

Mobile Communications

Universal Mobile Telecommunication System

4. Universal Mobile Telecommunication System

4.1 New service paradigms for mobile communication

4.2 Bandwidth and Standard process for UMTS

4.3 Spread Spectrum Communications - principles

4.4 UMTS Signalling and control functions

4.5 UMTS Core Network – IP integration issues

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The chapter is fully devoted to the *Universal Mobile Communication System*, which is becoming the system over which the more advanced mobile services at least in the medium term. The UMTS story starts in the nineties, exactly when the GSM was becoming its successful story.

In that period, everybody was convinced that the GSM, born specifically for the circuit/voice traffic would not been able to support all the variety of data traffic that at that stage were estimated for the near future.

We know now that the dream of a quick evolution of the mobile multimedia services has been significantly slow-down by a series of external factors. The GSM/GPRS succeeded in introducing gradually a great variety of data services.

However, the UMTS is now starting its real life and some services of the new generation are becoming available (2005). The UMTS is in fact a very advanced answer to the growing communication requirements. It enables a variety of innovative service concepts that it was even impossible to imagine only few years ago. Paragraph 4.1 shows some of these concepts.

The standardisation story of UMTS is briefly summarised in section 4.2. Section 4.3 attacks one of the two innovative elements characterising the UMTS with respect the GSM: the access technique.

Section 4.4 reports the new solutions adopted for the signalling configuration while Section 4.5 tackles the second innovative element, namely the integration with the IP context and the evolutionary steps foreseen for the Core Network of the UMTS.

4 Universal Mobile Telecommunications System

4.1 New service paradigms for mobile communications

bandwidth and connectivity requirements
seamless and ubiquitous connectivity
content and content delivery
agent paradigm
broadcast/multicast services
combinational services

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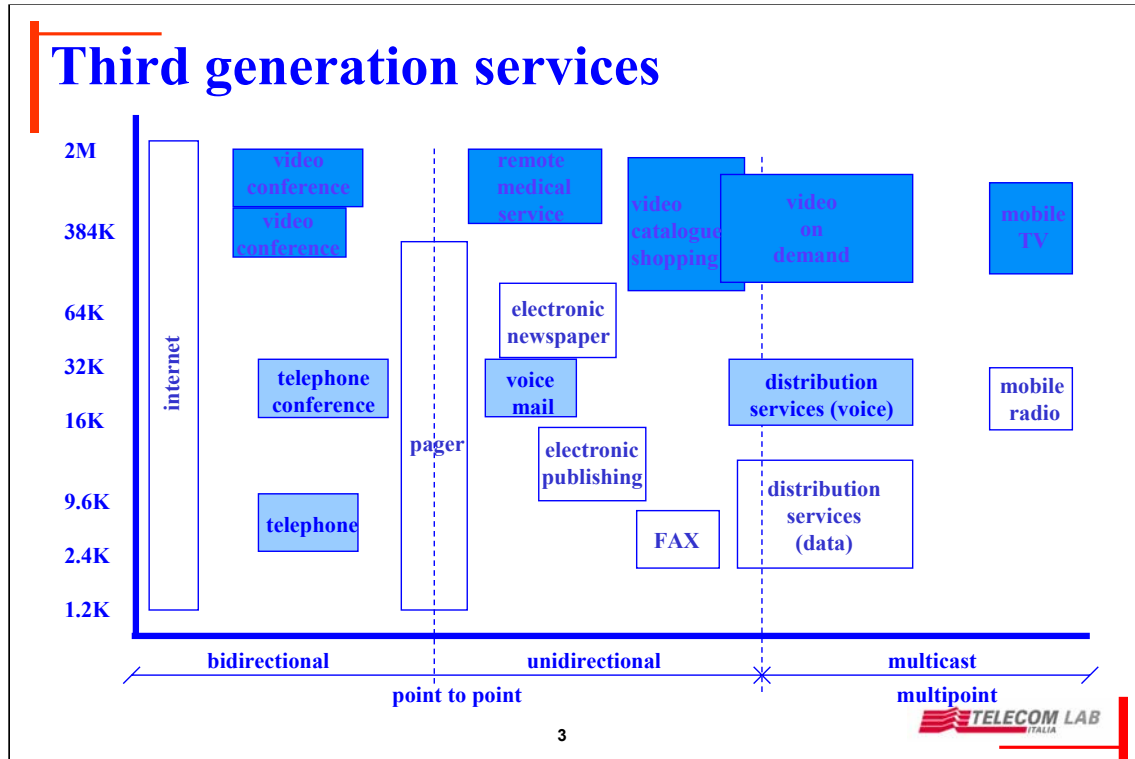
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Section 4.1 analyses the requirements that inspired the UMTS specification. First the *bit rate* requirements and the interconnection modes.

