SIEMENS

Siemens IP Multimedia Subsystem (IMS)

The Domain for Services

Contents

The goal of this white paper is to illustrate to the reader the service-related benefits of using an IP Multimedia Subsystem (hereafter referred to as IMS) network as an IP-based service control platform for mobile IP networks. Special attention will be paid to how IMS improves the end user service experience in terms of end user services and the service environment. We focus on the end user experience, as we firmly believe that this is the critical success factor which will allow Mobile Network Operators (hereafter referred to as MNOs) to successfully leverage their considerable investments in packet switched and 3G W-CDMA technologies, by enabling new services which end users are willing to use and are willing to pay for. To this end the paper will aim to show how the new services and new end user experience enabled by IMS will translate into increased revenues, increased customer satisfaction, reduced customer churn and increased differentiation (as well as reduced OPEX and reduced CAPEX).

IMS – The Domain for Services

IMS is defined by 3GPP as a new core network 'domain' (i.e. a new mobile network infrastructure composed of a number of discreet elements). But why should operators purchase and deploy a new core network domain and, more importantly, what does IMS bring to the end user in terms of new services and the overall end user experience? The best approach to answering this question is to compare and contrast IMS to today's existing CS (Circuit Switched) and PS (Packet Switched) core network domains in terms of what types of services each domain can offer to the end user.

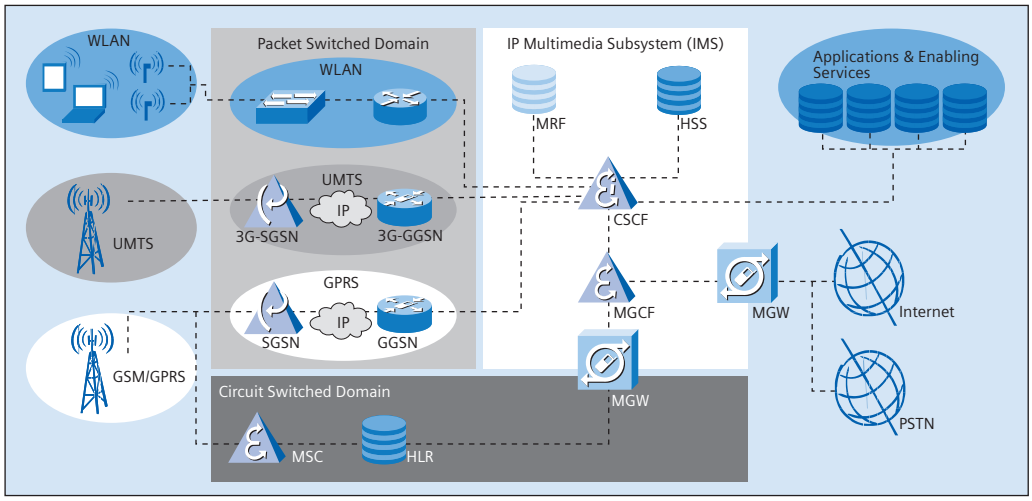

Figure 1: Position of the IP Multimedia Subsystem within a mobile network

Circuit Switched (CS) Domain – Voice and SMS

Circuit Switched networks mainly enable simple user-to-user voice services as well as SMS text messaging. However, the amazing boom in subscriber growth seen over the last few years is now gradually starting to level off. This slower rate of subscriber growth has led to increased competition for existing subscribers, which in turn is threatening to lead to steadily falling voice-based revenues as MNOs are forced to compete on price. These factors have greatly increased the risk that voice services will become commoditised (thus further reducing voice-based revenues), and that MNOs may, as a result, be relegated to pure 'bit-pipes'. Despite the historical success of CS Voice and SMS, MNOs have quickly realized that in order to avoid the twin pitfalls of falling voice revenues and bit-pipe relegation, they need to increase differentiation and create new revenue streams based on new types of services.

Packet Switched (PS) Domain – IP Data and 'Always On'

The deployment of Packet Switched networks (such as GPRS) is a direct result of the desire of MNOs to create new revenue streams. PS networks have enabled MNOs to introduce new user-to-server data services such as Multimedia Messaging (MMS), Streaming and Content Browsing, whereby a user needs to directly address a specific server in order to execute the service in question. These packet switched networks were designed to offer services which take advantage of IP-based transport and 'always on' capability. However, the success of Packet Switched networks and related services has been stifled due to a number of factors including lack of bandwidth, lack of appropriate handsets, a poor end user experience, lack of enticing services and confusing charging schemes.

3G W-CDMA – More Speed and Bandwidth

Many in the mobile industry believed that 3rd Generation (3G) 3G W-CDMA networks alone would enable MNOs to successfully leverage their investments in packet switched core networks in order to provide exciting new mobile services for end users. The main issue is that 3G W-CDMA is a technology

which is 'only' designed to substantially increase bandwidth rates and efficiency. For services, this means that bandwidth requirements for new, real time services can be achieved – in other words, 3G W-CDMA adds speed to services.

IMS was specifically designed to enable real-time, user-to-user mobile services such as rich voice services and video telephony. IMS enables these user-to-user communication services via a number of key mechanisms including session negotiation and management, Quality of Service (QoS) and Mobility Management amongst others.

