a result, those investing in standard IMS will receive minimal revenue benefits and no competitive advantage. They will be vulnerable to Closed IMS operators with more unique service packages and that may also have a lower cost structure. IMS will have brought little value to those investing in it.

In this situation, the Closed IMS/Wildcard operator maintains the highest ARPU because the customer base, although much smaller than the other operators, consists of higher value customers that were not interested in IIMS capabilities. Of those operators implementing IMS, the Early IMS operator would have a slightly higher ARPU as the push to talk capability does gain some niche acceptance. The Full IMS and Early IMS scenario operators do not gain any significant ARPU from IMS services. The Closed IMS – Wildcard scenario operator continues to have a higher ARPU, as the strategy targeted higher value users with unique (not mass market) services.

Figure 7.4 illustrates the expected changes in competitive position. The operator in the Closed IMS – Wildcard scenario may be able to leverage its product uniqueness to gain new subscribers. In gaining more subscribers, the Closed IMS – Wildcard operator will also be able to increase scale and decrease costs. The No IMS – Keep it Simple operator will likely make modest gains in market share as more mobile users seem to want a simpler solution, and the greater scale increases cost advantage. The Early IMS and Full IMS operators lose competitive advantage as they have invested in capabilities not valued by the market and simultaneously increased their cost structure by those investments. The Only IMS – Market Follower operator is also negatively impacted, but since this operator waited before investing in 3G and IMS, the cost impact is less than for Full IMS and Early IMS scenarios.

Figure 7.5. Sources of competitive advantage – low IMS acceptance.



Source: UMTS Forum and Telecompetition, Inc., January 2003.

7.1.5 Other "what if" Possibilities

There are, of course, other "what if" situations that could be considered. As the mobile industry integrates content into the service mix and migrates the network to IP, the possibility of convergence of networks, devices, and/or applications between fixed, mobile, and Internet industries increases. This lowering of the market entry barriers, while discouraging to incumbents, makes the market highly attractive to new players. With technology barriers decreased, the mobile value chain becomes accessible to players that define the market completely differently than tradition holds. For example, what if some truly disruptive situations happened such as:

- Brand equity of content providers provides significantly higher market power than that of mobile network operators.
- A dominant industry player with both fixed and mobile networks decides on a strategy that will encourage rapid substitution of fixed voice to mobile voice.

- An outside player provides a low quality, low cost mobile voice substitute.
- A greenfield mobile operator builds an all-IP network and gains significant cost advantage over incumbent mobile operators.

7.2 Implications

The future can never be known, only analysed in the light of our current understanding. Three possible IP futures have been presented with respect to IMS. How might an operator begin to use this information to evaluate options? Some general implications can be drawn from this report and the scenario and situation analyses presented.

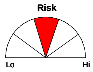
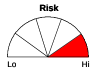
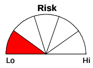
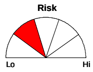
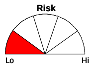
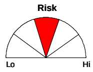
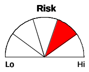
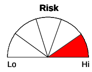
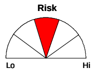
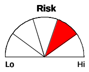
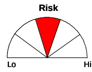
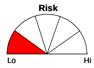
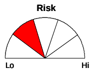
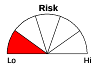
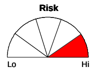
- IMS investment has more to do with service delivery than infrastructure cost savings.
- Compelling services must be created in order for operators to leverage maximum value from IMS investment.
- IMS investment does not by itself decrease cost structure or improve network efficiencies.
- Service feature differentiation is becoming a more important source of competitive advantage.

Table 7.5 examines the market risks in light of these three different futures for an operator adopting one of the approaches represented by the scenarios. The solid wedge within each “risk meter” indicates our estimation of how risky a given scenario is under the three situations analysed in this section. This could also be interpreted as the likelihood of market success given each situation. Table 7.5 illustrates the following implications from the scenarios and situation analysis:

- The risk for the operator in the No IMS – Keep it Simple scenario increases as IMS gains greater acceptance and decreases if IMS fails to take hold.
- The Full IMS – Technology Follower operator incurs the most risk if IMS fails to gain general market acceptance. In all three situations, though, this operator keeps risk at low to moderate levels.
- The Closed – Wildcard scenario operator is a fairly risky strategy regardless of the situation. Even in the Low IMS acceptance situation, this operator still has moderate risk from his closed network strategy.
- The Only IMS – Market Follower operator incurs the least amount of risk when IMS is not generally accepted and more risk as acceptance increases as this operator is forfeiting market position to save costs in the earlier years.
- The Early IMS – Market Leader is betting on the future of IMS and has the highest risk if IMS does not gain general acceptance.

Table 7.6. Risk profiles under different IMS situations.

In all cases, the Closed IMS / Wildcard strategy is risky.

	Most Likely – General Acceptance of IMS	**High Acceptance of IMS**	**Low Acceptance of IMS**
No IMS/Keep it Simple			
Full IMS / Technology Follower			
Closed IMS / Wildcard			
Only IMS / Market Follower			
Early IMS / Market Leader			

Source: UMTS Forum and Telecompetition, Inc., January 2003.

This risk assessment is subjective and the reader may have a different opinion regarding the risk of any of these approaches. The structure in Table 7.8 can be used as a tool to analyse these or other scenarios.

7.3 Summary

This report presents a structured way to consider the many choices facing network operators as they consider delivering IMS services. The analysis in this report is a continuation of a series of on-going market assessments conducted by the UTMS Forum. In particular, this report drew from previous analysis found in UMTS Forum Reports 9, 13, 17 and 20. Within these reports one can find detailed quantitative forecasts and qualitative descriptions of 3G and IMS services.

The purpose of this study has been to provide clarity of thinking on the critical questions facing operators: This has been accomplished by identifying five scenarios that represent clear deployment choices and market strategies, and by providing relative cost, revenue, competitive position and strategic implications around those scenarios. Revenues and ARPU analysis associated with IMS services have been based on the UMTS Forum's 3G service categories and the same bounded revenue forecasting methodology used for the UMTS 3G revenue and subscriber forecasts.

