

Mobile Communications

GSM and voice service

2. GSM and voice services

2.1 The physical layer

2.2 Network architecture; functions and protocols

2.3 Services and Service enablers

2. GSM and voice services

2.3 services and service enablers

voice services and IN role
circuit switched data services
SMS and toolkit
WAP and MMS
the SIM role
service enablers

extensions:

E2.4 convergence and IN

The charter describes the main techniques available for developing service over the GSM. No formal classifications are introduced.

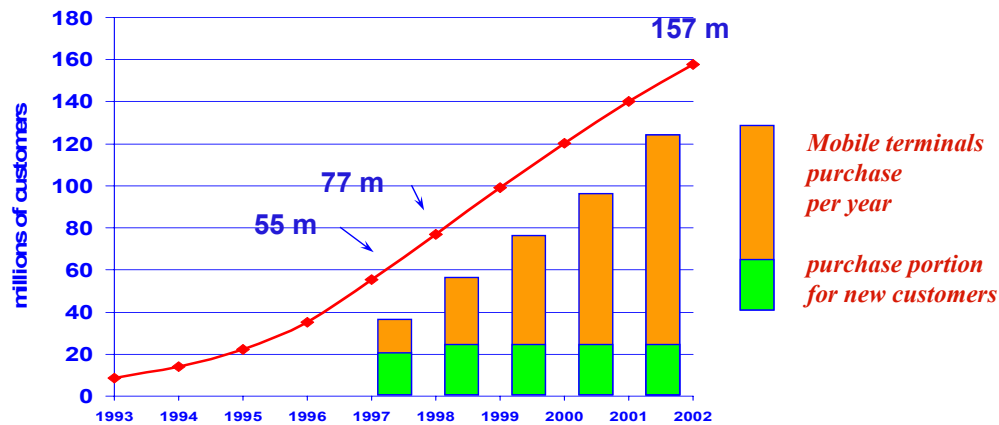
Voice services are first considered, then data services are briefly explained. The latter will be more extensively described in the charter devoted to the GPRS.

Service enabler mechanisms are then described: *Short Message Service (SMS)*, *Wireless Application Protocol (WAP)* and *Multimedia Mobile Service (MMS)*. These development possibilities are put in relation with the parallel *Information Technology* development.

A part is devoted to the evolution of the so called *middleware*, whose concepts will be further elaborated for the UMT.

The extension is devoted to the fixed-mobile convergence and the role played by the *Intelligent Network* in relation to the two networks.

Key factors for service evolution *the mobile terminal market*



Source: Dataquest/Arc/Motorola

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It is universally known how the evolution of mobile terminals represents in itself the key factor for the service evolution. The terminal evolution is particularly significant for the GSM system, due to its wide diffusion in the world.

Around 150 million mobile users were expected in Europe for year 2002 but the reality has overcome all the expectations. Within this growth, the terminal market is characterised by a significant portion of purchases of new terminals for new customers per year. Around 70% of users owns a “new” terminal (less than one year old).

This means that a very high updating rate is characterising the mobile terminal stock. Consequently, the updating rate of services and applications is very rapid as well.

The development of network/technology independent techniques for the definition and implementation of such services is facilitating the process. New services (that are mostly based on the terminal characteristics) can be introduced very rapidly on the market.

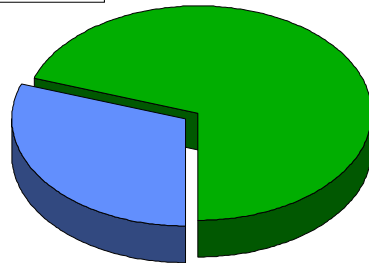
As for the SIM cards, they can be easily substituted to specific market segments, according to their needs.

The figure refers to the European market.

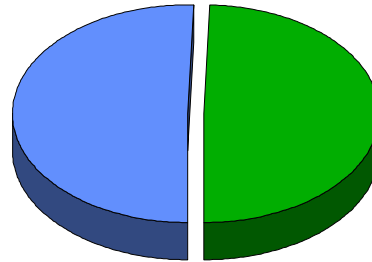
Key factors for GSM evolution

the growth of consumer market

■ Consumer
■ Business



Total 1997 Revenue:
\$33.8 Billion



Total 2002 Revenue:
\$84.3 Billion

Source: Dataquest

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Another factor acting in favour of the GSM service development, is the modification of the market share between the business and consumer segments.

At the moment, the revenue tied to the business segment is predominant (figure) but in few years, the consumer portion will become much more significant. The growth of the consumer market will presumably induce much wider opportunities for the introduction of Value Added Services.

The introduction of new kind of terminals will encourage the service differentiation trend.

Two terminal families will be particularly significant in the next years, namely:

- the information-centric terminals (communicator); typical applications are: fax, short messages, mail, wireless imaging, digital camera connectivity, smart messaging, WWW, notes, calendar
- the voice-centric terminals (smart phone) offering several low-bit rate services in addition to the basic voice connection.

It is however expected that in the next years, the pure voice service terminals will still play a fundamental role in the market.

Substitution option

Localised Service Area

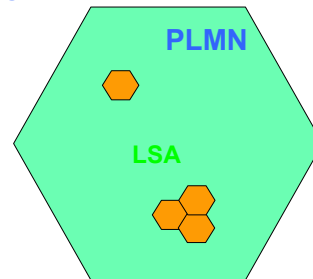
Segregation criteria:

Access codes
cell selection
handover

Segmentation based on:

services
pricing
access rights

	LSA	PLMN
exclusive	↔	↔
local	↔	↔
preferred	↔	↔



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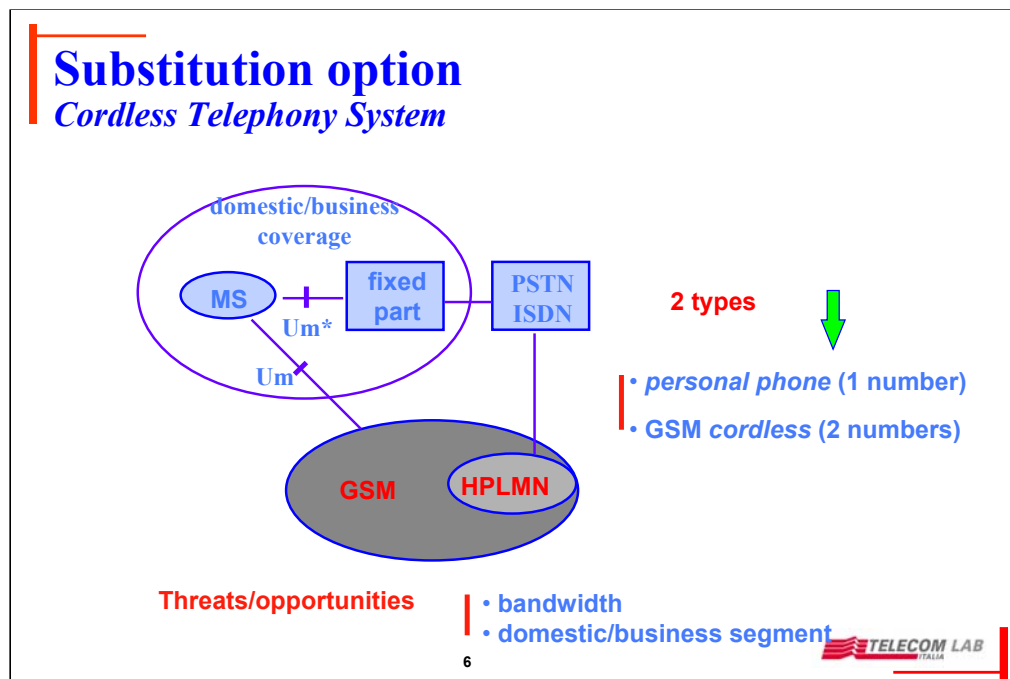
In alternative to the convergence scenario, a mobile-centric approach is gaining momentum, due to the continued penetration of mobile communication services. This trend has to be closely considered for assessing the “substitution” potential that can be represented by advanced mobile systems like GSM.

