

IP Multimedia Subsystem Solution

Executive Summary

Pressure from the competition and market de-regulation mean that carriers are experiencing a continuous decrease of ARPUs from voice services and broadband Internet access. Voice services and Internet access are set to become commodities, as the challenge is on to discover new, attractive revenue-generating services.

IP Multimedia Subsystem (IMS), defined by 3GPP/3GPP2 and now adopted by other international standardization bodies, designs a horizontal layered architecture for the development of Multimedia Services and Voice over Packet domain, using standard protocols (mainly IP, SIP -Session Initiation Protocol, and Diameter).

IMS is the enabling technology that allows multi-access multimedia communication services to be deployed on core IP transport networks.

Although IMS was initially defined in the mobile world, there is growing interest in IMS among wireline operators because they need to quickly develop new revenue-generating services to bridge the gap with mobile competitors. Moreover, they can leverage broadband (xDSL) to support IMS-enabled services and applications earlier and with better quality than 3G.

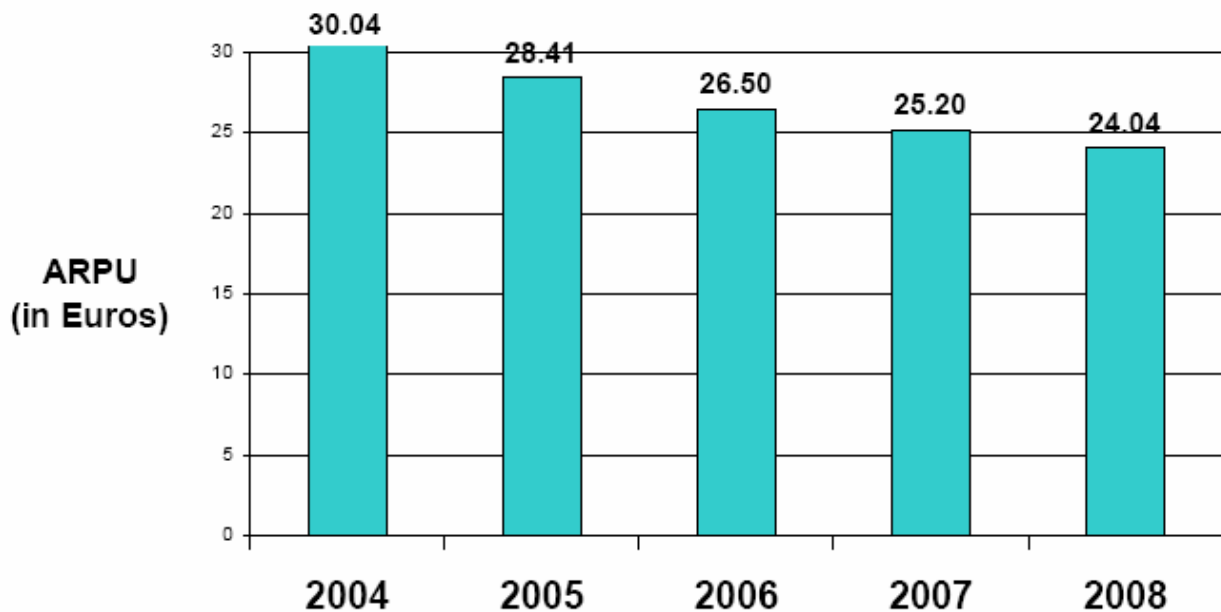
The Italtel IP Multimedia Subsystem solution provides Fixed and Mobile operators with a layered future-proof architecture that speeds up service creation and deployment. The Italtel modular solution approach allows either a smooth migration of existing incumbent operator infrastructures to a complete IMS framework, enabling new, additional services to be developed, or the greenfield development of a transport IP network from scratch, adding on all the available IMS components. Service Providers will be able to enrich their product range step-by-step, by combining and launching different services as soon as they are ready. This is made possible because IMS defines clear, standard interfaces for service development, and this is why one of the winning elements of the model will be field-proven interoperability between products from different vendors. The open IMS service architecture allows new services to be developed without the need to modify the underlying control and connectivity layers. As a result, the timeframe from service concept to service rollout is dramatically reduced. The flexibility of charging functions together with the ability to guarantee the required Quality of Service is another key advantage of IMS: today, operators are not aware of content types exchanged in call or web sessions (video, voice or data), so they are not able to charge customers on a content basis. IMS provides integrated charging functions that allow different charging models (content-based, time- or volume-based or event-based). Finally, IMS allows a mix of media types in a single session: each person can communicate with their relationship groups, choosing and combining the media they prefer -voice, picture, text and video all together, or stand-alone. Thanks to its wide experience in developing telecommunication systems and pioneering the delivery of NGN solutions, Italtel represents the best partner for operators that want to quickly and safely move into the new era of IP multimedia communications.