Given the unique market, regulatory, and technology issues faced by each operator, this report does not attempt to suggest an actual ARPU, market share, or cost of any individual operator in a scenario. Instead, it discusses the relative relationship between scenarios, illuminates many of the critical macro factors associated with IMS deployment, and provides an approach for further individual operator evaluation.

IMS deployment is a strategic decision, not a network technology decision. The decision to deploy IMS implies a direction towards an IP-based network architecture, a more sophisticated approach to service delivery and competitive advantage, and a willingness to enter into a broader industry alignment with fixed and Internet players

8 Bibliography

3GPP, TS 23.002 V5.7.0 (2002-06), Technical Specification Group Services and Systems Aspects; Architectural Requirements (Release 5), 2002.

3GPP, TS 23.207 V5.4.0 (2002-06), Technical Specification Group Services and Systems Aspects; End-to-End QoS Concept and Architecture (Release 5), 2002.

3GPP, TS 23.221 V5.5.0 (2002-06), Technical Specification Group Services and Systems Aspects; IP Multimedia Subsystem (IMS); Stage 2 (Release 5), 2002.

3GPP, TS 23.228 V5.5.0 (2002-06), Technical Specification Group Services and Systems Aspects; Network Architecture (Release 5), 2002.

Alcatel, IP Multimedia over 2.5G, 2002.

Analysys, Session Initiation Protocol: SIP-Related European Revenue Forecasts 2002-2007.

Ashton, Metzler & Associates, The Mobile Enterprise: From Isolated LAN to Always-On Mobile WAN, March 2002.

Baird, SPECTRUM Trends and Analysis of the Mobile Communications Sector, August 2002.

Business Communications Review, "Enterprise WAN: Challenges And Changes Ahead," November 2001.

Deutsche Bank, Awaiting Evidence Re-initiation of Mobile Telco Coverage, July 2002.

In-Stat / MDR, The Big Comeback? Excerpts from "Business Broadband in a Changed Economy," May 2002.

Intel, "Wireless Enterprise" Pilot, Technical Implementation Considerations, March 2002.

International Telecommunication Union, World Telecommunication Development Report, 2002.

Legg Mason, "The Wireless Industry Scorecard: Industry Analysis 1Q 2002," Sept. 12, 2002.

Lehman Brothers, The Affiliate Report: A Detailed Look at the Sprint PCS Affiliate Program, June 14, 2002.

Lehman Brothers, "Wireless Wisdom for 2HO2," June 17, 2002.

Macromedia, Inc. Developing Rich Internet Applications with Macromedia MX, April 2002.

Morgan Stanley, "Annual Telecom Services Survey: The Customer Speaks," February 26, 2002.

Morgan Stanley, "2Q02 Preview – Walking on Eggshells," July 10, 2002.

Nokia, Advantages of XHTML for Wireless Data, 2001.

Online Publishers Association, Online Paid Content U.S. Market Spending Report, August 2002.

Pew Internet & American Life Project, The Broadband Difference, February 2002.

Siemens, SIP Service for GPRS Networks, 2002.

Siemens AG, IP-based Mobile Networks, 2001.

Sonim Technologies, Inc., One SIP at a Time, 2002.

Sprint, "White Papers No. 8 Mobile Computing and the New Sales Force," 2001.

Ubiquity, "Technology Perspective, SIP – Playing Nicely with the Other Protocols," 2002.

UMTS Forum, UMTS Forum Report No. 9: The UMTS Third Generation Market – Structuring the Service Revenue Opportunities, UMTS Forum, 2000.

UMTS Forum, UMTS Forum Report No. 10: Shaping the Mobile Multimedia Future – An Extended Vision from the UMTS Forum, UMTS Forum, 2000.

UMTS Forum, UMTS Forum Report No. 11: Enabling UMTS / Third Generation Services and Applications, UMTS Forum, 2000.

UMTS Forum, UMTS Forum Report No. 13: The UMTS Third Generation Market – Phase II: Structuring the Service Revenue Opportunities, UMTS Forum, 2000.

UMTS Forum, UMTS Forum Report No. 14: Support of Third Generation Services using UMTS in a Converging Network Environment, UMTS Forum, 2001.

UMTS Forum, UMTS Forum Report No. 15: 3G Devices, UMTS Forum, 2001.

UMTS Forum, UMTS Forum Report No. 17: The UMTS Third Generation Market Study Update, UMTS Forum, August 2001.

UMTS Forum, UMTS Forum Report No. 20: IMS Service Vision for 3G Markets, UMTS Forum, May 2002.

UMTS Forum, UMTS Forum Report No. 24: Wireless Local Area Networks – a Qualitative Market Survey, UMTS Forum, October 2002.

9 Appendix

9.1 Mobile Needs of Business

9.1.1 Enterprise Needs for Mobile Networking

Enterprise technology investment decisions are ultimately driven by the need to increase productivity and return on investment. In the mobile industry, enterprises and small businesses were the first to adopt cellular voice because of the compelling economics for productivity improvements associated with providing employees with mobile phones. Equally compelling economics have been the drivers behind the major Information technology infrastructure investments in PCs, corporate networks, and web-based applications. While at one time the objective of enterprise technology investment was to place technology at all workers' fingertips, now the focus is shifting to include integrating the enterprise technology systems and applications (in particular, integrating voice/video communications services with corporate information services), and now extending those capabilities to mobile devices so that entire business processes can be optimised. It is no longer enough to place functional devices into employees' hands; these devices must interface and integrate with other corporate information and communications systems.