One of the key factor for substitution is the service innovation attitude characterising the mobile context. For instance, the Support of Localized Service Area (SoLSA) allows a GSM operator to offer specific service packages to defined groups of users, who are identified with relationship to their geographical position. The user association to the LSA (Local Service Area) is controlled by means of access keys and specific algorithms acting in the access, cell selection and handover phases.

An LSA, based on GSM coverage and functions, comprises one or more (not necessarily contiguous) cells. The definition of the LSA service area is done according to the user needs (e.g. indoor only or indoor/outdoor solutions).

In the figure, the "exclusive" mode limits the LSA access to LSA users who can also access the PLMN (public land mobile network), whereas PLMN users can not access the LSA. The "local" mode segregates the two access environments, while the "preferred mode" defines access conditions in both directions.

Another significant initiative that can condition the development of convergence solutions is the Cordless Telephony System (CTS) still under specification in ETSI. CTS is a GSM Phase 2+ service extending the use of GSM terminals to the context of domestic cordless. CTS allows direct access to the PSTN/ISDN network (at fixed network tariffs and by means of a home base station) when the user is moving within the home environment.



Two service profiles are envisaged for the CTS configuration:

- the “personal phone” profile, where the user is assigned a single number for being reached either through the GSM network or the PSTN/ISDN network. An automatic mobility management procedure, routes incoming calls through either network, depending on the user location
- the “GSM cordless” profile, where both networks can be used but the user maintains a double number (fixed and mobile network numbers).

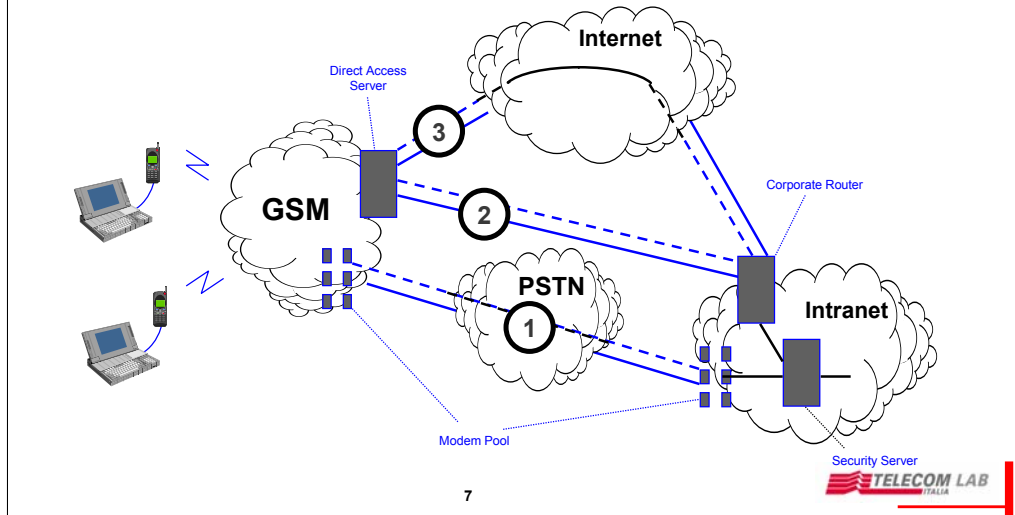
Based on the user's application choices, the CTS terminal can be configured according to different use modes, each identifying a specific registration rule:

- manual, GSM or CTS only
- automatic, GSM or CTS preferred (the terminal registers on the preferred network; in case of no coverage, it registers on the alternative one but it keeps trying on the preferred)
- parallel operation in both modes (the terminal is registered on both the CTS base and the GSM network).

New functions are needed in the fixed network, in order to enable the user mobility control between the CTS and the GSM environments. More than one mobile terminal can register at the same time onto a single CTS base station. In that case, the system can offer the following features:

- internal routing of local calls
- incoming call transfer between CTS terminals.

GSM access to Internet/Intranet



The GSM offers since now a series of sophisticated solutions for data services. The transmission capacity is limited so far to 9.6 kbit/s. Some important evolutionary steps have been introduced from around year 2000:

- High Speed Circuit Switched Data (HSCSD) offering the possibility of setting-up multiple bearers within a single, circuit-switched connection
- General Packet Radio Services (GPRS) introducing the packet-switching mode on the radio interface.

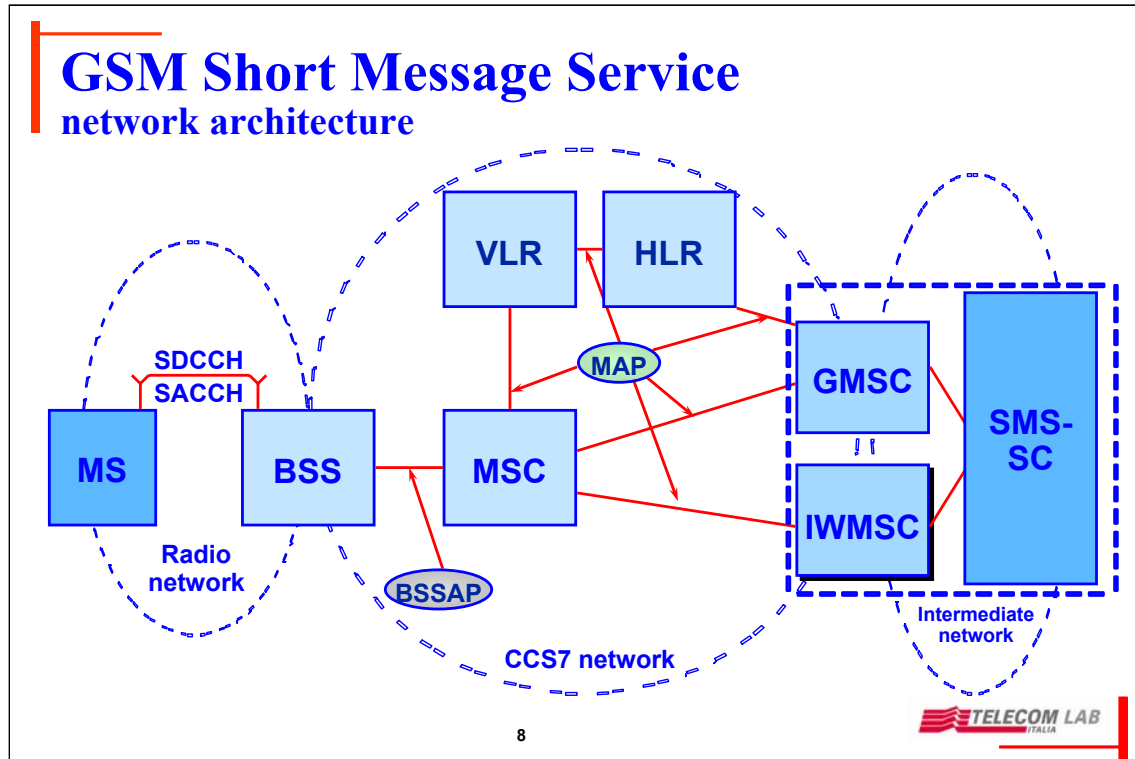
The GSM can access to Internet/Intranet either through:

- the PSTN; in this case a modem pool is used on both sides of the connection
- a direct access which is possible through a direct access server (the access server translates V.110 flows in 3.1 kHz audio flows: those given by the *interworking* function of the MSC).

To face the increasing data traffic, GSM may take advantage from the assigned bandwidth in the range of 1800 MHz (GSM 1800).

The GSM 900 and the GSM 1800 infrastructures can be integrated to each other: the latter can be planned to cover high density zones (micro cells) being completely based (controlled) by the GSM infrastructure (BSC). This integration can be realised at different hierarchical levels, and offers a variety of possible configurations, depending on the traffic needs and the level of saturation of the previous infrastructure.

This implies an efficient utilisation of the GSM infrastructure and can solve several bandwidth problems, allowing for a flexible and context-dependent exploitation of the system characteristics.



The services based on the very diffuse *Short Message Service* cover a wide field of applications. The figure represents the functional scheme of the service, fully embedded in the GSM network. It uses GSM channels like the *Slow Associated Communication Channel* (SACCH) and the *Stand Alone Dedicated Control Channel* (SDCCH).

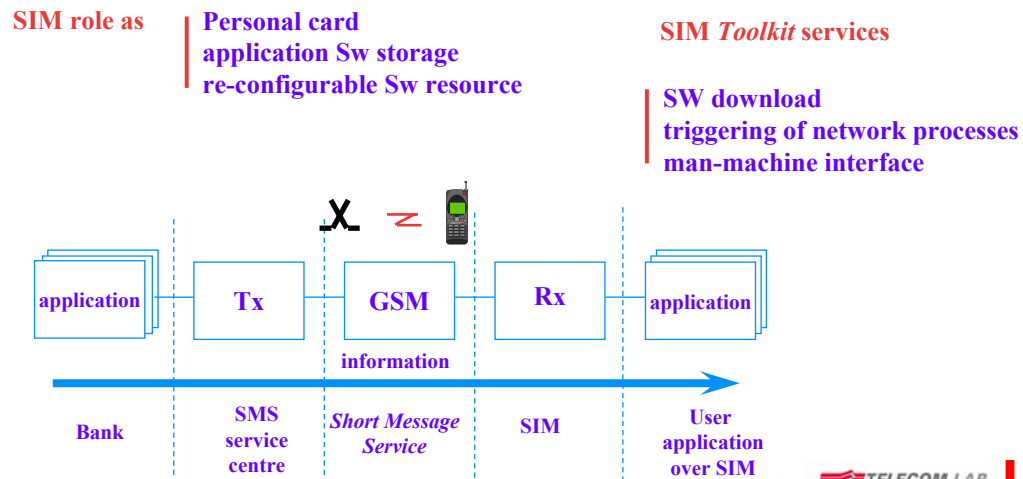
It is based on a *Store and Forward* functionality. The terminal generating the message communicates with the destination terminal (s) through a time disjunction since the message is first stored and then forwarded towards the appropriate destination. Delivery times are tied to the system status (e.g. channels load, unfinished work at the storage level). The time disjunction does not threaten the service efficiency: it is based on a communication that doesn't take place in real time.

The architecture of the SMS service is based on:

The *SMS Service Centre* (SC), a data base registering and delivering all the messages network generated. It is the hearth of the *Store and Forward* concept inspiring the service.

The *SMS Gateway MSC* (GMSC) transports the messages generated by the mobile; the *SMS Interworking MSC* (IWMSC) those terminated in the mobile terminal.

Key factors for service evolution SIM Toolkit



SIM Application Toolkit has been defined by ETSI as a flexible software solution for the creation of services for the GSM context.

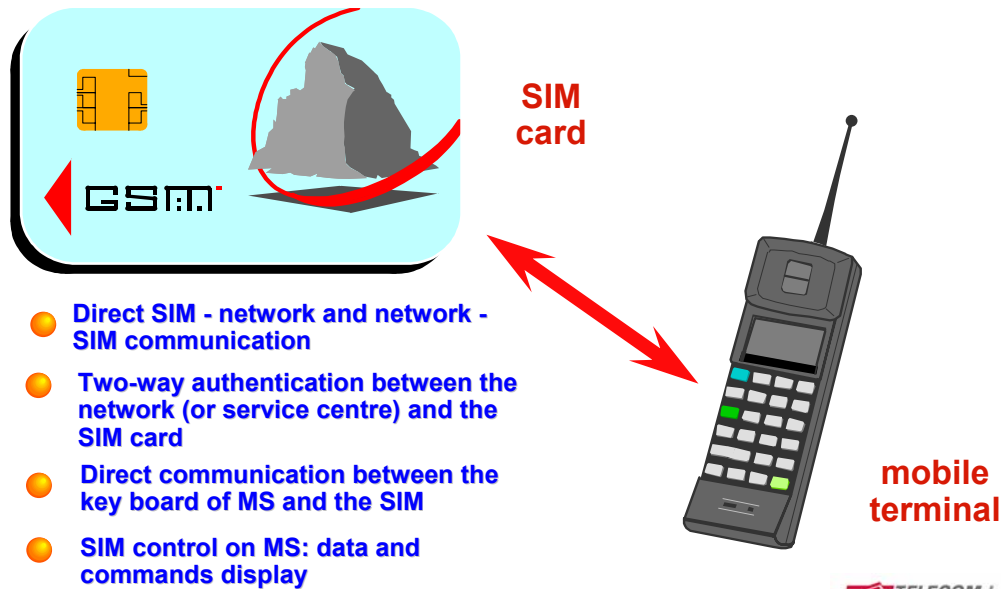
It offers two main functions to the user, namely:

- the “SIM data download” and
- the “Proactive SIM” functions.

The former allows for the download of files between a Service Centre and the Subscriber Identity Module via standardised GSM transport mechanisms (e.g. via the Short Message Service feature).

The latter enables the creation of functions triggering specific operation sequences on the mobile terminal.

SIM Application Toolkit



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SIM application toolkit allows for the inclusion of MS-directed commands in the protocol between the SIM and the MS (for instance the invoice of a short message). Through these facilities, the SIM can also be notified by the MS of the occurrence of specific events.