Secondly, the transparency criterion adopted with respect to the access technique. This transparency attitude concerns also the user mobility between different applications.

Other aspects are the evolution of *person-to content* services. The problem of an efficient content distribution is faced through some arguments on the *content delivery networks*.

The *peer-to-peer* model is then considered together with some new developments that are tied to a variety of broadcasting/multicasting services.



Third generation mobile services can be grouped according to a bi-dimensional scheme characterising the service bandwidth and its connectivity behaviour.

Wherever the de-regulation process has reached an advanced phase (USA, Canada, UK) new service delivery conditions are emerging. For instance, the ability of an operator to be active in both fixed and mobile service context, is strictly dependent on the regulatory constraints adopted in a particular country.

These conditions are likely to modify significantly the service grouping and delivery configurations in the near future.

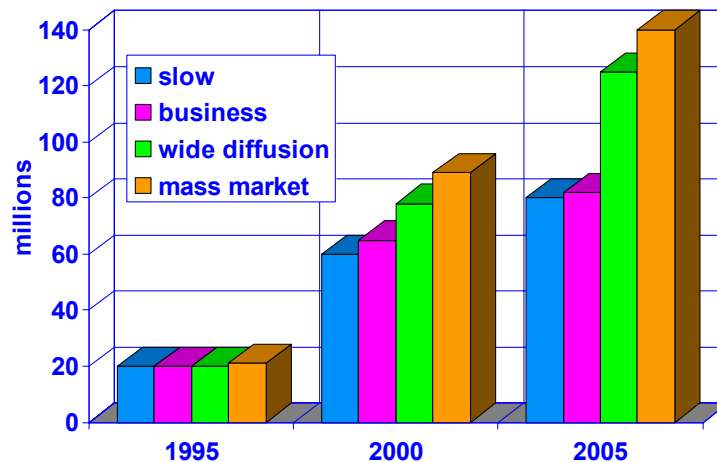
The user is interested in being offered an easy way to access services and an easy way to use the relevant features. Possibly, the user requires also that advanced solutions such as single subscription, single number are available together with a simplified process in contacting the Operator/Service Provider.

On the other hand, as for the service development process, Operator requirements and economical interests are rapidly changing, mainly due to the growing level of competition. In particular, mobile Operators are more and more concerned with:

- the reduction of operations costs
- the reduction of service time to market
- the capability of developing technology independent services.

This is just to say how the pure bit rate (or delay and connectivity) requirements are not enough to identify optimal solutions for mobile systems.

Mobile Multimedia - EU Forecast



[Intercai/Analysys]

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At the beginning of the 2000 it was predicted that multimedia services would have soon contribute significantly to the overall mobile users penetration. In this case, predictions were not so far from the nowadays reality.