Generally, there are six areas that an enterprise must address when adding mobile applications:

- Mobile applications: Which applications and data to make available to the user.
- Multiple device types: Must support different devices that use different technologies, including PDAs, laptops, mobile handsets, Blackberry devices, etc.
- Geographic coverage: Providing uniform access to all employees regardless of location.
- The mobile network: Technical capability of network and the service provider and how it is interconnected with the corporate infrastructure.
- Security: Remote and mobile access must maintain the same level of corporate security. Security concerns relative to SIP implementation are still under development.[12] In particular, there is a need for IMS services to cross the boundary of the corporate Intranet firewall. While this is a common practice (albeit clumsy and awkward in use) for mobile data users today, IMS extends this need for basic speech communication. A challenge for the IMS community here is the fundamental difference between the authentication processes used in fixed corporate Intranets, which is based on Microsoft Exchange Server and Passport, compared to the process used in GSM and UMTS networks, which is based on the SIM (in future UICC with USIM/ISIM).
- Reliability and performance: To gain employee productivity, the end-to-end system must have a high degree of reliability and perform as needed.

It is important to note that mobility support is but one of the issues facing enterprises and their IT departments. Enterprises have complex integration challenges as they attempt to fully leverage their enterprise applications, improve interconnections with partners and suppliers, and deliver content and services to consumers via the Internet.

Web Services and other technologies are being developed to address many of these enterprise application integration challenges and will likely be the primary focus of corporate IT investment for the next several years. In this context, though mobility support is desired, it takes a back seat to other issues that more directly impact the company's bottom line.

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[12] Currently network address translation (NAT) and firewall servers are not designed to deal with SIP protocols. A number of companies are working on NAT/Firewall traversal solutions, but these inevitably introduce additional delay.

9.1.2 Individual Needs of Mobile Workers

The need for mobile communications and remote office capability encompasses a wide range of occupations, industries, and work situations. The majority of mobile workers need to frequently or constantly access information on their desktop PC, company servers, or the Internet. The most widely used applications are email, messaging, accessing personal calendars and address books, and web browsing.

For the enterprise, mobile business workers and business travellers are two types of teleworkers that also includes employees working out of their homes or other remote sites. The need for mobile communications and for IMS capability will differ for each of these segments. Table 9.1 is a representative list of the different types of teleworkers comparing their remote networking requirements. As shown, some teleworkers have more “portable” needs – that is a need to change locations, but be relatively stationary once the change is made. Others need true “mobility” – that is change locations frequently and/or continue to be mobile once the change is made.

Table 9.1. Remote worker segments and access needs.

	Segment	Communications Needs
Portable	Home-Based Teleworkers and Self-Employed SOHOs	▪ Occasionally mobile, driven by specific events ▪ Laptop or PDA ▪ Home access to enterprise or supplier/customer resources – either wireless or wireline ▪ Extensive use of messaging services ▪ Synchronisation and integration of messaging and calendars ▪ Public WLAN users, if available
Portable and Mobile	Mobile Executives and business travellers	▪ Frequently or occasionally mobile, driven by specific events ▪ Concentrated amounts of time in public locations (e.g. airports, hotels) ▪ Portable data communications – mobile terminal, laptop or PDA ▪ Remote access to enterprise information resources, including ability to collaborate with co-workers in real-time ▪ Public WLAN users, if available ▪ Extensive use of voice, conference and messaging services ▪ Synchronisation and integration of messaging and calendars ▪ Global roaming of voice and data services
Mobile	Mobile Field Professions (e.g. sales, technicians, engineers, service)	▪ Frequently mobile, driven by route or schedule ▪ Frequent communications, often for short periods of time at many different locations ▪ Remote access to enterprise information resources (e.g. sales/price information, product data, on-line manuals), including ability to collaborate with co-workers in real-time ▪ Mobile data communications – PDA or laptop ▪ Extensive use of voice, conference and messaging services ▪ Synchronisation and integration of messaging and calendars ▪ Calendar synchronisation and integration
	Commuters	▪ Mobile access to voice and messaging services while commuting (high speed / vehicular) ▪ Mobile terminal or PDA ▪ Extensive use of voice and messaging services ▪ Synchronisation and integration of messaging and calendars ▪ Ease of use – voice activation and easy-to-read displays

Source: UMTS Forum and Telecompetition, Inc., October 2002.

The proliferation of information networks and technology has also created a need for integration of access devices and terminals. It is not uncommon for mobile professionals to own fixed PCs, laptops, PDAs, and mobile phones. The need to integrate messaging and synchronise calendars between devices both fixed and mobile is becoming increasingly important. Now, there is also the drive to integrate multimedia communications, conferencing and information services, epitomised by the increasing use of products such as Microsoft NetMeeting within enterprises.

9.2 Example IMS Services

Advanced Mobile Videophone Service (Consumer)

Advanced Mobile Videophone is a two-way, real-time, conversational video, with the same feature capabilities as voice service. As with the existing early stage mobile videophone service, IMS Advanced Mobile Videophone Service will be a person-to-person transmission, but will extend this to person-to-multiparty transmissions and enables additional functional capabilities such as the ability to independently initiate the video component and the ability to set up or receive other media calls.

IMS Multimedia Group Broadcast (Business)

Multimedia Group Broadcast is a voice call, enhanced with multimedia elements, which can be either two-way or one-way, 1:n or n:n communications. With this service, multimedia content would be broadcast from a central point (server or live conference) to a work group. IMS Multimedia Group Broadcast adds the mobile environment to currently available conferencing options and provides a new mechanism for communication with employees that have no access to fixed Internet and/or fixed wireline telephony. When used as an extension of fixed group conferencing services, IMS Multimedia Group Broadcast would allow users with mobile devices to participate more fully in a Web conference or Web cast.

IMS Mobile Gaming (Consumer)

The future IMS Mobile Gaming is a multi-player games service that will not only incorporate the advanced capabilities described for both Advanced Mobile Videophone and IMS Multimedia Group Broadcast, but also seamlessly integrate sophisticated application (e.g. gaming) servers and clients. Critical IMS enabling capabilities include the ability to add two way voice or video communications between players, set up calls to multiple destinations and add or delete any player or media element (such as video) at any time during the game. The IMS-based network could provide for these requirements. Presence and location information could also be integrated through the use of IMS, giving game developers a unique set of capabilities to incorporate into future games.