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Market Trends

The telecom service business model as we know it today is rapidly changing. Carriers are experiencing a continuous decrease of ARPUs from voice services and Internet access. Due to competitive pressure, market de-regulation and technological innovation, carriers' margins on voice services are dramatically reduced. Despite improvements in technology and bandwidth availability, basic broadband access ARPU is expected to decrease in the coming years as well.



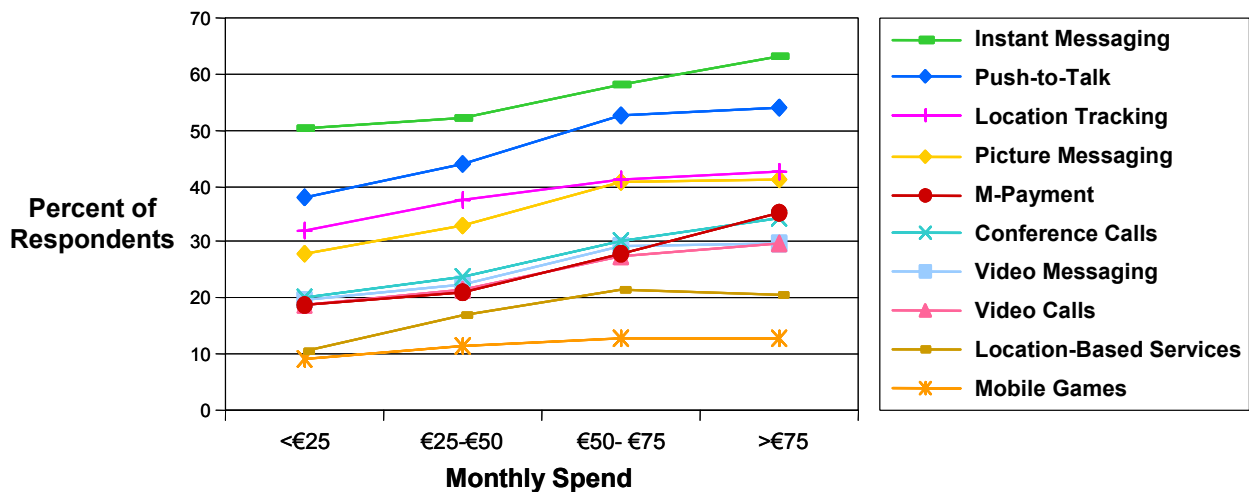
Source: The Yankee Group EMEA Consumer Fixed-Line & Media Forecast, Western Europe, Fourth Quarter 2004

Figure 1 – Decreasing trend of basic broadband ARPU

Fixed and mobile operators can no longer increase revenues by offering voice services and basic broadband Internet access only. Operators need to find new revenue-generating services and reduce customer churn by bundling voice and basic broadband access with attractive services. New services should be deployed quickly, minimizing introduction costs and avoiding the risks of introducing unsuccessful products. This new service bundle concept will not only keep existing customers engaged, but will also attract users wishing to experience an innovative communication paradigm. Customers are asking for mobility and high quality communication and data services that can be used anywhere at any time in an Internet-like fashion. To differentiate themselves from the mobile community, which has already started to develop portals and to offer person-to-content services, wireline operators must focus on real-time multimedia communication services over IP. The person-to-person communication model allows end users to produce and deliver content

themselves, removing the need for operators to make large investments in third-party-content provider contracts. IMS represents the enabling technology that can make network convergence and innovative service offers a reality. Thanks to IMS, subscribers will communicate, provide and exchange multimedia content over a new multiple-access, service-rich network.

Figure 2 below shows a forecast of customer interest in new services, with the customer base divided by monthly spend.