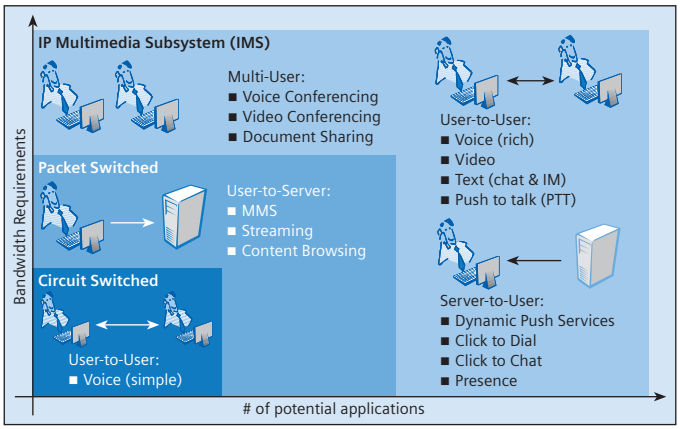

Figure 2: Services Enabled by each Core Network Domain

The IP Multimedia Subsystem (IMS) – The Domain for Services

Enter a new domain: the IP Multimedia Subsystem (IMS). It was realized by both infrastructure vendors and MNOs early on that increased bandwidth would not be enough to enable the plethora of new and desirable services on mobile IP networks which both shareholders and end users are expecting. IMS is ideally placed to fill this gap.

However, IMS enables much more than just real-time, user-to-user services. Using IMS technology MNOs will also be able to offer non-real-time, user-to-user services such as chat and IM, as well as Multi-User services such as multimedia conferencing and chat rooms, and Server-to-User services such as dynamic push services and click to dial.

Key IMS Capabilities for New Mobile IP Services

IMS was designed to provide a number of key functionalities required to enable new mobile IP services via mobile networks. Four of the key functionalities are explained below:

Multimedia Session Negotiation and Management – key to communication services

A session is essentially a connection between two communication endpoints (e.g. mobile phone, PDA, laptop, etc.). The first endpoint usually requests a connection to the second endpoint and the endpoints then negotiate exactly how the communication will take place (e.g. use of specific codecs, what types of media will be included in the session, etc.). Once this negotiation is complete, then an interactive session is established between the two endpoints and the endpoints begin exchanging commands and data.

This multimedia session negotiation and session management can be achieved through the use of the SIP protocol (Session Initiation Protocol) as defined by 3GPP and IMS which is essentially a mobile SIP network designed to support this functionality. (IMS provides routing, network location, and addressing functionalities.)

As opposed to the CS and PS Domains, IMS enables any type of media session to be established (e.g. voice, video, text, etc.) and for sessions to be dynamically modified 'on the fly' (e.g. adding a video component to an existing voice session). This capability opens up a number of new and innovative user-to-user and multi-user services such as rich voice services, video telephony, chat, push to talk (PTT) and multimedia conferencing, all of which are based on the concept of a multimedia session.

Quality of Service (QoS) – key to quality real-time service realisation

Real-time mobile IP communication is difficult due to fluctuating bandwidths, which severely affect the transmission of IP packets through the network. In normal IP networks, IP transport would be what is known as 'best effort', meaning that the network will do its best to ensure the required bandwidths, but there is no guarantee. The result is that real-time mobile IP services could function poorly or not at all (i.e. voice quality is poor or garbled, video 'jitter', etc.) depending on the bandwidth availability and network congestion.

The concept of Quality of Service (QoS) was developed in order to overcome these issues and provide some type of guaranteed level of transmission instead of 'best effort'. QoS ensures that critical elements of IP transmission such as transmission rate, gateway delay and error rates can be measured, improved and guaranteed in advance. By these means, users are able to specify the level of quality they require depending on the type of service and the user's circumstances.

The 'intelligence' required to enable QoS within a mobile IP network is located in IMS in the form of an entity known as the Policy Decision Function (PDF) which interacts with and controls the

underlying packet network (via the Go interface to the GGSN). Thus, IMS provides an effective and standardized solution for operators who want to implement real-time IP mobile services without gambling on best effort transmission and the resulting customer dissatisfaction.

Mobility Management – critical for roaming
The underlying IMS infrastructure enables mobile IP communication services via its ability to find other users in the network and then to establish a session with that user. The key IMS components enabling mobility management are the CSCF (Call Session Control Function) and HSS (Home Subscriber Service). The HSS holds all of the key subscriber data and enables users (or servers) to find and communicate with other end users. The CSCF is essentially a proxy which aids in the setup and management of sessions and forwards messages between IMS networks. Thus, IMS is critical to enabling both mobility management within MNO's home network, as well as service mobility when roaming between different network providers.

Service Execution, Control and Interaction – foundations for a robust service platform
In a complex mobile service landscape wherein the operator has deployed a large number of services, it is absolutely crucial that the operator is able to control the invocation of services and the interaction between the various service components. In the CS and PS domains, service execution is application controlled, which makes service interaction increasingly complex and reduces overall service transparency and control. IMS meets this challenge by providing a robust, efficient and transparent service execution, control and interaction infrastructure.

When a user registers on the MNO's IMS network his Subscriber Service Profile (SSP) is downloaded by the CSCF from the HSS. The SSP contains a great deal of service-related information per individual end user and enables the CSCF to:

- Identify which service(s) need to be executed, based on filter criteria held in the SSP.
- Determine the order in which multiple services are executed (if applicable).
- Determine the address(es) of the application server(s) which should execute the requested end user service(s).
- Inform the application server(s) of the order in which services should be executed in the case that multiple services need to be executed on the same application server(s).

This Service Control and Interaction capability enables MNOs to use IMS as a reusable service infrastructure platform by allowing them to effectively control and manage the complexities involved in service filtering, triggering and interaction.

Due to ever increasing internet take-up rates, most mobile end users expect mobile services (such as browsing in the case of WAP or document download in the case of GPRS data) to conform to a web-like user experience. For a number of reasons, however, today's mobile services based on existing circuit-switched and packet-switched technology cannot fully achieve this web-like user experience.

End users want their mobile experience to be seamless, transparent, convenient, intuitive and easy to use. One of the key selling points of IMS is that it provides MNOs with a number of capabilities which are required to transform the mobile end user experience into something which is more akin to the web services paradigm. The importance of this benefit cannot be overstated as it will be this factor, perhaps more than any other, which will affect the overall take-up level of ALL new services which a MNO hopes to deploy and earn revenue with.