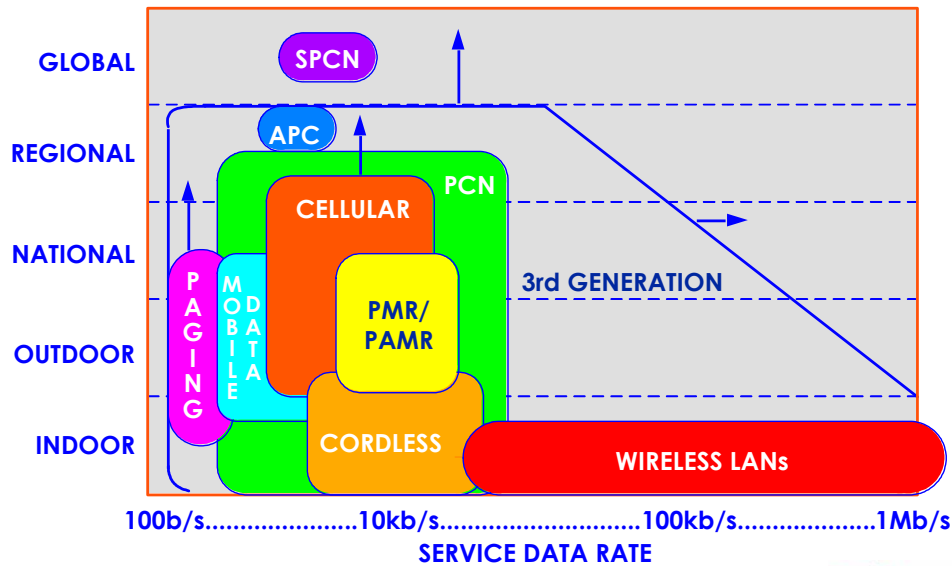
The personal computer diffusion, the explosion of Internet and the dramatic growth of the traffic on the Web, represent a clear evidence of the Information Technology-driven development.

The data exchange arising between a couple of computers, reflects a rather different statistical model with respect to usual voice-based services. Data communication typically generates separate bursts of information for which the transmission delay does not represent a critical issue. Conversely, data integrity requirements assume great importance for data communication.

On the other hand, the fast development of mobile communication services and systems, is progressively creating the conditions for the development of mobile multimedia services, where data and voice connections coexist, possibly within the same call.

Present estimates show that access flexibility and the possibility of being reached everywhere are considered to be of extreme importance by people usually working with a PC. The greatest obstacles to the development of mobile data services reside, for the time being, in the high prices that still are applied to mobile communication.

Positioning of different Mobile Systems



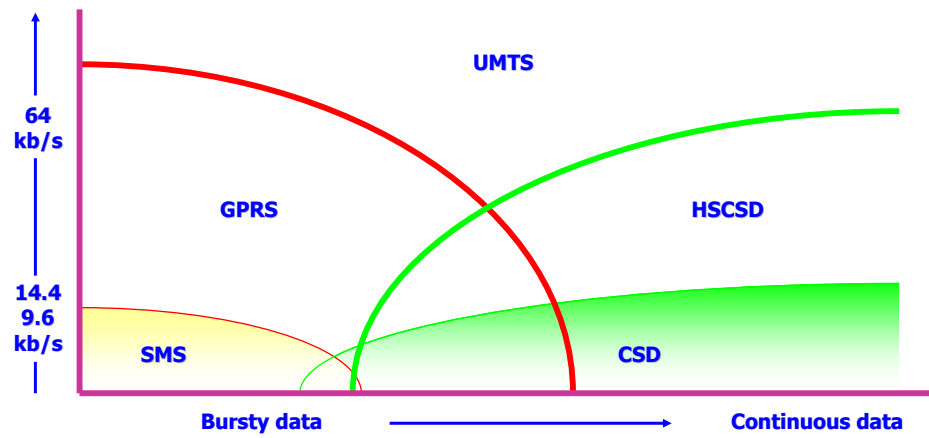
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The figure highlights the service coverage offered by the various systems well established or being developed in the market arena. Data rate and reference contexts are offering a service/application view for each system.