Source: Yankee Group European Connected Consumer Survey

Figure 2 – Customer interest in new services by spend

The IP Multimedia Subsystem

IMS (IP Multimedia Subsystem) architecture was first defined by 3GPP/3GPP2 and has now been adopted by other international standardization bodies. It designs a horizontal architecture for the development of Multimedia Services and Voice over packet domain, using standard protocols (mainly IP and SIP -Session Initiation Protocol).

Thanks to its well-defined layered nature, IMS architecture allows the development of a “core network” completely independent from any particular access technology: this

Third Generation Partnership Project (3GPP) is the leading standardization organization for cellular networks. 3GPP was established in December 1998. The original scope of 3GPP was to produce globally applicable Technical Specifications and Technical Reports for a 3rd Generation Mobile System based on evolved GSM core networks and the radio access technologies that they support (i.e., Universal Terrestrial Radio Access (UTRA) in both Frequency Division Duplex (FDD) and Time Division Duplex (TDD) modes). The scope was subsequently amended to include the maintenance and development of the Global System for Mobile communication (GSM) Technical Specifications and Technical Reports, including evolved radio access technologies (e.g. General Packet Radio Service (GPRS) and Enhanced Data rates for GSM Evolution (EDGE)). Recent technical specifications cover W-CDMA named UMTS (in Europe) and FOMA (in Japan).

means the opportunity to support customers at home and on the move.

Moreover, IMS provides a future-proof architecture that speeds up service deployment, while ensuring basic interworking with legacy systems.

In the IMS scenario, Service Enablers such as Presence, Messaging and Group Management, and Global Enablers such as Charging and Security, play a strategic role because they can become common functions: in fact, they can be reused by multiple applications, thus eliminating overlapping functionalities and reducing costs for introducing new services.

New services enabled by IMS

IMS allows new services to be managed together as a whole, enabling the development of key applications such as presence, instant messaging or multimedia session control in order to build more complex communication applications. The following section provides a typical IMS-enabled communication use case that can be easily obtained by composing basic service features. A list of innovative IMS-enabled application examples is presented at the end of the section to emphasize the potential and flexibility of the IMS solution.

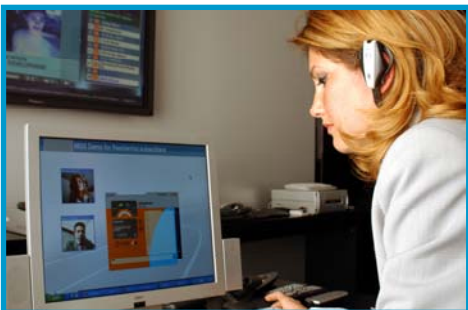
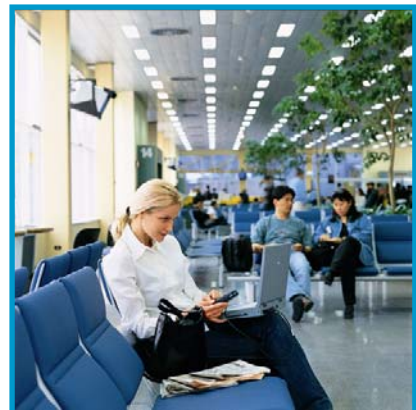
A service use case example

The following use case shows how IMS can support person-to-person multimedia communication sessions that allow customers to dynamically modify their services.

Mary is at the airport using her WiFi-enabled PDA. She calls her colleague Paul at the office. Mary calls Paul's personal number and the call is routed to Paul's desk phone. Paul needs to leave the office for a few minutes and asks Mary to continue their conversation using his mobile phone. After transferring the call to the mobile phone, both users decide to activate the video mode to show what they're talking about.

Later on, they realize that they need some help from another colleague in the company. Mary sees that Ann is available online through the presence

application and invites her to the videoconference. After Ann accepts the call she's connected to the videoconference through the soft-phone on her PC. Ann shows the requested documentation and is able to send a presentation to her colleagues during the call.



By adopting an IMS enabled network architecture, fixed and mobile operators can easily implement service scenarios similar to the one described above.