Dynamic Multimedia Session Control
The circuit switched domain only allows users to have one type of service per bearer or session (and severely limits the session media types). Thus, for example, if an end user is currently on a voice call, he would need to terminate or suspend the voice call in order to send an Instant Message from the same mobile terminal. With GPRS, whilst it is technically possible to have more than one parallel IP session running, the user is effectively limited by bandwidth and QoS restrictions as well as charging issues.

Alternatively, IMS enables a much more flexible and easy-to-use session model. Using a MNO's IMS service infrastructure, end users can initiate multiple services within a single session, can trigger synchronized services in multiple sessions and/or have multiple unrelated sessions running at the same time. An example of each type of session is illustrated below.

Multiple Services – Single Session
This type of scenario is sometimes referred to as dynamic media control whereby a user can alter media types within a single session.

For example: John calls his friend Susan and requests a voice and video session. Susan has just woken up and doesn't feel up to a video call, so she only accepts the voice component of the call. Once Susan is out of bed and finds her appearance 'presentable', she requests a video component to be added to the session with John and (using IMS infrastructure)

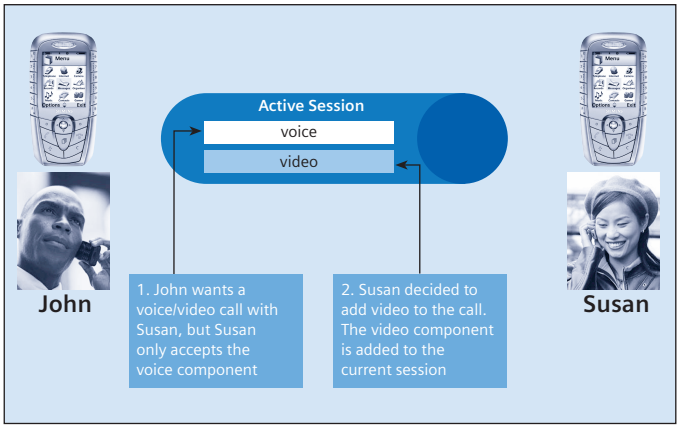

Figure 3: Multiple Services - Single Session Example

video is dynamically added to the call

For end users, this type of session enables converged services which bundle together multiple service components, both real time and non-real time. This greatly increases the number of possible service 'building blocks' and correspondingly increases the number of possible services which MNOs could create and deploy. At the same time, customer satisfaction would be increased due to overall service transparency and convenience.

Synchronised Services – Multiple Sessions

This type of scenario involves services which are interlinked and can trigger other types of services within discreet, independent sessions. An example would be a Click to Dial service. In this scenario, John is browsing an airline's flight plan with his mobile device. He has a question regarding one of the flights and clicks on the 'Speak to a Customer Service Agent' button. This action triggers IMS to set up a voice session between John and the airline's customer support call centre. Thus, after clicking the Click to Dial button, John would have two related sessions running in parallel – one session for browsing the airline's flight plan and one session to speak with the airline's customer service agent. This enables John to view the flight plan whilst at the same time speaking with the customer service agent using the same mobile device.

This type of service interaction leads to services which are very similar to a web-like user experience. In other words, services are intuitively linked and are thus transparent and easy to use for the end user. It is this type of service interaction which can contribute the most to a 'seamless' user experience.

Unrelated Services – Multiple Sessions

This last scenario involves the user having a number of unrelated services running in parallel, independent sessions. For example, John is having a quick chat session with Susan, when his other friend, Peter, calls him requesting a voice session. John can then accept the voice session with Peter, which would run in parallel with the chat session with Susan (i.e. when John accepts the voice session with Peter the chat session continues as a parallel live session).

This type of scenario is very similar to the web experience whereby users can have a number of active 'windows' (sessions) running in parallel. This ability to have multiple sessions of unrelated services allows users to multi-task, which greatly increases the overall transparency and satisfaction of the end user experience.

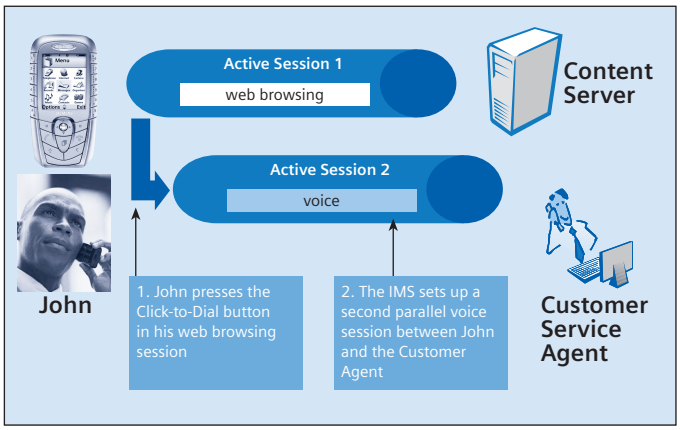

Figure 4: Synchronised Services - Multiple Sessions Example

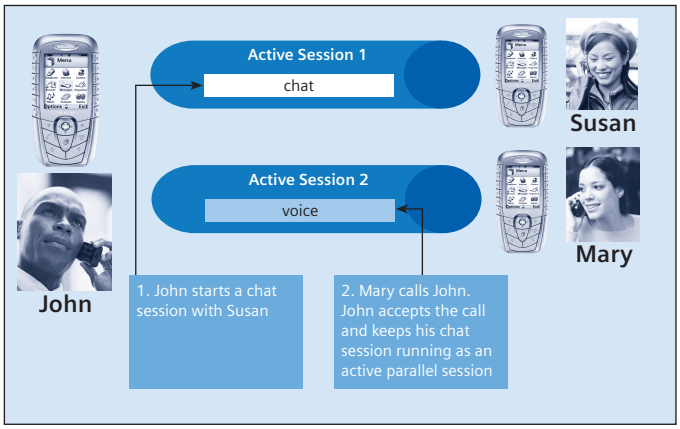

Figure 5: Unrelated Services - Multiple Sessions Example

Single Sign On & Converged Billing
Siemens IMS @vantage provides two additional features which give users a convenient and easy-to-use service experience:

- Single Sign On
- Converged Billing

In a complex service environment, the user may potentially need to go through the process of authenticating himself for each individual service (i.e. the user needs to enter a username and password for each individual service). Additionally, in this type of environment, users may have to pay separately for each individual service. This is very inconvenient for the end user and may also cause the end user concerns in terms of data security by having to provide payment details on numerous occasions.
Siemens IMS @vantage surmounts these issues by introducing Single Sign On and Converged Billing.

Single Sign On
Using the Siemens Single Sign On feature, the end user (invisibly) receives a token when he first registers at the MNO's IMS system. This token is then passed within all subsequent service requests.

Thus, the user does not need to re-authenticate for each individual service, as the token indicates to IMS that the user has already been authenticated. Once the user has signed on to the MNO's IMS he can use all of his subscribed services (a list of which is held on the HSS) without the need to subsequently re-authenticate. This increases overall convenience and simplicity for the end user. Additionally, the Siemens Single Sign On feature will be compliant with 3GPP specifications.

Converged Billing
Siemens IMS @vantage also enables a converged billing concept whereby MNOs can charge on the basis of the service, content or volume (or a mixture of these types) in a prepaid and post-paid manner. For end users, this means that they will be able to use the MNO as a converged point of billing for all of their services regardless of the charging model used. Additionally, this gives end users the assurance that all of their billing is handled centrally by a secure source and gives them transparency in terms of their total mobile spending.

IMS is able to support three enhanced ranges of services (User-to-User, Multiuser and Server-to-User), each of which can provide the operator with new revenue streams and increased differentiation. All of these service ranges enable new communication services, which have historically proven to be the most successful mobile services.

User-to-User Services
Key to the success of 3rd Generation Wireless Networks will be the introduction of new real-time and non-real-time User-to-User services which go beyond today's simple voice calls and SMS text messaging. Via the concept of multimedia session management, IMS will be able to provide a range of new services such as rich voice (VoIP) services, video telephony, chat sessions and Push to Talk (PTT).

Example Service 1 – Push-to-Talk
Push-To-Talk (PTT) is a two-way communication service which expands on the concept of voice-based messaging. As opposed to a normal mobile phone call which is full-duplex, wherein both parties can hear each other simultaneously, PTT is half-duplex meaning that only one party can speak at a time while the other party (or parties) must listen.

The person who wants to speak holds down the PTT button and speaks into their mobile device and then releases the button when finished. The listener hears the message and can then press the PTT button on their own mobile device to respond.

The key control mechanism in the service is the pressing of the PTT button. The end user who presses the PTT down effectively controls the direction in which the communication must travel. Any listening end users can only respond when the first user has released the PTT button.

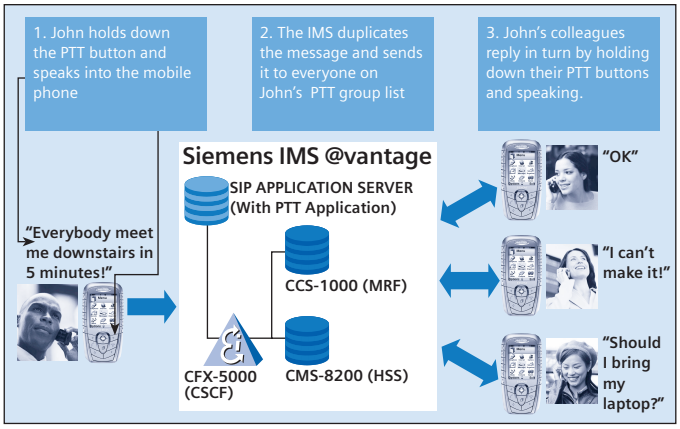

Figure 6: PTT Example

As opposed to standard phone calls, PTT is usually reserved for very short bursts of communication. The content of PTT calls is usually instructional, directional and immediate. It is this immediacy which makes PTT such an attractive service. For example, instead of calling each employee individually, a manager could make a group PTT call telling each of his employees to meet downstairs in 5 minutes time (see example above).

PTT introduces a new 'near-real-time' service which provides a valuable tool to business users and a fun and useful new service for the mass market. PTT will largely be used by business users who work in a distributed working environment such as emergency personnel, construction workers, transport workers, etc. However, PTT could also be a successful mass market application due to its low cost (compared to traditional voice communication), instant voice connection (no call set-up delays) and group call capability (one-to-many or many-to-many). In this respect it offers a very attractive and more user-friendly enhancement to SMS messaging.

PTT could enable a number of different revenue strategies depending on individual MNO preferences and circumstances. It could be implemented as a 'loss-leader' type service whereby the MNO offers PTT free of charge, relying on the stickiness of the application to retain end users and accruing revenue via the other services it sells.
Alternatively, PTT could be a service for which users pay a flat monthly charge, a per user fee, or a mixture of these two.