In this context, UMTS is assigned a fundamental role. Accordingly, the Standardisation activities are assigning very clearly some ambitious features to UMTS, in the sense that it should be able to offer:

- voice and data services for mobile users (possibly characterised by different mobility levels) in any environment (indoor, outdoor, urban, rural)
- a wide service spectrum, with transport capability up to 2Mbit/s, even in high traffic conditions
- variable bit rate capabilities with high degree of flexibility as far as the radio resource usage is concerned
- the ability to cope with a variety of access requirements, including different kinds of terminals (from personal communicators to mobile workstations)
- the ability to operate in a mixed cellular environment (macro, micro and pico cells) to cover a variety of mobility and traffic requirements
- domestic and global roaming capability.

Positioning the UMTS



No comment

Seamless Ubiquitous Connectivity

"the ability of using personal services in any place, at any time, whatever the access and the administrative domain are"

Gained through



□ A Personal Connectivity Space

- aware of habits, time and location needs
- able to adapt to these requirements through local and remote info/resources
- implementing context-aware services, tailored to user (personalisation)
- ensuring the expected level of security, privacy, trust

□ A connectivity between Personal Space and Telecommunication Network

- resource control, dynamic spectrum allocation
- interoperability
- local – centralised processing capability
- distributed storage resources
- co-ordinated mobility control

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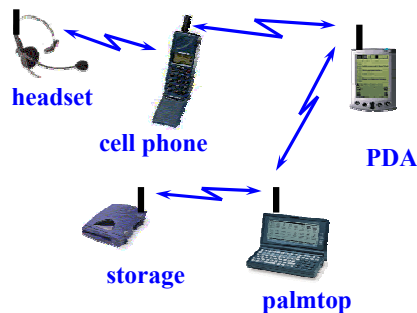
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The *ubiquitous communication* is a general requirement inducing some important consequence on both the technical side and the service arena. In fact, some essential features have driven the UMTS features in order to fulfil the ambitious requirements of third generation systems:

- the evolution of services and terminals towards the *multi access* attitude
- the access configuration and the compatibility between different administrative domains (the interoperability between different operators at both the local and the global level)
- the network and the related control (e.g. the integration between packet and circuit networks)
- the content distribution according to efficient criteria (the content fruition depends on both the terminal and the utilisation context)
- the rising of new communication models (e.g. the *peer-to-peer* paradigm which is going to substantially modify the service process.

Ad hoc networking

the personal connectivity space



New conditions for ubiquity

access
hierarchy
coverage extension
reconfiguration capability
interworking



ad hoc applications.....

...or local completion of global applications?

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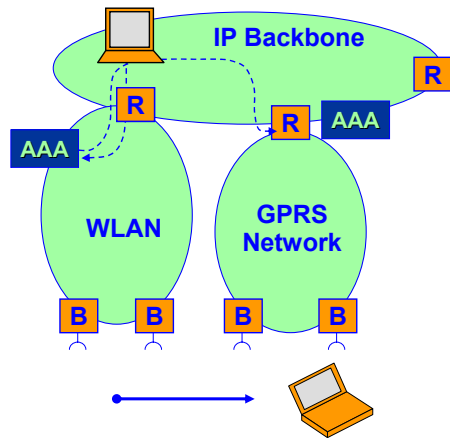
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The *everywhere* attribute relegated to services, implies the possibility of relying for the service coverage to different networks, tuned on the specific user requirements in a given context. Accordingly, the issues of multiple access, control hierarchy, complementary coverage and terminal-network inter working are becoming key.

This approach starts from the personal communication space and arrives up to the global communication space, the latter being offered by the cellular networks. However, not necessarily this variety of radio technologies will take place: a vision relying on the UMTS as a single radio technique, able to fulfill a variety of user and service requirements in different contexts is heavily addressed by the traditional cellular operators. In addition, the UMTS is also promising a considerable level of flexibility in the radio resource allocation.

Wireless LAN

widening access... or completing 3G?



Which role
For W-LAN solutions?