Mobile VPN (Business)

This service is part of the Mobile Intranet/Extranet Access[13] service category and provides mobile workers with mobile access to corporate Intranets and other corporate information resources. With Mobile VPN a mobile worker can access corporate information, for example viewing documents or downloading them onto a mobile device or mobility-enabled laptop. 3G (UMTS) technology will provide sufficient bandwidth to allow reasonably fast access that makes the application appealing to mobile “road warriors”. The additional capability provided via IMS and SIP provides additional service interaction, integration, and transparency that create a more productive workflow for the remote worker. Specifically, IMS enhances the service in the following ways:

- Allows easier integration with other corporate networks and information resources as all are based on an IP architecture. This includes the ability to interact with VoIP switches in order to create a “visual voice mail” voice message through the mobile phone that is accessible via email.
- The Mobile VPN user will be able to simultaneously access other media resources (e.g. documents) while talking to someone about the media being viewed.
- The Mobile VPN user will be able to combine different types of media from different corporate resources and transmit over the public or corporate network. For example, the user could attach a document file from the server to an email message, add a voice annotation to the message and send to someone outside the corporate VPN.

13 This service category is one of the six service categories defined by the UMTS Forum in Report 9. It is defined as: A business 3G service that provides secure mobile access to corporate Local Area Networks (LANs) Virtual Private Networks (VPNs), and the Internet.

These qualitative distinctions in service functionality can be very valuable to remote mobile workers who may be operating in less comfortable physical environments with limited physical access to corporate resources.

"Mixed Media" Mobile Access (Business)

This service is also part of the Mobile Intranet / Extranet Access Service category and an enhancement to the Mobile VPN service described above. With Mixed Media capability, the Mobile VPN user will be able to respond to different types of media messages through any media type in the same session. (e.g. respond to a voice mail message by sending an email while listening – without disconnecting the voice call.) The addition of "presence capability" and with the ability to access PIM / contact information kept in the corporate Intranet or on the user's fixed PC, the user is able to respond to messages through any media type and in a way that is acceptable to the receiving party.

For example, a remote worker receives an urgent message from his office about a delayed customer shipment. With Mobile VPN, the remote worker is able to access the corporate shipping records, track the problem and provide status back to the client while talking to his office. His PIM provides the phone number to call the customer back, but the customer has indicated that he will be in a meeting and can only view messages on his PDA (no phone calls). The remote worker creates an audio message to attach to the email and sends it high priority to his customer.

Multimedia Messaging with Presence (Consumer)

This service is part of the Multimedia Messaging Service Category.[14] Short Messaging Services (SMS) are extremely popular with the youth in Western Europe, Japan, and other countries. The addition of 3G/UMTS capacity will allow these SMS users to also send and receive multimedia attachments such as downloaded video clips (e.g. movie trailers), audio clips, photos, user-created video clips, etc. The addition of IMS will allow an interactive element, much like in mobile gaming, where the user can collaborate and interact with other users while creating and/or viewing the multimedia message. For example,

- Teenage friends can take pictures of clothing while window-shopping at the mall, send it to their friends at another store, and then discuss the item on the phone while simultaneously viewing it.
- Similarly, several teenagers in different locations can simultaneously download a movie trailer video clip and discuss whether they want to see the movie while viewing the clip.

Alert Service (Consumer)

This service is part of the Location-Based Services Category.[15] This service proactively sends a message to a pre-subscribed user based on predetermined preferences and taking into consideration the current location of the user. An alert service could include information such as traffic reports, promotions offered by nearby retailers, proximity of a friend, or location of an elderly person or child who has wandered too far away. 3G/UMTS technology provides the bandwidth to send visually appealing multimedia alerts based on the current location of the user. The addition of IMS provides additional service interaction and integration that will allow the user receiving the alerts to more easily access additional information and respond in a variety of ways.

For example,

- A user receives a promotional alert that a nearby retailer is having a sale on a popular item. The user can simultaneously view the multimedia picture of the item while calling the store

[14] A consumer 3G service, that offers non-real-time, multimedia messaging with always-on capabilities allowing the provision of instant messaging. Targeted at closed user groups that can be services provider- or user-defined.

[15] Location-Based Service category is defined as: a business and consumer 3G service that enables users to find other people, vehicles, resources, services or machines. It also enables others to find users, as well as enabling users to identify their own location via terminal or vehicle identification.

to ask more questions. She can also store the promotional coupon on her mobile device or sent it to her PC at home.

- With presence and location information available, she can also know that a friend is shopping nearby. She forwards the promotional multimedia clip to her friend and they discuss whether to meet and possibly purchase the item.
- Driving home the user receives a traffic alert of an accident ahead. The navigational instructions can be received and include information of restaurants in the area to have dinner until the traffic clears. With the service interaction provided by IMS, the alert service provider can also provide access to the personal contact (PIM) information of the user to find, for example, lists of favourite restaurants in the area or location of nearby friends.

Remote Diagnostics (Business / Government)

This service is part of the Business Multimedia Messaging Service category.[16] With this service, pictures or video clips can be taken of situations that require review by remote professionals. This could include vehicle accidents that require more advanced medical opinions about the people injured in the accident. It could also include property damage or service calls for technical equipment where the on-site claims adjuster or technician needs an additional expert opinion. With 3G/UMTS, the mobile user has sufficient bandwidth to send a picture or video clip via his mobile device. With the addition of IMS, the mobile user can also interact simultaneously with the second individual and more easily manage the multimedia file with other information about the situation.