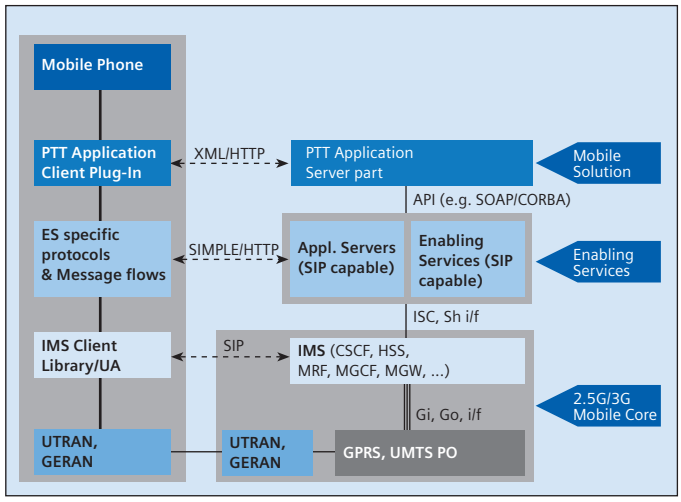

Figure 7: PTT Architecture using IMS

IMS adds value to any PTT application from an end user perspective by integrating Presence and Instant Messaging into the service as well as providing critical single-sign-on and billing functionality. For a MNO who had already rolled-out an IMS network, deploying the PTT application would only mean an additional application on top of an SIP-capable Application Server and introducing a PTT client plug-in (which could be downloaded onto the client). This translates a very large CAPEX savings compared to deploying a PTT via a proprietary, redundant island solution. By deploying the PTT application via IMS, the operator could also make substantial OPEX savings as the application and its infrastructure could be managed via the central IMS OAM mechanism.

Example Service 2 – Enhanced Call Line Identification (CLI)
Call Line Identification (CLI) whereby the end user can see who is calling his mobile device is a feature which most mobile users (and fixed) take for granted. IMS can enhance this very basic (yet very desirable) service by enabling users to create a variety of personalised 'calling cards' which will be displayed on other users' mobile devices when the user calls or is called. These calling cards can contain a wide array of customizable components including pictures, text, music, speech, links and/or animation.

Additionally, users could make a variety of different calling cards and then define filter criteria to determine which calling card should be displayed. Filter criteria could include calling/called party, time of day, event trigger (e.g. call is answered, busy signal, call ended, incoming call, etc.) or a mixture of all these criteria. For example, a user may wish to have an individual greeting card for his work contacts, one for his family and one for his friends.
Alternatively, users can define time-based filter criteria which would allow the user to use a work calling card during business hours and a private calling card for evenings and weekends.
Users may also want to have different cards for different telephony 'events'. For example, a user could have four different types of calling cards for call ringing, call answered, busy signal and call ended respectively.
Busy Signal and Call Ended calling cards could be stored in the called party's memory as a form of virtual message.

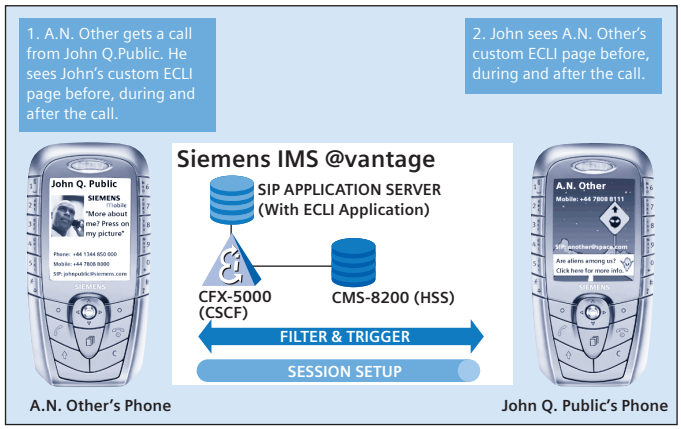

Figure 8: Enhanced CLI Example

Target customers for the Enhanced CLI service would be both business users and mass market users. It would appeal to business users as it is an additional marketing tool and allows them to enhance their networking portfolios via the use of virtual calling cards (which are stored on the phones of called parties). Mass market users such as teens would appreciate the personalised nature of the service, giving them an added opportunity to express their individuality.

As regards revenue strategies, the Enhanced CLI application could potentially be a free-of-charge service (to increase customer loyalty and reduce churn) or follow a flat fee pricing model.

IMS provides the basic infrastructure to enable the Enhanced CLI service including critical service filtering and triggering capability (determining which calling card should be displayed) as well as session setup capability. The application would require minimal CAPEX for those operators who had deployed and IMS, with the Enhanced CLI application (running on a SIP-capable Application Server) and the requisite client SW plug-in (downloadable on the client) being the only added investment required to deploy the service.

Multiuser Services

IMS also enables new multiuser services which allow one-to-many and many-to-many services such as multimedia conferencing, group chat sessions or multi-user PTT services. In fact, one of the original reasons for the creation of the SIP protocol (which is the basis for IMS) was to provide real-time mobile conferencing services. Multiuser services are enabled in IMS via a dedicated media server dubbed the MRF (Multimedia Resource Function). Siemens will provide its CCS-1000 Media Server to perform the role of the MRF in order to enable multiuser services.

Example 1 – Multimedia Conferencing

The use of conferencing has skyrocketed in recent years as businesses try to reduce travel expenditure and increase efficiency. Many users are used to working with simple voice conferencing services or more complex web-based multimedia conferencing services such as Microsoft NetMeeting, which also enables white-board and document sharing functionality. The rise of more powerful mobile devices with large colour displays, combined with the conferencing and Quality of Service functionality provided by IMS, makes mobile multimedia conferencing a service which more and more mobile users will be willing and happy to use.