- Internet/Intranet access
- service compatibility with the global mobile network (service continuity)
- single AAA over different access domains...
- or SIM-based customer management?
- heavy impact of regulatory statements

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The interoperability issue becomes vital for the UMTS mostly with respect to the WLAN family. The latter can in fact offer wide band access to the mobile users, even if only in specific zones (*hot spot*).

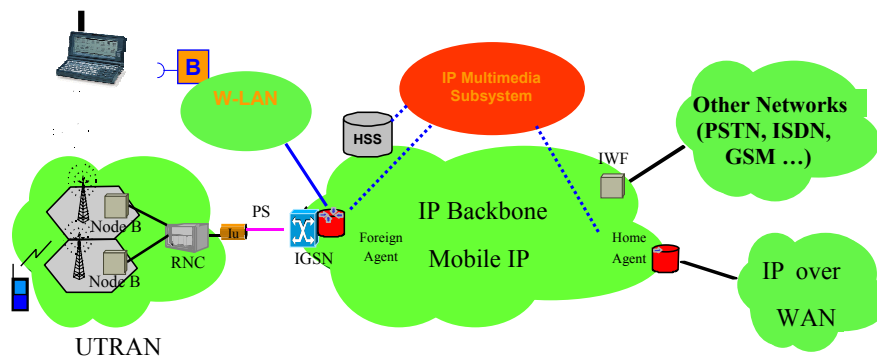
The WLAN and UMTS characteristics can be compared in order to identify their complementary role or, conversely their overlapping attitude with respect to the market perspectives:

- local ↔ global coverage
- authentication, authorisation and accounting features: IP-based ↔ UMTS-based
- offered services in the two contexts: segregation ↔ integration
- mobility control: ensured in the WLAN context according to the *mobile* IP mode ↔ ensured through the canonical cellular features in the UMTS.

An integrated view is emerging, where the WLAN access can offer a wide band availability for a *quasi* static use while the UMTS is offering a global coverage with high mobility levels and *roaming* features among different networks.

Networking and Control (UMTS all IP) a new enabler for ubiquity

IP Service Domain dealing with multimedia (SIP) protocol
IP Multimedia Subsystem for multimedia call control



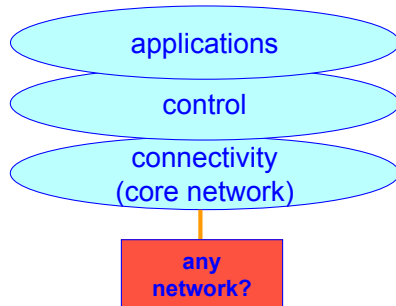
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No comments

A new layered model

connectivity, control, applications



New conditions for ubiquity

transparent applications

powerful service enablers (e.g. SIP)