Examples of services

The most interesting and revenue-generating services enabled by the adoption of an IMS framework are the following:

Multimedia Call Session

IMS removes the limits of traditional phone communication so that conferences can be held among several individuals and media other than voice can be used. One-to-one voice or video calls can be expanded to one-to-many by simply adding new participants. An ongoing voice call can be transformed into a video call by simply activating the video option.

Rich media call

A voice or video call that is enriched by allowing users to simultaneously share content such as video, text, images or other data.

Presence

Presence allows a user to learn (see) information about other users and to make known (publish) his/her willingness to communicate. Examples of presence information may include:

- availability to communicate (e.g. idle, in a meeting, at lunch, on vacation)
- preferred means of communication (e.g. voice, messaging)
- mood (e.g. happy, sad, etc.)

Presence may work in conjunction with other services such as Push services, Call Forwarding, etc.

Messaging

Messaging evolves to a Unified Messaging solution that includes e-mail or instant messaging with text only, voice and video messaging, voice and video mailbox, chat or push content from a third party. The user's mailbox can be reached using multiple access devices such as laptop, PDA, mobile phone, fixed line phone and multiple user interfaces such as web, e-mail, voice with text-to-speech conversion, MMS or SMS for mobile operators.

Information sharing

Once a call session is established, users can start sharing all kinds of multimedia content or documents such as presentations or formatted text.

The Italtel IMS Solution

Solution overview

The Italtel IMS Solution consists of a set of products that fulfils all the necessary IMS standard functions. The same suite of products can be used in the same way for Wireless, Wireline and Corporate networks, allowing the implementation of a control layer for converged networks. The Italtel solution achieves a seamless convergence, delivering voice and multimedia services to diverse access devices and technologies over an integrated architecture, according to the end-user's requirements and status.

The solution framework easily allows interworking with external PSTN/PLMN or other SIP/H.323 based networks, thanks to the implementation of gateway functionality.

The Italtel IP Multimedia Solution consists of the following components:

IMS Core

- **CSCF** – Call Session Control Function represents the Core IMS platform that provides Session Control functions to the network connectivity layer. CSCF is achieved by integrating the Italtel advanced native SIP Session Controller, which is developed in accordance with 3GPP standards. The platform supports BGCF, I-CSCF, P-CSCF and S-CSCF configurations, providing all the mandatory and optional functions required by the IMS architecture.
- **UDB** – Universal Database is a common single database that stores and handles all subscriber information. HSS stores the profiles of users according to HSS functions and implements AAA and SLF functions.
- **MRF** – Media Resource Function provides Specialized Resource Function and Media Server functions for both traditional and next-generation convergent networks. MRF combines MRFC and MRFP functions, and thus is perfectly compliant with IMS requirements.
- **SSW** – Class 4/5 Softswitch is a next-generation multi-service system based on an open architecture that allows the creation of a fully convergent environment, enabling operators to offer a wide range of voice and multimedia services and transporting all traffic into a unique IP infrastructure while maintaining full interworking with legacy systems. SSW platform performs MGCF, SGW, C4/C5 Softswitch and IM-SSF emulation.
- **MGW** – Media Gateway platform carries out interworking between CS networks and PS networks, allowing traditional TDM access networks to evolve into next generation ones.
- **SBC** - Session Border Control is a commercial third party platform that performs the SBC function of IMS architecture. SBC can be configured to support both Access and Network SBC functionality.

Service Layer

- **AS** - Application Server is a SIP-based flexible software platform, which supports the implementation, introduction and control of a wide range of next generation services, integrating voice-over-IP technology and web programmability. The platform is capable of hosting the most important enabling services such as Presence, Group Management, Messaging and other session-based services.

OSS & BSS

- **Charging and Mediation** component is used to collect charging data from the other platforms using online and offline mediation systems.
- **OSS** component implements multi-element configuration and monitoring features.