Using an IMS-based conferencing solution, users will have the following functionality:

- **Reservation & Scheduling:**
  Use of a dedicated reservation and scheduling server which reserves conference resources for the scheduled time/participants. The user could choose to have a dial-in conference (whereby users dial in to a conference bridge number) or choose automatic conference setup (whereby the CCS-1000 Media Server calls each of the scheduled participants and automatically sets up the conference session at the appointed time). Additionally, users can choose a presence-enabled conference setup, whereby the media server automatically invites the participants once their presence status shows them as available.
- **Conference Control & Monitoring:**
  The ability to dynamically monitor and control the parameters of a conference once it is under way is enabled by an intuitive and dynamic web interface. Conference participants can monitor the participant's names, phone numbers, terminal types and basic conference settings. Control of the conference can be predetermined or granted to other users during the life of the conference. Conference control allows users to manage activities such as locking the conference on a single participant, muting the audio of a specific participant or determining how the video output should be displayed, amongst others.

- **Document Sharing & Whiteboard Facility:** Document sharing allows conference participants to view and manipulate documents such as Microsoft PowerPoint slides or Word documents. Additionally, users will have a virtual whiteboard facility which mimics a meeting room whiteboard in order to aid creative thought and documentation of agenda points.
- **Full Multimedia Functionality:** The ability to have conferences which involve both video and audio components. Additionally, users will be able to have group or one-to-one chat sessions and/or to send Instant Messages during the conference.

Target customers for the Multimedia service would mainly be business users. The full functionality of the service, combined with the ensured QoS enabled by IMS, would make the service an attractive proposition to most business users. The multimedia conferencing service could also be integrated into mass market application such as mobile games or other entertainment applications which could be enhanced by three or more users taking part simultaneously.

As regards revenue strategies, the Multimedia Conferencing service would most likely profit from a mixed pricing concept, whereby users pay a flat monthly fee to access the service and then pay a per minute fee for using the service.

The mobile multimedia conferencing application as described above would be very difficult and expensive to operate without an IMS infrastructure. IMS provides a SIP-capable conferencing server (The Siemens CCS-1000 media server) which controls the conference and manages the conference bridge resources. Additionally, the multimedia session management ensures that session setup is managed individually for each participant, thus ensuring the best possible display and sound quality to match the specific device capabilities. Lastly, the QoS mechanisms provided by IMS enable a high-quality user experience in order to guarantee business usage.

Example 2 – Group Chat
The phenomenal growth in SMS text messaging illustrates the popularity and revenue potential of mobile text communication. Group chat enhances text messaging by allowing three or more users to engage in a real-time text messaging 'session'. The result is virtually identical to Internet-based 'chat rooms' which allow multiple users to have online text-based conversations with one another.

Target customers for the Group Chat service would largely be mass market users, although the service does provide value add for business users as well. The ability to have mobile group chat sessions in real time would revolutionise text-based mobile messaging, especially when integrated with other IMS-enabling services such as Presence. The group chat service could also be integrated into mass market applications such as mobile games or other entertainment applications which could be enhanced by three or more users taking part in simultaneous text messaging.

There are a number of different revenue strategies that MNOs could use for the Group Chat service, either individually or in combination. MNOs could charge a flat monthly fee, charge on a per-chat-session basis or charge based on chat session duration. As users are already paying for SMS text messaging, MNOs should be able to make extremely healthy revenues by providing an enhanced mobile text communication service such as Group Chat.

The ability of IMS to setup and manage real-time communication sessions of three or more users (via the MRF) is the core of the Group Chat service. IMS additionally enhances the service by enabling easy integration with other services (such as click-to-dial and presence) to further increase the service's attractiveness. Lastly, IMS enables flexible charging options through its ability to provide converged service, event (content) and transport (volume) based charging.

Server-to-User Services
The ability of IMS to locate users within the network (mobility management), its underlying signalling infrastructure and its ability to allow servers to act as User Agents (i.e. initiating and receiving SIP messages) allows MNOs to introduce innovative Server-to-User services. Examples include click-to-dial and click-to-chat which are based upon 3rd party call control concepts and services whereby servers act as user agents, such as presence and dynamic push services.

Example 1 – Click to Dial
Click-to-dial is a service whereby when a user 'clicks' on an onscreen button or icon, the IMS network will automatically negotiate and setup a voice session between the person who 'clicked' and one or more designated others.

An example use case for click-to-dial would be the ability to integrate the service into a web page. For example, John is viewing a MNO's homepage and has a question about his bill. He clicks on the 'Questions about your Bill?' button. A voice session (VoIP) would then automatically be set up between John and one of the MNO's customer service agents who deals with billing enquiries.

Click-to-dial is a service which would appeal to all-types of end users as it can be usefully integrated into virtually any type of application and can initiate any media session type (voice, video, chat, conference, etc.). It could be used in customer service WebPages as above, but would be equally interesting if, for example, used in mobile games (e.g. setting up voice, video or chat sessions for games with 2+ players) or integrated into an Enhanced CLI calling card (e.g. "click 'here' to contact me").

In terms of revenue, click-to-dial does not, in and of itself, represent a direct source of revenue. Instead, it increases the customer's ease of use and enhances the attractiveness applications thereby indirectly increasing service revenues and helping MNOs to achieve greater differentiation, reduce churn and ensuring a greater degree of customer loyalty. Additionally, click-to-dial and related services act as drivers for other services, thereby increasing overall MNO revenue.

IMS is the core enabler for the click-to-dial service as it enables the underlying technological concept which is known as 3rd party call control. 3rd party call control is a concept whereby a 3rd party (i.e. a server) can initiate, negotiate and setup a session between two mobile endpoints. This type of service is enabled via the ability of IMS to treat an application server as User Agent which is able to trigger services between two or more parties.

Example 2 – Dynamic Push Service

Dynamic Push Services enable users to passively receive useful and desirable information which is 'pushed' to them based upon a number of personalised factors such as presence status, geographic location, device type and capabilities, media preference and content preference. Dynamic push services could be general in nature (providing a wide variety of content) or could be interest-specific (e.g. a football push service).