For example,

- A mechanic responding to a car breakdown sends a picture of the damaged part to a repair specialist at the corporate office. While viewing the picture, the mechanic and specialist discuss the problem and how to fix it. The specialist can send a short video clip that illustrates the procedure.
- A claims adjuster at a home damaged by a storm sends a picture of the damage to his office server. With IMS he can discuss the claim with a valuer while they both simultaneously access the claim file on the server, create a new file together and attach it into the report, add additional voice annotations, fill out the final form together, and forward the package to the appropriate office for payment.

Dispatch Service (or Push-to-Talk Voice Conferencing)[17]

A Dispatch Service can potentially be implemented very easily using SIP call processing. It is unique in that it does not require the full capability of an IMS network and so is a very attractive possibility for an Early IMS network deployment and service start up, as described in section 5.1.6. Furthermore, in various forms, Dispatch Services already have a proven market acceptance.

The term “Dispatch Service” comes from the type of two-way radio system used by dispatchers. Dispatchers are most immediately associated with the emergency services, Fire, Police and Ambulance as well as radio controlled taxi services and delivery services etc. This description provides a clue to the difference between it and a mobile telephone service such as GSM:

The main difference is that communication is one way at a time, initiated by pressing and holding a switch (usually on the microphone) rather than by dialling, and the communication can be overheard by others in the community of interest. As well as “Dispatch Service”, similar systems are known as “Push-to-Talk”, “Two-Way Radio”, and “Walkie Talkies”.

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[16] Business MMS is defined as: A business 3G service, that offers non-real-time, multimedia messaging with always-on capabilities, personalisation, and user-to-user networking and allows the provision of instant messaging. Targeted at closed business communities that can be services provider or customer defined.

[17] Dispatch services take advantage of the one-to-many capability inherent in the IMS concept. This capability facilitates the introduction of a wide variety of closed user group or community services. Instant messaging is another important example.

The motivation for using such systems rather than cellular telephones is partly historical – two-way radios were available long before mobile phones, but mainly because of the immediacy of the communication – push-to-talk rather than a dialling process, making the system easy to operate in difficult situations. Voice conferencing is another crucial feature and is inherently provided in a far simpler way than is possible with telephone systems. This is vital for users such as Police and Fire, because officers can overhear calls to and from others and can respond with help as needed. The provision of a loudspeaker output is far simpler than for a speakerphone and it works well in noisy environments. There are many radio systems in use today that provide services with these characteristics:

- Citizens Band Radio (CB) – popular with truckers for social use.
- Amateur Radio (Ham Radio).
- The VHF Marine Radio Service (also used for ship-to-ship and leisure).
- Unlicensed Radio Service (exemplified by small walkie-talkies such as the Motorola TalkAbout products).
- Military tactical radios (Squad Radio).
- Professional dispatch systems including those used by emergency services (e.g. SMR and Tetra).

The existing technologies used to implement existing systems vary greatly, from the simplest self-contained open channel radios such as CB to the sophisticated trunked radio systems used for nation-wide dispatch services and by emergency services. The disadvantage with the simpler systems is that they are range limited (usually to a few km between users). There are two well-known systems based on cellular networks. The first is the Nextel network in the USA, which provides both a mobile phone service and a push-to-talk facility with loudspeaker in the same terminal. The Nextel network uses proprietary technology from Motorola, based on a modified GSM core network and a TDM radio access system. It provides a professional grade dispatch service with nationwide range and coverage and is now also proving popular with consumer users. The second is the GSM-R specifications produced originally for the European railways, which adds sophisticated dispatch and conferencing features to GSM.

All the above systems have proved popular in their various markets apart from GSM-R, which has not been widely implemented. The problem is that a “push-to-talk” dispatch service is extremely complex to add to an existing cellular network by means of conventional ISDN based technology such as GSM-R. Every switch, base station and terminal would need to be upgraded.

The provision of a “push-to-talk” dispatch service based on SIP would be a very simple addition to an IMS network. With SIP, service could be implemented in a single Application Server, rather than as software in every Switch and Base Station. Furthermore, the full facilities of IMS would not be needed, at least at start up. QoS and media processing could be left until later. In a start-up network, all the necessary SIP/IMS Call Processing and the Dispatch application could probably be implemented in a single server. There are already commercial organisations promoting such products suitable for implementation in GPRS (2.5G) networks.

A SIP/IMS/UMTS implementation of “Push-to-Talk” Dispatch would not suffer from the range limitations of the simpler radio systems such as CB. It should therefore prove popular with families and buddy groups who want an instant means to keep in touch wherever they are. Because a nationwide open channel system is clearly impractical, users would have to program their community of interest into the terminal (as with the Nextel system). Pricing will be critical, because it is competing with free-to-air systems such as CB and the Unlicensed Radio Service.

A simple start-up network based on a limited deployment of IMS without all the features would provide a satisfactory service for consumer users. However a later one based on full deployment of IMS should provide the service quality needed by professional users and thus provides another new revenue opportunity for cellular operators. The addition of SIP-based Priority Service features would make the system suitable for use even by critical emergency services. A location-based feature could also be added, enabling a restricted area open channel service like CB to be provided for community interest users such as truckers.

The examples shown here, while being entirely practical, also demonstrate the variety and innovation in services that can be achieved with SIP and IMS.

Technical Viability of Service Concepts

The service concepts described are possible with IMS and in the network deployment scenarios presented later in this report. Specifically,

- The IMS architecture enables two-way voice and video, at the high quality and reliability expected by a telephone user today, to be incorporated into the information services described above.
- The SIP multimedia call control enables the communication part of the application (two-way voice or video) to be fully integrated with the information part described in the above scenarios (i.e. Presence, location, document retrieval, voice mail, email) and with messaging (document retrieval, voice mail, email, picture mail and video streams) with one simple set up process for the user – point and click or voice recognition.
- The media gateways, which are part of the IMS architecture, enable media such as graphics, images and video that come from the corporate or public fixed networks to be re-formatted so that they can be efficiently transmitted to a mobile device.