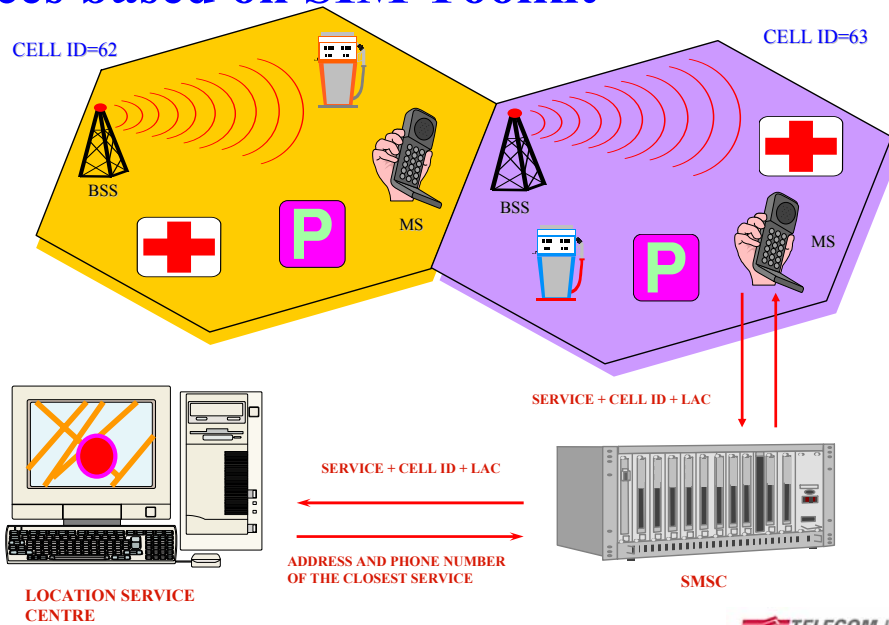
This service, on the MS side, can be considered as complementary with respect to that offered by CAMEL on the network side. In fact, thanks to the *triggering* facilities between SIM and the MS, the SIM could be directly in contact with applications residing in the Home Mobile Network. Transport services can be SMS or USSD.

SIM toolkit allows for an access to VASs which is completely transparent to the network and the underlying transport media. In fact, the transaction is evolving directly between the SIM and the requested application.

On the Operator's side, the SIM Application Toolkit, is offering several service opportunities. Examples are: use of short numbering schemes for specific services; downloading of pre-paid cards.

A fundamental role is played by the interface between the terminal and the SIM. This is one of the Operator/Manufactures de-coupling factors.

Services based on SIM Toolkit

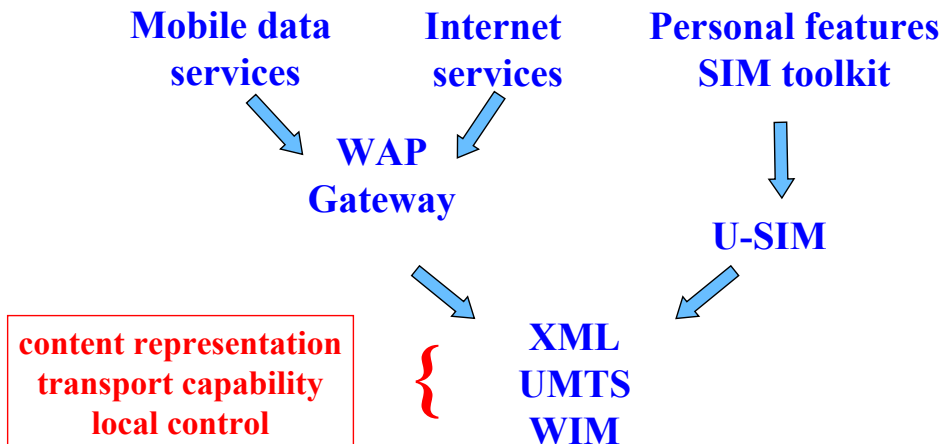


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The figure shows as a mobile location-aware application can be defined through SIM application toolkit. The mobile terminal is localised through one of the GSM-based location scheme (based e.g on the cell identity and the timing advance).

A short message automatically generated by the mobile terminal is sending the necessary information enabling the localisation of the Mobile Terminal and the kind of location-based service requested. In the case of Figure 8, the location server is supplying the terminal with information about the closest service (e.g. the closest parking area).

Mobile and IP-based data services the convergence path



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The service development perspectives are following two different kinds of paths that can find their own convergence point.

One is proceeding from the identified common interest between Mobile and IP for data services; this is recovered by WAP or WAP-like solutions

The other is proceeding along the personalisation path; this is anticipated by SIM-based applications (SIM toolkit)

The convergent solution is recovering the needed:

- representation capabilities (use of eXtended Mark-up Language)
- capacity (UMTS features)
- personal service features, including the capability of controlling the micro browser of the mobile terminal through the SIM (Wireless Identity Module).

Internet today

70+M addresses

200+ M users

30+ M web sites

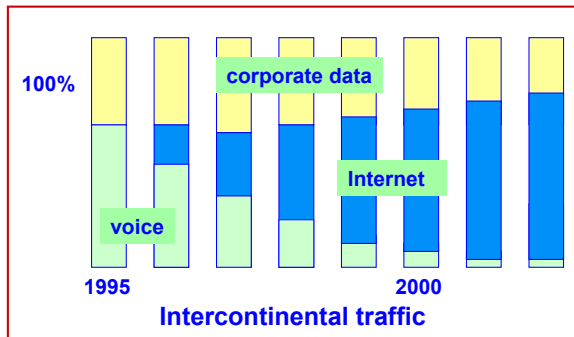
2 B web pages

300% / year Internet traffic growth

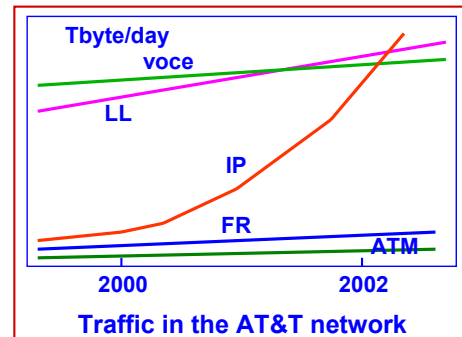
440M mailbox

average message dimension +192%

e-mail traffic: 7x per year



sources: CSELT, Mc Quillan, AT&T

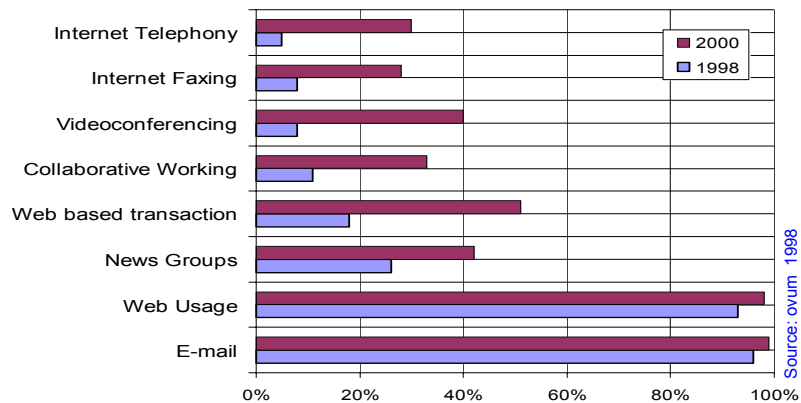


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To explain these concepts, it is useful to enter a little into the service tied to Information Technology which have been developed thanks to the diffusion of the Internet paradigm.