For example, John is a big fan of Rochester United Football Club (RUFC). John logs on to RUFC's site using his mobile IMS terminal and clicks on the banner for the push service. When John subscribes to the service he has the option to choose what types of information he wants to receive (goals, club news, player info, special offers, etc.) as well as when and how he wants to receive the pushed information. In this example, John chooses to receive pushed info at any time (based on his presence and location status) and chooses for the network to automatically decide which media types his current device can utilise.After the subscription is made, the Push Service subscribes to John's presence information via the MNO's IMS infrastructure. Thus, the information server knows when John is online and available and also knows his geographic location (which forms part of John's presence data). On the next day, RUFC are playing but John is unable to go to the game. RUFC score a goal in the second half of the game. The Push Service makes sure John is present and available and then sends him a suitable media message. In this case, John is using a high-end device and the push service (having detected the device capabilities and choosing the appropriate content type) sends John a streamed video replay of the goal.

Later in the day, John is shopping and the push service detects, via access to his location information, that he is near to RUFC's club shop. The push service then pushes an Instant Message to John telling him that if he purchases a RUFC kit and quotes a special offer number he can purchase the kit for half price.

The dynamic push service is a service suitable for both business and mass market applications. For mass market users it represents an extremely personalised and dynamic way to receive desired information (traffic, special interest, shopping, etc.). The service is also applicable to business scenarios. For example, when a user approaches the Siemens office building he will be pushed a message showing him a map of the location, where to park and where the entrance is.

IMS enables the dynamic push service through its ability to support SIP User agents and its mobility management functionality. IMS further enhances the service by enabling device-specific session setup and negotiation and via its ability to easily integrate SIP-based enabling services such as presence and instant messaging. In the user scenario illustrated above, IMS would also enable the streaming of the goal via its in-built media server (MRF, Siemens CCS-1000 Media Server) and its ability to manage QoS. Lastly, IMS enables flexible charging options through its ability to provide converged service, event (content) and transport (volume) based charging.

Boundless Service Potential

The above examples illustrate only a tiny fraction of the total number of services which could conceivably be deployed using IMS infrastructure. Unlike other types of service platforms, due to its ability to easily integrate different services and service enablers, the total number of possible services grows exponentially with the number of service 'building blocks' available for integration. Thus, due to the number of service building blocks which IMS enables and its ability t o easily integrate these building blocks, IMS can offer a virtually unlimited number of potential applications.

Service integration is enabled using IMS via a number of methods including standardised interfaces, common databases, service control and service interaction capabilities, the inherent capabilities of the SIP protocol and the relative ease of developing and deploying SIP-based services on an IMS network.

The ability of IMS to support fast, cost-effective and easy service creation, combined with the ability of IMS to integrate a wide variety of service building blocks, vastly increases the probability that MNOs will create and launch new killer services. The large number of potential services also contributes to the MNO's service differentiation possibilities

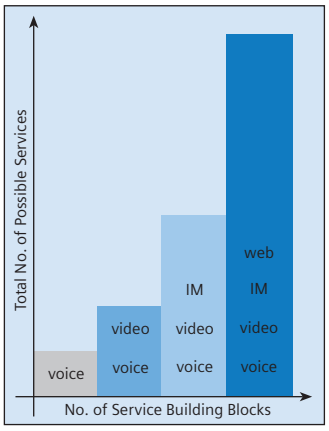

Figure 9: IMS Enables Boundless Services

IMS vs. Proprietary Island Solutions

In the previous section, it was explained that IMS can provide new mobile user-to-user, multiuser and server-to-user services such as Push-to-Talk, Multimedia Conferencing and Dynamic Push Services. Readers of this paper, however, might have read about or seen other technical solutions for implementing such services without using an IMS. In this sense, it is acknowledged that there are other technological solutions which can, at least in part, provide services similar in functionality to those enabled via IMS. However, in this section we will illustrate how and why IMS is preferable to these individual 'island' solutions.

Proprietary Islands
Island solutions are thus named as they provide a set of dedicated components to realize only the specific service they support, independent of any other service-related infrastructure. In this sense, a Push-to-Talk island solution would be a set of specialized components (such as a Proxy, a database, some gateways, OAM, billing/charging, etc.). The functionalities of these components, as well as external and internal interfaces, are most often proprietary in nature.

The High Costs of Island Solutions
Due to island solutions' proprietary and specialized nature, it is very difficult to reuse the island solutions' components (e.g. databases, proxies, gateways, etc.) for other services. By the same token, when an MNO implements multiple island solutions (e.g. one for PTT, one for presence, one for conferencing, etc.) there will be an inevitable amount of redundancy amongst the island services' components (e.g. multiple OAMs, multiple databases, etc.) due to the specialized and proprietary nature of the solutions. This translates into increased CAPEX (through the purchase of redundant, overlapping components and high integration costs) as well as greatly increased OPEX (i.e. high operation and maintenance costs due to the complexity arising from multiple island solutions) for the MNO. This problem of increased CAPEX and increased OPEX grows exponentially with the more island solutions the MNO deploys.

Island Solutions = No Synergies and Restricted Services
Additionally, the MNO loses out on significant synergistic gains which could be achieved through combining the functionalities of each island solution (e.g. integrating a presence service with conferencing). Even if the operator tried to integrate the island solutions, such an act would require large amounts of integration resources due to the proprietary and specialized nature of the each individual solution.

Island Solutions = No Roaming
Lastly, the nature of the island solutions makes roaming scenarios virtually impossible, thus relegating the solutions to the home network only. This translates into lost revenue for MNOs and decreased satisfaction for end users. In fact, without the ability to use their services whilst roaming, many end users (especially business users) would be put off from the services of the MNO altogether.

Standardised Reusable Service Platform – the IMS
IMS on the other hand represents a standardized, reusable platform which can be used to create, deploy and execute a wide array of different and innovative services. IMS is being standardized by 3GPP and thus IMS entities (CSCF, HSS, MRF, etc.) are standardized in terms of functionality as well as internal and external interfaces. Especially crucial for service deployment is the standardization of the ISC and SH interfaces which provide standardized interfaces for the integration of application servers into IMS.