9.3 Service Implications of GPRS and WLAN

As an intermediate step toward 3G, many carriers are deploying General Packet Radio System (GPRS). GPRS provides packet radio access for GSM and TDMA users. Typically, GPRS is deployed as an overlay packet data network to the existing wireless voice network to offer “higher-speed” data services.

GPRS (General Packet Radio Service) also offers faster data transmission than a standard GSM network. GPRS provides packet-based transport within existing GSM and UMTS networks to bring IP services to the end-user. Therefore, 2G networks with GPRS together with WLAN, are capable of providing a starting point for market introduction of some mobile data applications such as text and picture messaging, presence, and interactive service that don’t require voice interaction. If combined with IMS platforms, some additional integration of these services could be realised, adding the possibility of session-based applications (an example being Global Text Telephony).

One thing is clear: GPRS is needed to provide the underlying IP transport for next generation 3G services. GPRS can be used to provide some of the individual service offerings envisioned for IMS but without the level of service, service integration, and media conversion needed for mass-market adoption. Though deploying IMS GPRS-overlay is feasible, the capacity constraints of the GPRS network will not allow operators to achieve a full-blown IMS. In particular, most GPRS-enabled GSM networks would not have the capacity to deliver the real time IP-based person-to-person services, which are at the heart of IMS, because most of their capacity is needed for basic, conventional circuit-switched voice traffic.

As illustrated in this section, mobile services that combine voice and other multimedia elements such as video, graphics, sound and other data can be provided in some manner without using an IMS-capable UMTS network. For example, WLAN technology (WiFi or 802.11) will provide the bandwidth necessary under many circumstances to support the high speed, interactive multimedia transmission needed for the IMS services described earlier. However, if these networks become heavily loaded, the quality of two-way voice or video communication will deteriorate rapidly. This is because without IMS or VoIP techniques, there is no prioritisation of the voice packets versus other data, and they will suffer unacceptable delay and jitter.

However, even with an IMS platform, 2G GPRS and WLAN cannot provide the full breadth of service capability as UMTS/IMS infrastructure. Neither 2G networks nor WLAN were designed with IP telephony applications such as VoIP in mind. WLAN, for example, does not provide the necessary coverage for realistic telephony services.

9.4 Network Elements – Definitions

Network Elements of the CS Domain (Without IMS Capability) – Definitions

The following definitions and explanation are provided for further clarification of the scenarios presented in Section 4.

MSC: The Mobile Switching Centre is the main interface between the radio system and the fixed telephone network. Its fundamental purpose, like a fixed network switch, is to switch the connections between subscribers, but differs in that it has to perform location registration and handover procedures in order to serve the mobility of the subscribers.

GMSC: The Gateway MSC has the capability, in addition to that of an MSC, to select and interrogate HLRs in order to route a call from the PSTN to the correct MSC for the wanted mobile subscriber.

GLR: The Gateway Location Register (optional) handles location management of roaming subscribers in the visited network without involving a HLR.

TC/IWF: The Transcoder and Interworking Function performs conversions between the spectrally efficient, robust speech coding (TC) and formats for circuit switched data services (IWF), used over the radio interface and those used in the fixed networks.

Network Elements Common to the CS Domain and the PS Domain

HLR: The Home Location Register is a database containing key information about subscribers that belong to the network. It includes subscription information (i.e. which services the user is entitled to use) as well as some information on the subscriber's current location, enabling incoming calls to be correctly routed to him and charging information to be sent to networks that the subscriber roams to. The HLR is one of the key components that enable mobility and roaming in GSM, GPRS and UMTS networks.

VLR: The Visitor Location Register is a dynamic database that contains information about mobiles that have roamed into its area. In particular, the Location Area in which the mobile has registered itself. The VLR in a visited network exchanges information with the HLR in the subscriber's home network to enable the correct routing and handling of calls.

AuC: The Authentication Centre is a database that is associated with each HLR. For every subscriber registered with the HLR, it stores an identity key and uses it in the processes of authenticating the mobile and ciphering its transmission.

EIR: The Equipment Identity Register stores the International Mobile Equipment Identity (IMEI) number for each mobile, classifying it as either "white listed", "black listed" or "grey listed".

Network Elements of the Packet Switched Domain

SGSN: The Serving GPRS Support Node, together with the GGSN (below) constitutes the interface between the radio system and fixed packet data networks (including the Internet and intranets). The SGSN stores routing information to the cell or area where the mobile is located plus its associated VLR.

GGSN: The Gateway GPRS Support Node communicates with the HLR and stores routing information to the SGSN where the mobile is registered.

BG: The Border Gateway is an interface to the external inter-PLMN links connecting to other GPRS (or UMTS PS) networks. It provides security to protect the PLMN and its subscribers.

The Radio Access Network Elements

RNC or **BSC:** The Radio Network Controller (RNC) provides the control for a network of UMTS base stations that are based on WCDMA technology. The Base Station Controller (BSC) provides a similar function in EDGE-based UMTS networks. The principal function provided is the real-time handover of mobiles between base stations.

BTS: The Base Transceiver Station (BTS) provides the radio transmission and reception for one cell in EDGE-based UMTS networks.

The Mobile Station (MS) comprises two parts:

ME: The Mobile Equipment is the main physical, hardware and software part of a mobile terminal. Although the ME is usually thought of as the subscriber's property that he purchases, operators often subsidise the cost of the mobile and so this is also part of his investment costs. Operators perform some network testing of mobiles.

SIM: The Subscriber Identity Module is the second major part of the Mobile Station and is usually a removable device, which stores the subscriber's profile (e.g. his service provider, phone number, subscription data, as well as personal data such as directories and stored short messages). It provides the authentication and encryption functions between the terminal and the network on bearer level, as defined by the GSM specifications. For 3G and IMS, the SIM has evolved further from the original GSM SIM as described below:

> **USIM:** The UMTS Subscriber Identity Module is specified for 3G, starting from 3GPP Release '99 and provides authentication and encryption functions that are improved over the GSM SIM. Like the GSM SIM, the USIM is, technically, the property of the network operator.
>
> **ISIM:** The IMS Subscriber Identity Module is defined from 3GPP Release 5.