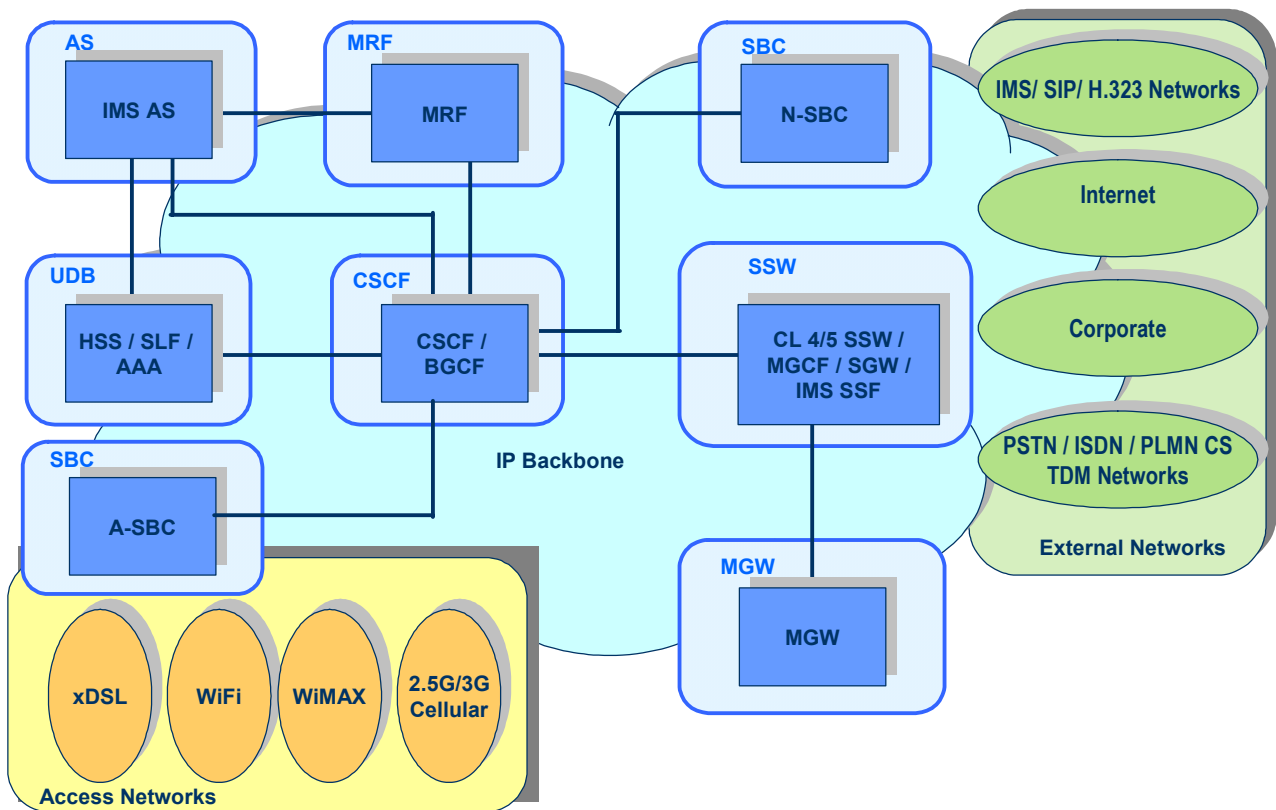


Figure 3 – Italtel IMS Architecture overview

Features & Benefits

The Italtel IP Multimedia Subsystem solution offers the following features and benefits:

One architecture framework for multiple networks

The IP Multimedia Subsystem is based on a core IP-based packet switched network that can be used to transport voice, video and data communications. The Italtel IMS solution is based on a common 3GPP standard framework that can be seamlessly used to control wireless, wireline or enterprise networks.

The centralization of network and service control functions and the adoption of an IP core network infrastructure to transport different media types dramatically reduces management and operating costs, improving the scalability of the solution with the added benefit of reducing capital expenditure.

The Italtel IMS solution is based on a suite of platforms such as SSW and MGW components that enables interworking with different existing access technologies such as ISDN PRI, ISUP, xDSL in the fixed network domain, WLAN and WiFi in the radio network domain and GPRS/EDGE or UMTS in the cellular network domain. Moreover, the support for protocol adaptation in the SSW component allows existing OLO networks based on H.323 or SIP protocols to be interconnected.

The IMS solution is an enabler of true convergence across fixed and mobile access, delivering the best features and benefits of both networks.

Service providers will be able to deliver mobility applications across different access networks and terminals. Subscribers will be able to use their multimedia communication services regardless of the access network, independently of time and place, and using the device they prefer (mobile phone, PDA, laptop or desk phone).