Cost Effective
The standardized nature, combined with the core functionality of IMS entities, enables it to act as a reusable service platform.

In most cases, new services would only require the creation and deployment of the new service on a SIP application server and a corresponding client plug-in. IMS would provide most of the underlying components and functionality on behalf of the new service (registration, session setup, security, billing, OAM, etc.). This translates into massive CAPEX as well as OPEX savings for the MNO, especially in a complex service environment where a large number of services have been deployed.

Integration Synergies = Increase Revenues
Due to its standardized functionality and interfaces, the MNO is able to easily, quickly and inexpensively integrate different services (both real time and non-real time) to form more complex and

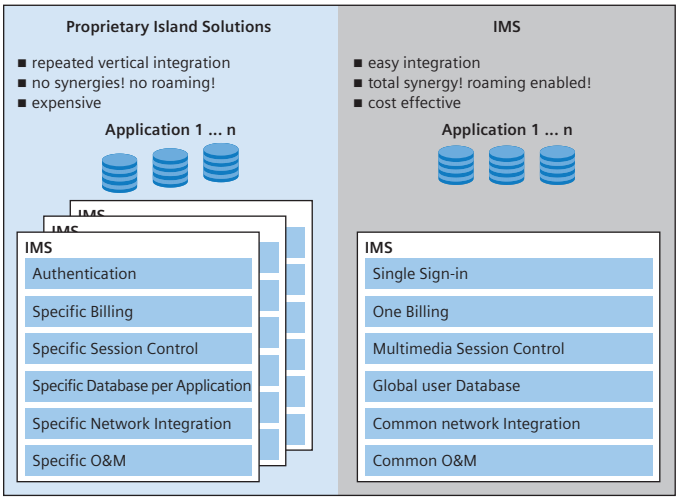

Figure 10: Comparison of IMS and Proprietary Island Solutions

attractive 'bundled services'. For example, if the MNO had already deployed Instant Messaging and Presence via IMS, he could easily integrate these services into other services such as Mobile Games or Push-to-Talk. Thus IMS enables MNOs to leverage all of their service investments in order to create a greater diversity of innovative services, thereby increasing revenues through increased differentiation and customer satisfaction.

IMS = Service Roaming

Lastly, IMS enables end users to roam and still be able to use their services via their home network. This translates into increased revenue for MNOs and is absolutely crucial to making successful business services.

IMS is nothing new in the sense that the underlying technical concepts of IMS have been discussed in standardization and technology circles for some time. Thus, IMS has had a relatively low profile as it has (to date) mainly been relegated to very technical discussion forums whose main concern was in defining IMS networks in technical terms, which involves the definition of such things as service control, service interaction, Quality of Service, Mobility Management, etc. However, what is only now beginning to emerge are the very real benefits which IMS can provide in terms of new services and the end user service experience.

This translation of technical concepts into end user benefits often takes a while to emerge, but with IMS we are now seeing this emergence take centre stage in the world of 3rd generation mobile services. Vendors, MNOs and Application Developers are all showing an increased interest in IMS due to its ability to revolutionise the end user experience and its ability to enable new and innovative services.

But what's to say that IMS will succeed where other technologies have failed? The answer to this question does not lie with the IMS vendor, the MNO or the application developer, despite the growing interest in IMS from these circles. This question can only be answered by the end user.

Thus, this white paper has attempted to illustrate how IMS will not only radically improve the end user service experience, but also enable a wide variety of new services which end users will be willing to use and to pay for. We at Siemens believe that IMS is not another attempt at supply-side economics (i.e. "build it and they will come") in the mobile industry. Instead, we believe that IMS heralds a paradigm shift in the mobile industry in that IMS is a technology which brings real benefits to the end user, for the reasons outlined in this paper. This is not to detract from IMS's other benefits such as substantial OPEX and CAPEX savings, but it is the key factor which will determine the ultimate success of IMS.

The future is now!

Siemens can provide MNOs with a full turnkey commercial IMS solution.

Abbreviations

2G	Second Generation
3G	Third Generation
3GPP	Third Generation Partnership Project
API	Application Programming Interface
CAPEX	Capital Expenditure
CLI	Call Line Identification
CS	Circuit Switched
CSCF	Call Session Control Function
HSS	Home Subscriber Service
HTTP	Hypertext Transfer Protocol
ISP	Internet Service Provider
GERAN	GPRS EDGE Radio Access Network
GGSN	Gateway GPRS Support Node
GPRS	Global Packet Radio Service
GSM	Global System for Mobile communication
IM	Instant Messaging
IMS	IP Multimedia Subsystem
IP	Internet Protocol
MGCF	Media Gateway Control Function
MGW	Media Gateway
MMS	Multimedia Messaging
MNO	Mobile Network Operator
MSC	Mobile Switching Center
MRF	Multimedia Resource Function
OAM	Operations And Maintenance
OPEX	Operating Expenditure
PDA	Personal Digital Assistant
PDF	Policy Decision Function
PS	Packet Switched
PSTN	Public Switched Telephone Network
PTT	Push to Talk
QoS	Quality of Service
SGSN	Serving GPRS Support Node
SIMPLE	Sip for Instant Messaging and Presence Leveraging Extensions
SIP	Session Initiation Protocol
SSP	Subscriber Service Profile
SMS	Short Message Service
UA	User Agent
UTRAN	Universal Terrestrial Radio Access Network
VoIP	Voice over IP
W-CDMA	Wideband Code Division Multiple Access
WAP	Wireless Access Protocol
WLAN	Wireless Local Area Network
XML	Extensible Markup Language

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