Entities Supporting Message Services

SC/MMS/WAP: The (Short Message Service) Service Centre (SC) is the entity where short messages are collected and delivered to and from subscribers. In addition some SMS functionality is included in some MSCs (designated SMS Gateway MSCs or SMS Interworking MSCs – not shown in Figure 4.1). The Multimedia Messaging Service (MMS) server and relay is also indicated in Figure 4.1, as well as the WAP gateway.

CBC: The Cell Broadcast Centre is responsible for the management of Cell Broadcast Service messages.

MBMS: (Multimedia Broadcast Message Service) is an enhancement of Cell Broadcast for multimedia.

Entities Supporting Location Services (LCS)

SMLC: The Serving Mobile Location Centre manages the resources required and calculates the estimated position and accuracy of the mobile.

GMLC: The Gateway Mobile Location Centre is the interface to external (e.g. third party) location-based services. The GMLC performs registration authorization and requests routing information from the HLR.

Entities associated with CAMEL

CAMEL: Customised Applications for Mobile Enhanced Logic is a toolkit based IN services creation feature. One most important service that has been implemented through CAMEL is the support of pre-pay subscribers. Parts of the CAMEL application are distributed in the MSC/GMSC (gsmSSF) and SGSN (gprsSRF), but two can be separately identified (gsmSCF and gsmSRF) and in the network architecture diagrams, are contained within the CAMEL block.

9.5 Network Elements Replacing Previous Elements in the CS Domain

This section describes new platforms and the changes needed to implement IMS.

MSC Server: This now provides the signalling functions that were previously part of the MSC. It includes the Call Control and Mobility Management processing.

CS-MGW: The Circuit Switched Media Gateway function now provides for the transport of user data (i.e. the switching function) that was previously part of the MSC. Thus with the introduction of the MSC Server and the CS-MGW, the MSC has effectively been split into two, separating the signalling and users' traffic. The CS-MGW can support media conversion and processing, thus providing the previous functions of the TC/IWF.

GMSC-Server: This now provides the signalling functions that were previously part of the GMSC. Like the MSC Server, it is associated with a CS-MGW, which provides for the transport function of the GMSC.

Network Elements Replacing Previous Elements common to the CS and PS Domains

VLR: The VLR has always been closely associated physically with the MSC. When the MSC server is introduced, the VLR functions will be integrated with it, although in some implementations it serves the PS domain as well as the CS domain.

Note that the change-overs involving the MSC Server, GMSC Server, VLR and CS-MGW are not, strictly speaking, part of the introduction of IMS. However, operators will almost certainly implement them as an inevitable consequence of introducing the new architecture. Therefore they have been included here.

HSS: The Home Subscriber Server replaces the previous HLR and AuC, acting as the master database for users and providing for user security. In addition, it extends its control function to the IMS and provides for user IP addressing.

New Network Elements Introduced for IMS

CSCF: The Call Session Control Function manages the SIP session establishment and call control. In the current 3GPP architecture referred to here, the CSCF also incorporates the Policy Control Function (PCF), which manages the Quality of Service policy. The CSCF can have three roles. The Proxy CSCF (**P-CSCF**) is the first contact point from a mobile into the IMS. The Serving CSCF (**S-CSCF**) actually handles the session states in the network and the Interrogating CSCF (**I-CSCF**) is the contact point for connections destined to a subscriber of the network.

IM-MGW: The IP Multimedia Gateway Function provides bearer control in the IMS core network. It can also support media conversion and payload processing such as transcoding and echo cancellation.

MRFP: The Multimedia Resource Function Processor sources media streams (e.g. for multimedia announcements), processes media streams (e.g. conversion to formats appropriate to mobile terminals) and mixes media streams (e.g. for multi parties).

MRFC: The Multimedia Resource Function Controller controls media resources in the MRFP, interprets media requirements coming from Application Servers and S-CSCF and also generates Call Data Records.

AS/PS: An Application Server (e.g. a SIP Application Server or OSA Server) is an edge-of-network entity that offers value added IM services. A specific example is a Presence Server (PS). To emphasise this further, the application servers are the platforms that determine the characteristics and special features of calls. Unlike for conventional mobile and fixed networks where the call processing is mainly software tied to the switches and network platforms, in IMS the Application Servers are physically separate platforms which can be owned by a third parties as well as network operators and can even reside in different connected networks.

MGCF: The Media Gateway Control Function performs protocol conversion between the ISDN User Part (ISUP) and IMS call control (i.e. ISUP/SIP conversion).

SGW: The Signalling Gateway Function performs transport level conversion between IP-based transport of signalling and ISDN-based transport of signalling (SS7 or C7). Note that together, the MGCF and SGW enable IMS terminals to interwork with legacy circuit switched networks (e.g. PSTNs).

SEG: The Security Gateway provides security protection for the IP-based control plane signalling between networks.

Other New Entities in the IMS

Other new entities not shown include the Subscription Locator Function (SLF), which locates the specific HSS containing the required subscriber data and would probably be implemented as part of the I-CSCF. The Breakout Gateway Control Function (BGCF) selects the network in which PSTN breakout is to occur and selects the MGCF within the network where breakout is to occur. There are also specific entities for the Global Text Telephony Service.

Existing 3G Network Elements Which Require Significant Upgrades for IMS

RAN: The Radio Access Network components, RNC (BSC), and Node Bs (BTS) require upgrades in order to provide for a full IMS capability. These could include SIP signalling compression as well as header compression in order to provide efficient transport of IP over the air.

ME: The mobile equipments will be new designs, incorporating the SIP call processing, facilities for handling the new services and the mandatory Wideband AMR speech codec.