The evolution of the intercontinental traffic for type of traffic in the AT&T network helps in understanding the quantitative development of Internet-tied services.

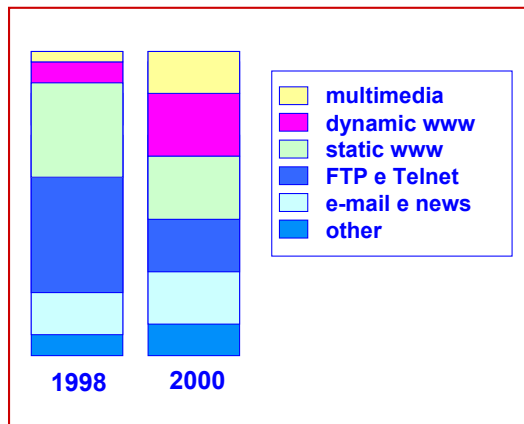
Internet: main applications



**New traffic types, based on the UDP protocol start to rise:
Audio/Video Multicast, IP Telephony, Real Audio, MPEG streaming**

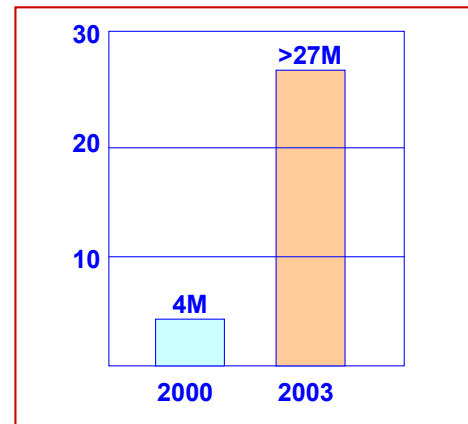
The telecommunication word is progressively approaching the service trends typical of the Internet-driven applications.

Towards the wideband



Application mix

sources: Pioneer, Yankee Group

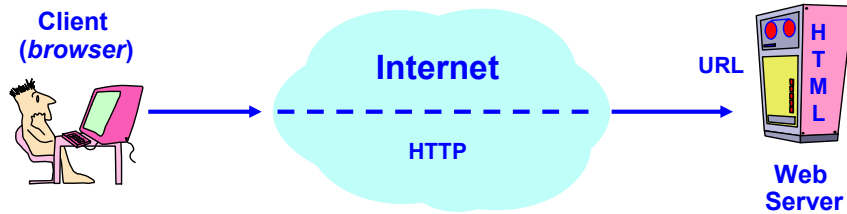


Broadband users USA

source: Forrester

By turn, the Internet word is more and more oriented towards the wideband scenario which has been recently enabled by the success of the ADSL technique.

The Web model



HyperText Markup Language (HTML):
formal language used to write pages

HyperText Transmission Protocol (HTTP):
information transport protocol

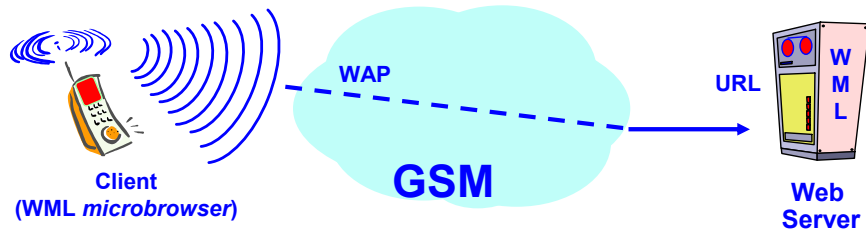
Uniform Resource Locator (URL):
address of the Web page

The figure shows the Internet model, enabling a number of content-driven services.

In this light, one can read the recent trend of the mobile services towards a new paradigm that is derived from the Internet success.

The WAP experience, even though through not a great success, represents the first attempt of approaching that word.

WAP alone model



Wireless Markup Language (WML):
formal language used to write pages

Wireless Application Protocol (WAP):
information transport protocol

Uniform Resource Locator (URL):
address of the WAP page

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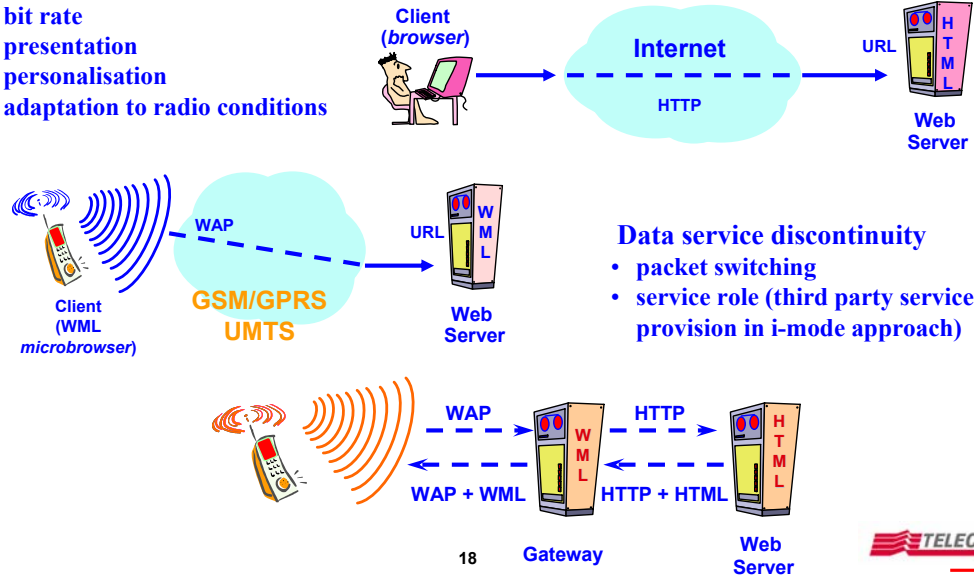
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While the Short Message is in any case a telecommunication service using extensively the GSM features, the WAP initiative has been explicitly addressed as an attempt to supply the mobile users with the same content access capability typical of the Web services.

The major limitations are due to the need of translating the original content in the Wireless Mark-up Language (WML). This fact limits the diffusion and hence the fruition of the contents themselves.