A standard based architecture

The Italtel IMS solution is completely based on standard interfaces, not only on the border components such as MGW, SSW and SBC but also among the other platforms in the framework.

This approach guarantees interworking with existing access networks and legacy platforms, allowing service providers to leverage previous investments. Moreover, operators can different platforms to build a multi-vendor architecture and implement a single communications network.

Thanks to standard adoption, Italtel IMS architecture is future-proof and allows interoperability with other network operators from the outset, thus supporting the future mass-market adoption of IMS-based services.

Service creation and reuse of components

The Italtel IMS is a horizontal architecture that allows reuse of common framework functions and components. Reusable components are divided into Global Enablers and

Service Enablers. Global Enablers are common functions developed on top of the call session control and define how service requests are routed, how the user is identified, how charging is performed and how service interaction is achieved. Service enablers are achieved through the development of service logic components that are hosted in the Italtel Application Server (AS) platform. Presence, Group List Management, User Interaction and Conference Control are all examples of Service Enablers. Global and Service Enablers can be reused to quickly create new services.

The solution at the Service Layer adopts open standard APIs and common developer toolsets that abstract the lower-layer implementation details. A complete IDE (Integrated Development Environment) along with advanced programming tools such as SIP Servlet API, J2EE, Parlay/OSA and IMS Service Control (ISC) is provided to enable rapid 'in house' or third party service creation. Moreover, the Italtel IMS Service Creation environment can be enhanced using web services technology and SOA concepts to support interaction with external third party service providers.

Using already-deployed common functions such as Global and Service Enablers, new services can be integrated and deployed in a very short time and deployed on existing AS platforms. In this way, the timeframe from service idea to service rollout can be dramatically reduced with the consequence of minimizing costs for the introduction of new services. Along with cost reduction, the risks of introducing unsuccessful services are also minimized. Services can be started or stopped in the Service Layer without needing to modify the underlying control and connectivity layers or change the existing common features. Thanks to the framework flexibility, it is possible to open up the application environment to third-party developers or external content providers, thus multiplying the possibility of creating revenue-generating attractive services.