GGSN: Additional functionality is required in the GGSN in order to implement the QoS management for IMS. This includes an IP Bearer Service Manager and an interface (Go) to the PCF function of the P-CSCF.

SGSN: The SGSN is enhanced to handle Resource Reservation (RSVP) message flows.

CAMEL: At first sight, it might be thought that the IN services provided by the CAMEL toolkit would be irrelevant to IP-based services. However, operators will undoubtedly want to retain its provision of pre-pay services for IMS. The current thinking is that this will be achieved through a new element (IM-SSF) between the CAMEL platform and S-CSCF.

T/C: Transcoders in the network will have to be upgraded to handle the Wideband AMR speech coding which has been made mandatory for Release 5 mobiles by 3GPP.

The Billing System will have to be upgraded to handle the new IMS services. Consideration will have to be given to third party billing for externally provided innovative IMS telephony services.

OA&M: The Operations, Administration and Maintenance system will need a substantial upgrade to handle the new platforms introduced by IMS. In addition to this, the concept of terminals with downloadable service logic and applications means that a new OA&M element, Terminal Management is being included in 3GPP standardisation.

9.6 Effect on Other Platforms of introducing IMS

Other 3G platforms which remain in a network supporting IMS and legacy services, but which have not been identified as needing substantial upgrades, include CBC, SMLC, GMLC, SC, and EIR as well as MMS and WAP servers. They will almost certainly require at least a software upgrade in order to handle the presence of the new mobiles in the network as well as to interface with the other new platforms.

Backbone and Backhaul Networks

With the introduction of IMS, the transport of time critical real-time services such as speech telephony is moved from the circuit-switched domain, where every speech bit has a pre-assigned timeslot, to the packet-switched domain, where speech packets potentially contend for slots with less critical data service packets. For IMS, the operator needs to examine his packet domain network to ensure that the QoS requirements for real-time services are met. This will be particularly important at nodes where trunking or combination occurs and hence the likelihood of contention. The control and route selection technology developed for VoIP networks, Resource Reservation Protocol (RSVP), may need to be introduced and individual routers may need to be upgraded to support Multi Protocol Label Switching (MPLS). This consideration also extends to any external IP networks and inter-PLMN networks based on IP, where IMS services need to be delivered.

Other Investment Factors to be Considered for IMS

Buildings, plant, antennas and installation: These will require little change as a result of implementing IMS. Even the costly base station sites should require no change, because the coverage for IMS should be the same as achieved for 3G CS and PS services. A relatively small amount should be allowed for the installation of the new platforms, however.

Network planning and optimisation is likely to be a major factor. Real time services, based on packet technology are a new paradigm, especially over radio. Existing packet services for non-real time services are much more robust and can tolerate lost packets. Therefore it is believed that much of the drive testing, performance analysis, problem finding and rectification that was seen at the introduction of GSM, GPRS and 3G will have to be repeated again for IMS.

9.7 Web Services

Any discussion of new advanced mobile IP-based services must also reflect advances in the wired Internet. Chief among these advances is the growing industry interest and commitment to the collection of standards and technologies broadly defined as "Web Services".[18] Web Services is likely to become the dominant platform for the future development of web-based applications. The mobile community must decide to what extent it will encourage interworking between web services and IMS services. This decision process is a necessity because the IMS architecture differs from the Internet architecture used for web services. In particular, the authentication process adopted by the GSM/UMTS community (SIM-based) differs from that of the Internet/intranet community (Microsoft Exchange Server and Passport).

Most major enterprise software vendors currently endorse the Web Services concept. However, the Web Services "push" is being led by two powerful camps with fairly incompatible architectures: Java (Sun Microsystems) and .Net (Microsoft). Though there is no apparent winner (yet) in this struggle, the Web Services concept will likely become the dominant application development paradigm within the next five years.

For the enterprise, MS.Net and other Web Services-based software provide a vehicle for reducing complexity in their networks and their users. MS.Net is likely to be deployed in intranets and extranets over the next few years. In addition, enterprise's continued adoption of the dominant Microsoft application desktop and server software (including NetMeeting and Windows XP) will implicitly support "Web Services" to the extent Microsoft migrates its software to that architecture.

While Web Services is not directly related to IMS in a technical sense, it represents a trend that should be considered by operators planning on providing IMS services to the enterprise market. In effect, enterprise customers are already adopting an alternative approach using non-network based technology to achieve similar advantages as IMS – less complexity for network management and to users. When available, IMS services will need to integrate into an existing network environment that is at least partially designed under the .Net or Web Services concept.

Mobile industry groups such as 3GPP and the Open Mobile Alliance (OMA) are also working on open services initiatives. For example, the 3GPP architecture concept includes APIs for greater network interoperability. Although not currently included in the 3GPP Rel-5 standard for IMS, an IMS could potentially support Web Services with their ability to eliminate technical complexity for the end user and manage interoperability. Web Services provide selected services (e.g. user authentication, location or billing, etc.) to third party application service providers. This introduces an Internet-centric business model rather than the traditional telephony specialised infrastructure providers model. This is a very different competitive environment for the operators and provides a much larger development community to experiment with new services.

The increasing interest in Web Services is good news for IMS. Both SIP and SOAP utilize XML, a key component of Web Services. SIP brings a new level of sophistication and flexibility to IP-based real time, multimedia services. Web Services creates an application and services layer that facilitates the rapid creation, deployment, and customisation of mobile voice and data applications. Operators will have greater options to deploy application servers and services themselves or use third parties.

For the first time in history, advances in next-generation communications networks are fully compatible with advancements in enterprise IT and application development. Much of this is driven by the underlying and pervasive trend toward IP-based networking.

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[18] The term "web services" has been created by the Internet and development communities, and is not used in the same context as the UMTS Forum defined "services" in Reports 9. "Web services" in this context refers to a software development architecture/platform, not to any of the six categories of revenue generating 3G services defined in Report 9 or described in Section 3 of this report.