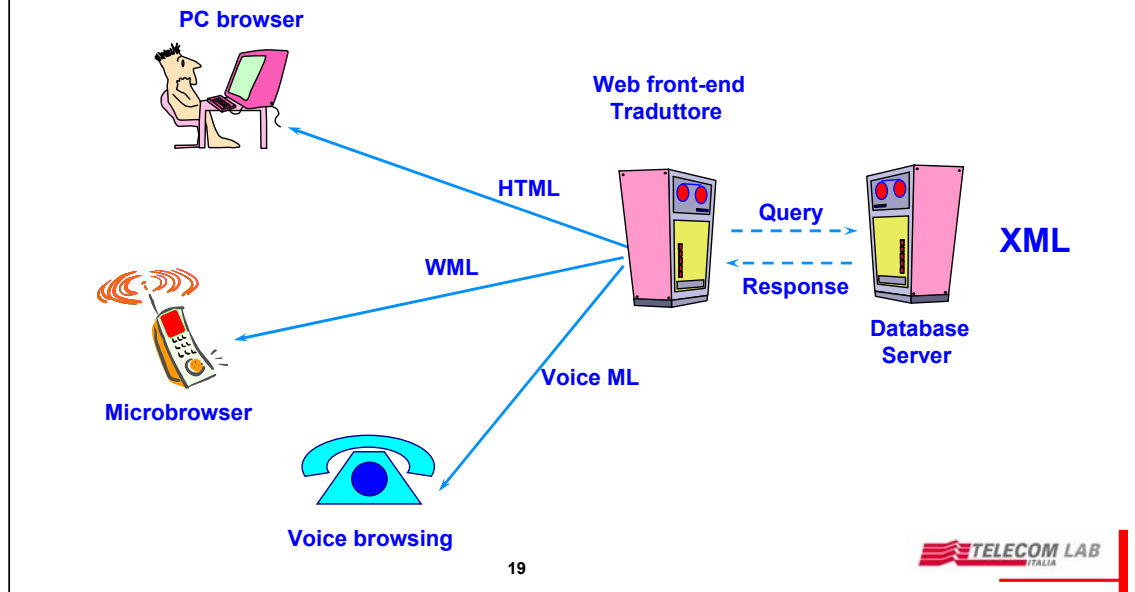
Service evolution interacting with data

- bit rate
- presentation
- personalisation
- adaptation to radio conditions



A first integration between the two contexts is possible also through an automatic translation (or a simplified translation) of the content between the two representation languages.

A general model



The WAP protocol is based on a micro browser realized in the terminal and a representation language, the Wireless Mark-up Language (WML) derived from the Hipertext Mark-up Language (HTML).

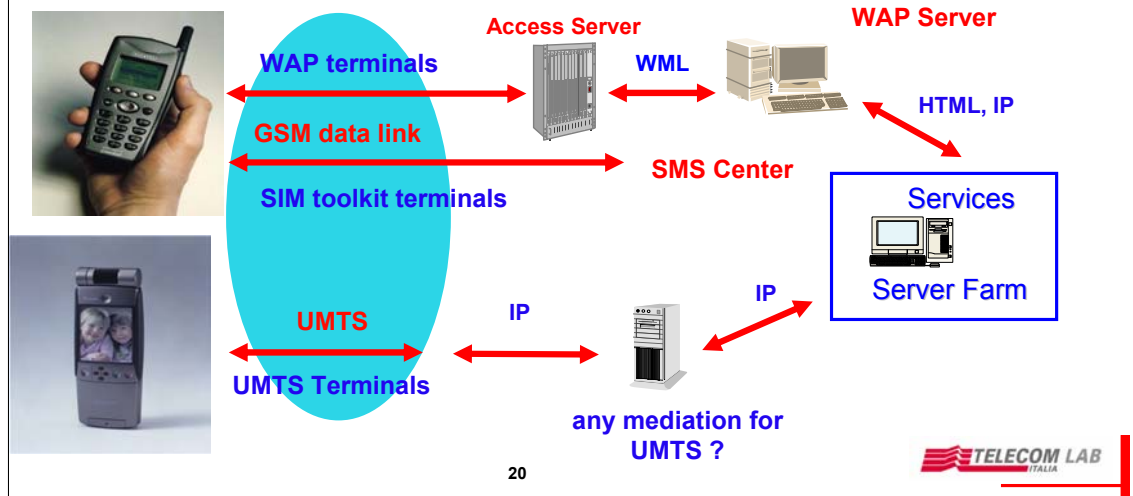
All this allows the mobile terminal to have access to the WEB but just through an adaptation, supplied by a stack of protocols and the translation of the related content.

The WAP gateway/proxy executes all this kind of functions.

WAP can make use of a variety of transport solutions offered by the GSM (or by other networks). In the GSM context it relies on GPRS, the SMS services or the circuit-switched data capabilities.

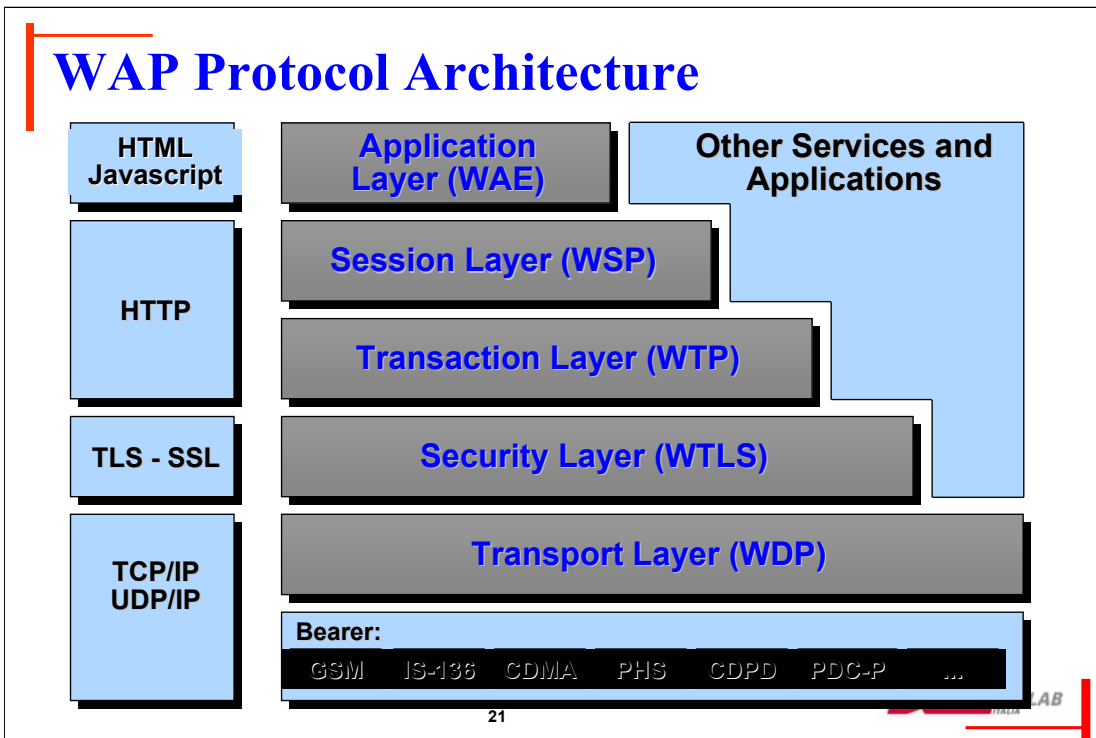
Mobile and IP-based data services

a general framework for applications and contents



Also voice-centric terminals offer transport capabilities for data transmission. The new generation terminals may offer two kinds of solutions, namely:

- the one based on WAP/MEXE as a *browser* and on Symbian as operation system
- that based on Microsoft Micro Edition as a *browser* and on Windows CE as operation system.



The WAP is offering a complete stack of protocols. The figure compares them with those adopted in the IP context.