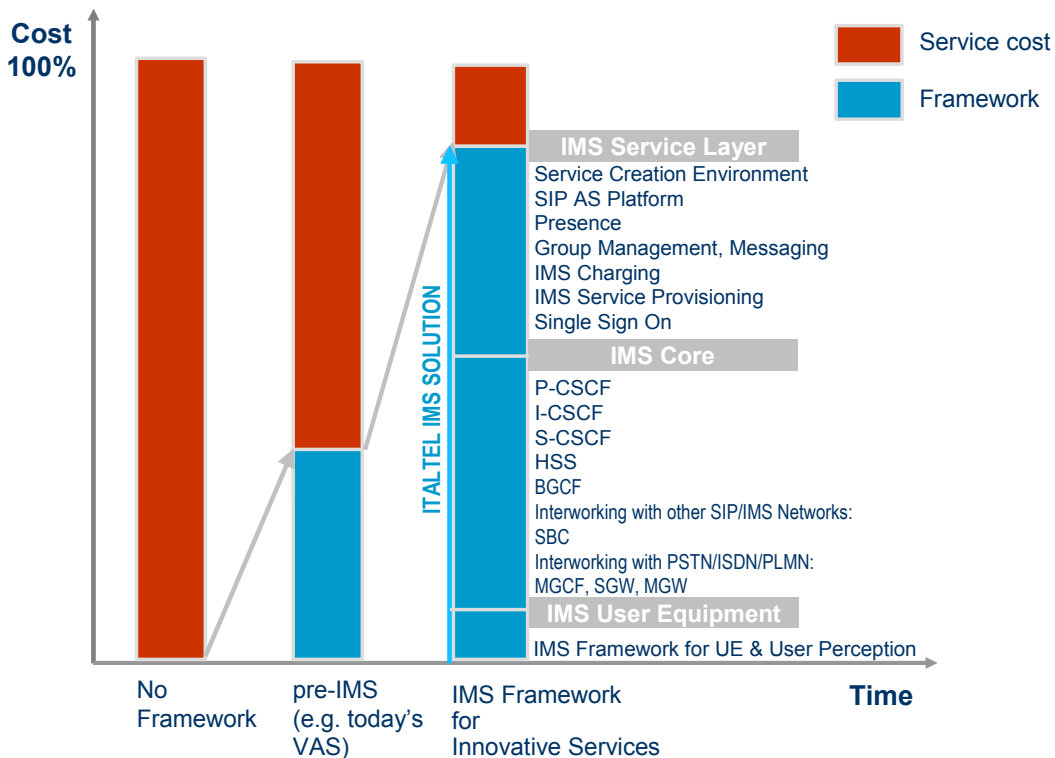


Figure 4 - Impact of IMS Framework on cost of introducing new services

Home service control

Services are always hosted and executed in the home IMS network domain. In this way the IMS network operator is able to deploy and start services regardless of the roaming partners, further minimizing the Time-to-Market of new services.

Subscribers will be able to access their services independently of their roaming status or geographical position, experiencing the advantage of maintaining the same service environment even when they are away from the home network.

Maintaining a business relationship with the end-user

Thanks to the introduction of the Italtel IMS framework, the operator can provide new innovative multimedia communication services deployable in a short timeframe, tailored to the subscriber's needs and accessible from a variety of devices and network premises. This approach keeps subscribers engaged and increases traffic volume across the network, generating new revenue streams.

Thanks to the centralized service control, the Italtel IMS solution is able to provide complete and detailed charging information for each subscriber. The IMS systems can be easily interfaced with the service provider's real-time billing systems. This feature enables a flexible and converged billing approach whereby service providers can charge on a service, volume or time basis in pre- or post-paid mode. Moreover, the solution provides a standard centralized interface to OSS and BSS back-end systems, enabling the reduction of integration and management costs (e.g. new tariff plans can be easily introduced without affecting the deployed infrastructure).

Improving overall end-user experience

The Italtel IMS solution allows service providers to deliver person-to-person real-time multimedia communication services. Subscribers can dynamically invoke new services when involved in a communication session. A point-to-point call session can be established between two users and easily switched to a point-to-multipoint call without the need to pre-allocate a network resource. Multiple services can be delivered on the same session through negotiation and synchronization (e.g. voice, video and data sharing). Sessions can be modified by adding media types or service features on the fly (e.g. add data sharing to a call). Moreover, the same peer can establish a multiple-service session (e.g. a presence session with a video call) and manage it on a single device.

The Italtel IMS solution enables more than just real-time services. Non-real-time services such as chat and Instant Messaging and server-to-user services such as click-to-dial, click-to-conference and dynamic push services are also supported.

A carrier-grade solution

The Italtel IMS solution is designed to support millions of subscribers providing telecom-grade quality of service in a complex multimedia service offering. The overall system scalability is accomplished independently of the traffic mix, leveraging the modular IMS

architecture design. Since S-CSCF components are dynamically allocated to users during the registration phase, the CSCF capacity can grow in proportion to the number of subscribers.

In the Service Layer Application, Servers are statically allocated to users based on the service profile definition in HSS. This means that their capacity can grow in accordance with the distribution of services and in proportion to the use of different services. Internetworking capacity can grow in accordance with the use of services that use these features (e.g. TDM interworking, H.323 interworking, etc.).

Future Evolution

The Italtel IMS solution design strategy ensures the extensibility of the IMS Service Layer towards a complete Service Delivery Platform.

Global and Service Enabler components are built using open APIs that abstract core network functions and simplify access to underlying IMS protocols (SIP and Diameter). Service enabler components are deployed to deliver service features such as presence, location and messaging that can be reused to implement more complex services.

A common framework is built to manage the end-user service interaction, ensure the end-user identification and profile management and interface existing or new OSS/BSS systems. Using this toolset, service providers can easily create, deploy and execute innovative end-user services by integrating IMS with legacy network capabilities and common IT functions in an open and flexible environment.

Why Italtel?

Italtel designs, develops and installs new-generation integrated multi-service networks (voice/data/video), accompanied by a full range of support services. And with some added value: a systems integration capability and leading-edge products. In the last ten years Italtel has invested a significant part of its revenues in innovation.

Thanks to its extensive experience in developing telecommunication systems and signalling protocols for major operators, Italtel delivers fully tested and pre-integrated solutions that ensure interoperability with existing infrastructures and networks.