There is a general trend in adopting simplified translation mechanisms in order to simplify the transparency of the data with respect to the underlying technology. Ad-hoc servers have been adopted as supporting systems.

A suitable solution consists in adopting in a generalised way the eXtended Markup Language (XML) which can be used in both contexts.

Short-term evolution

terminals for M-Services and MMS



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The evolution towards new generation services (M-services) and Multimedia Messaging Service (MMS) has been inspired to the success cellular systems have had in the field of messaging.

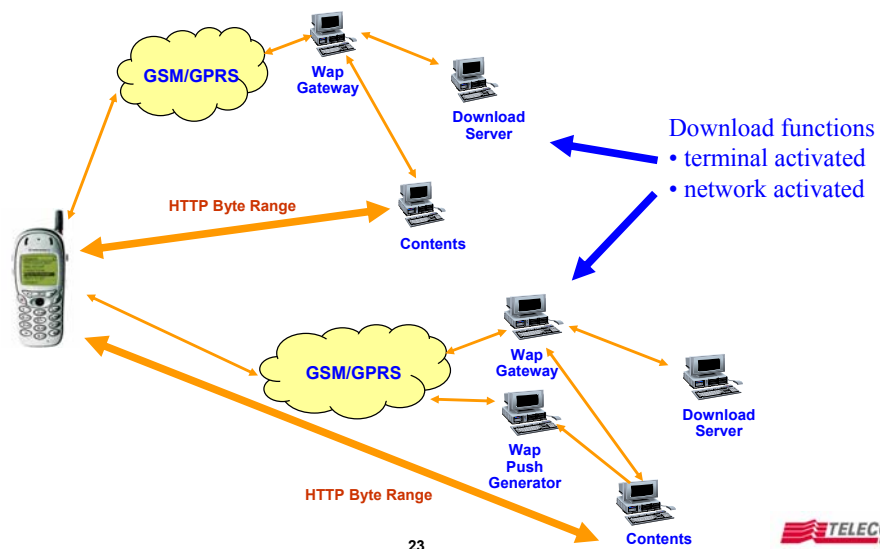
In fact they enable services that can be seen as an extension of the SMS service. In Internet as well the multimedia messaging is having a remarkable success. The mobile context adds:

- the quickness of the sending phase
- the rapid diffusion of the terminal, guaranteed by the quick pace of substitution
- the user friendliness.

The M-services are defined through a set of guidelines approved with the proposal of launching new service functionalities. The guidelines have been approved in May 2001. This is not an alternative Standard to the WAP. The M-services use the GPRS as a transport medium. The main characteristics are:

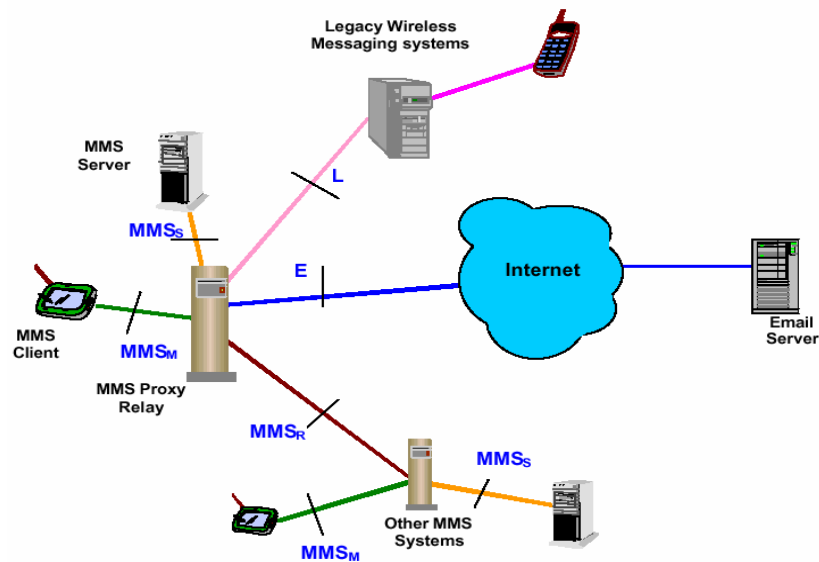
- graphical interface common for the WAP browser (high definition , colour display, soft keys, bookmarks)
- down-load functions for the contents (ringing tones, wall paper, screen saver, audio, video, games Java applets) also originated by the network through push messages.
- support of evolved messaging (enhanced SMS, MMS, e-mail).

M-services download functions



An example of functions enabled by the M-services: the download function can be activated by the mobile terminal or by the network.

Multimedia Messaging Service



The multimedia messaging Service is a WEB-centric solution for the advanced messaging. It has been standardized to offer a richer set of contents. It allows also the personalization of the content presentation modality.

The used paradigm is that of the Store and Forward (typical of the e-mail).

The system has been specified to interoperate with existing messaging systems (e-mail)

In practice, the MMS service represents:

- a way to send text, sounds, images and video (new messaging)
- a good re-use of Internet-based protocols
- a new development path for innovative terminals (including an MMS user agent)

It is a multimedia application written in Synchronised Multimedia Integration Language (SMILE). Contains a variety of media components tied to each other through spatial and temporal relationships.

The components are coded by making use of standard languages.

MMS – a communication example



The client:

- Composes the message to be sent with its parts (text, images, audio, etc.) as well as their presentation
- Selects the list of recipients
- Sends the message to receiving MMS Proxy-Relay by using interface MMS_M



The MMS Proxy-Relay on the receiving side:

- Routes the MM towards the other MMS Proxy-Relay and other messaging systems (e.g e-mail) for those addressed clients not connected to the receiving MMS Proxy-Relay
- For clients connected to the receiving MMS Proxy-Relay executes the following actions



The addressed MMS Proxy-Relay (may coincide with the preceding one):

- Stores the MM in the associated MMS Server
- Sends notification to the addressed MMS client by using MMS_M interface
- Sends the sending part notification of the delivered message



The addressed client:

- Upon notification reception, recovers the MM from MMS Server
- Sends to the sending party possible *reading* confirmation

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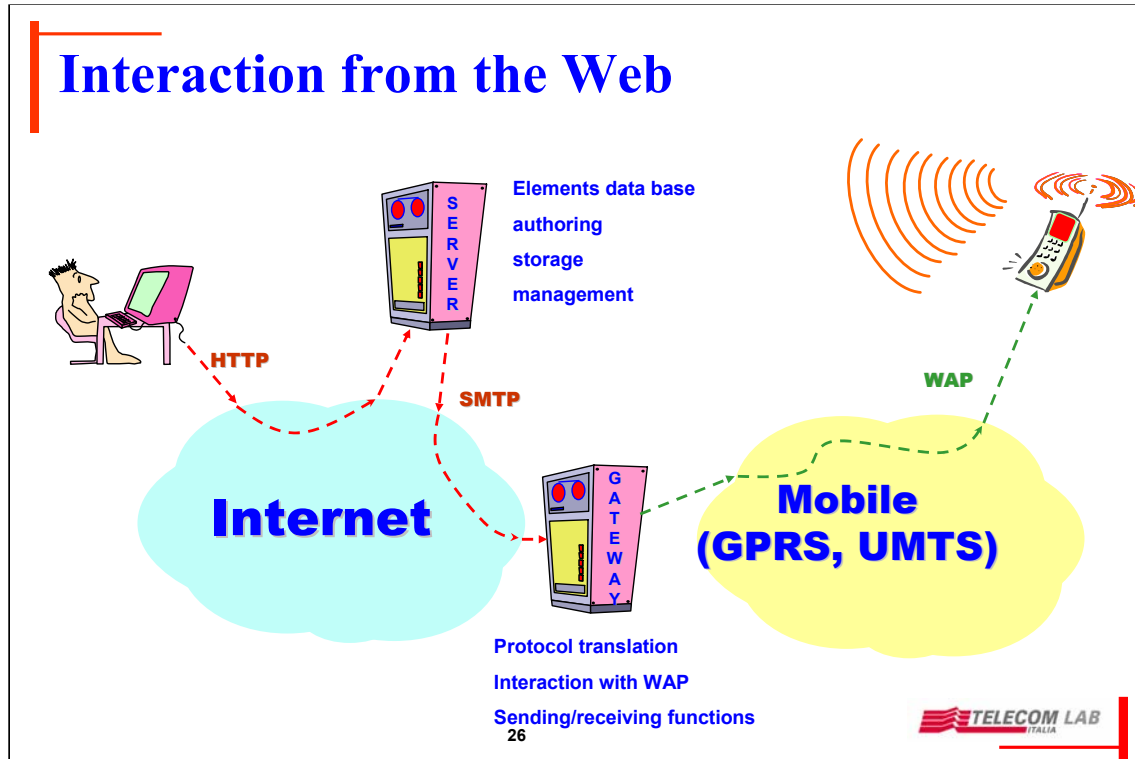
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An example for the creation of a communication process, based on the preceding figure. The address can be written both as telephone number and as e-mail address.

- the message may contain:
- text
- audio coded in adaptive multi rate (AMR)
- JPEG base

The competitiveness values of the MMS vs. the other solution are:

- compatible with SMS (SMS>MMS)
- compatible with same limitations (MMS>SMS)
- compatible with GSM/WAP (WAP reading of an MMS)
- able to work over all the numerical mobile bearers (GSM, GPRS, UMTS).



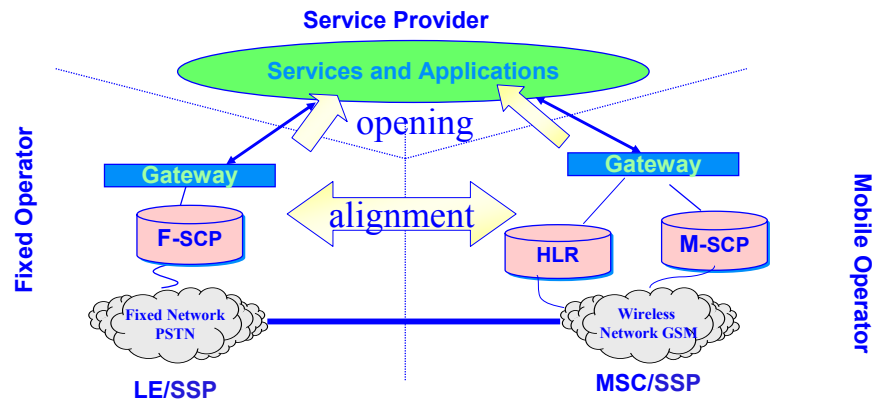
The possibilities to interact from Internet through an application server performing the following roles:

- contains the data base of the message standard elements (music, logo, images)
- data base of personal elements (pictures, voice, small video)
- message storage with related storing functions
- authoring of the message elements
- The interaction from PC may be rather simple (with respect to the interaction through the cellular phone)
- Interaction with WAP

The main interaction problem resides in the terminal compatibility (screen, colour plan, dimension and definition of the image).

Specific devices are being produced able to translate/adapt in function of any type of terminals.

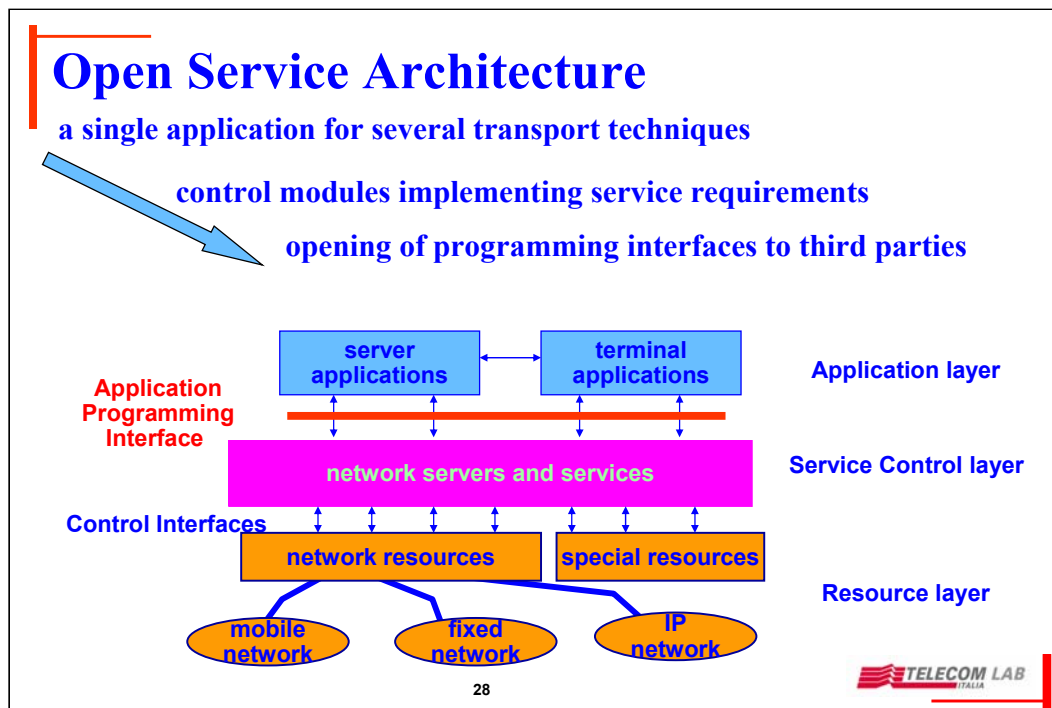
From Service Control alignment to Open Service Architectures



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The trend of aligning the IN platforms, has recently been modified by a new concept, inspired to a real convergence attitude: the Open Service Architecture concept. It decouples completely the application layer with respect to the underlying networks by making use of intermediate functions that are controlling the network capabilities according to the service requirements generated by the upper service layers.



The Open Service Architecture is fully consistent with a client/server model where client and server establish a relationship which is completely independent from the underlying control and network configuration.

The introduction of these concepts will possibly take place through a phased approach.

In the short term, the following service configurations are realised:

- remote service execution (client- server; CAMEL)
- service emulation (re-allocation of service logic to the visited network) as is done in SIM toolkit, Agent technology.

In the medium term, the separation of network capabilities with respect to service and application layer can be pursued in a more complete way.

This requires the introduction of Network Programming Interfaces and the intermediate Service Control Layer (middleware).