Italtel works closely with selected “Best of Breed” partners, which are fully interoperable and field-proven and can be plugged into Italtel’s open architectures in order to provide tested end-to-end solutions and to allow Service Providers to easily introduce and launch new applications and services.

Italtel revenues for 2004 totalled around 542 million euros. Since 2000, Italtel’s shareholders have been Clayton, Dubilier & Rice (the main shareholder), Telecom Italia, Cisco Systems, Advent International, Brera Capital and the employees.

Conclusions

Since Voice over IP and Telephone over IP have been successful in the fixed network operator business, standardization organizations like 3GPP have started to collect results and define specifications for next-generation IP-based wireless architectures. All these specifications have now been collected under the IP Multimedia Subsystem framework. Although IMS started as a standard for next generation wireless networks, it was soon embraced by the wireline community, after they realized the potential of the framework to control fixed IP-based communications as well. While wireless operators are still waiting for IMS compliant devices and are still investigating the business opportunity to introduce IMS in their networks, wireline operators are now able to anticipate the implementation of IMS to realize a true convergence in networks and communication services.

The Italtel IP Multimedia Subsystem solution represents an IMS-based framework architecture that is completely compliant with 3GPP and ETSI TISPAN standards and enables the development of innovative multi-access multimedia communication services for wireless, wireline and enterprise networks.

Thanks to its experience in developing NGN solutions, Italtel is able to take operators into the IMS world, allowing existing networks to migrate smoothly towards the new architecture.

The layered, open standard and future-proof characteristics of the Italtel solution allow a time-effective introduction of new customer-attractive services, minimizing costs and avoiding the risks involved in introducing unsuccessful services.

Its wide experience in developing telecommunication systems and pioneering NGN solutions make Italtel the best partner for operators that now intend to move into the new era of IP multimedia communication.

Acronyms and definitions

AAA	Authorization Authentication and Accounting
AGCF	Access Gateway Control Function (defined by ETSI TISPAN)
AGW	Access Gateway
ALG	Application Layer Gateway
AN	Access Network
BGCF	Breakout Gateway Control Function
CAMEL	Customized Application for Mobile services Enhanced Logic
CS	Circuit Switched domain (GSM/UMTS)
DBP	Diameter Based Protocol
DCC	Diameter Credit Control (application over DBP)
DNS	Domain Name Server
FMC	Fixed Mobile Convergence
FW	Firewall
HSS	Home Subscriber System (i.e. IMS-HSS + CS/PS HLR/AuC)
I-CSCF	Interrogating CSCF
IMS-HSS	The IMS-related part of HSS
ISC	IMS Service Control (reference point between S-SCF and AS)
CSCF	Call Session Control Function
IMS	IP Multimedia Subsystem (defined by 3GPP)
IN	Intelligent Network
ISM	IMS Subscriber Module
MGCF	Media Gateway Control Function
MGW	Media Gateway
MRF	Media Resource Function
MRFC	Media Resource Function Controller
MRFP	Media Resource Function Processor
MSRP	Message Session Relay Protocol
NAT	Network Address Translator
NGN	Next Generation Networks (defined by ETSI TISPAN)
P-CSCF	Proxy-CSCF
PS	Packet Switched domain (GSM/UMTS)
RGW	Residential Gateway
RTCP	Real Time Control Protocol
RTP	Real Time transport Protocol
S-CSCF	Serving CSCF
SCE	Service Creation Environment
SCF	Service Control Function
SCP	Service Control Point
SIM	Subscriber Identity Module (GSM)
SIP	Session Initiation Protocol
SIP-AS	SIP Application Server

SBC	Session Border Control
SLF	Subscription Locator Function
SSF	Service Switching Function
SSW	Class 4/5 or Class-independent Soft-switch
TISPAN	ETSI Technical Committee - Telecommunications and Internet converged Services and Protocols for Advanced Networking
UICC	Universal Integrated Circuit Card – a smart card for cellular/mobile terminals including (combination of) SIM, USIM, and ISM applications
USIM	UMTS Subscriber Identity Module
WLAN	Wireless LAN
WiFi	Wireless Fidelity
xDSL	any type of Digital Subscriber Line (e.g. ADSL)