IP QoS control in multi service environment

mobile IP

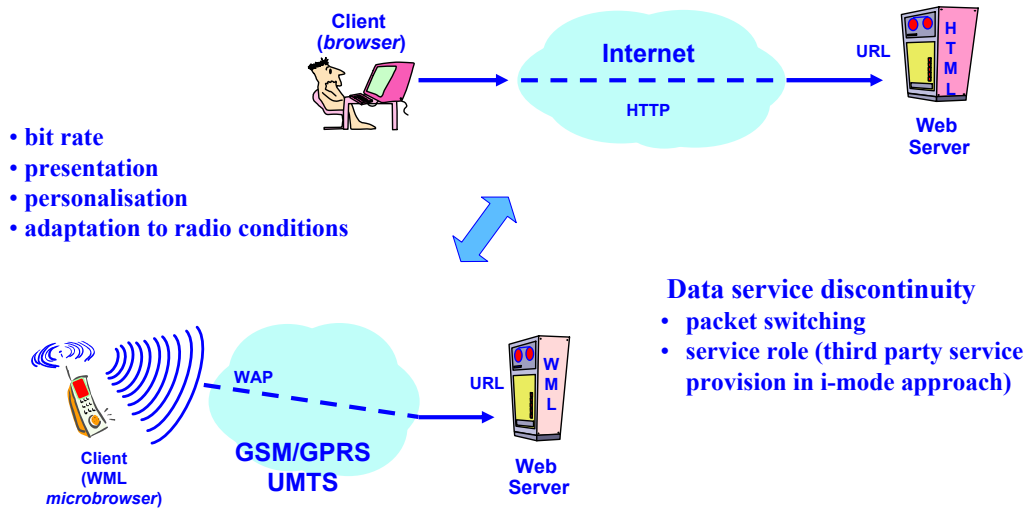
interworking with other networks

single sign-in in access

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Service evolution...

interacting with data



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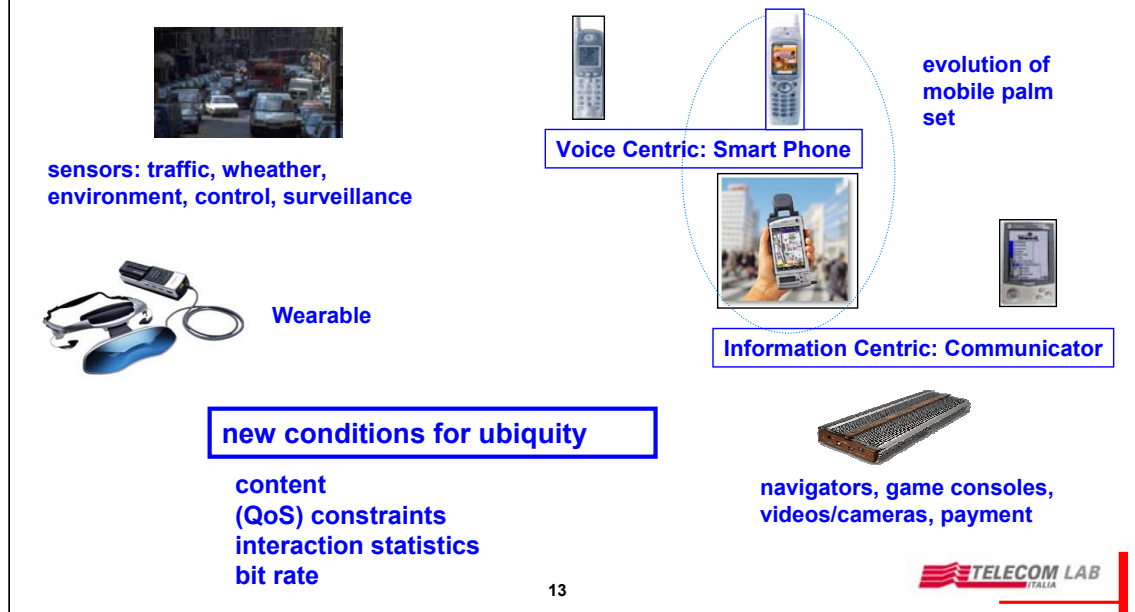
A convergence concept is gaining momentum between Mobile and Internet. It proceeds over two development lines:

- the content line (convergence between the mobile context and the *Information Technology* context for data services); the *Wireless Application Protocol*, has started this development path
- the personalization line, which has been anticipated by mobile-specific service development tools like the *SIM toolkit*.

With the UMTS, this convergence should reach a more advanced status, since the third generation system should be able to recover on the side of:

- representation requirements (use of the *eXtended Mark-up Language*)
- capacity requirements (GPRS, EDGE, UMTS)
- personalization requirements, including for instance the capacity of controlling in a personalised way the *microbrowser* of a mobile terminal by means of the SIM card.

.....through appropriate terminal *data oriented, addressable, interactive machines*



The terminal role is played through their service attitude (built on data or voice or special applications requirements).

The presence of a variety of *specialised* terminals demands for more complex network functions and, at the same time, raises the interoperability problems as well as the compatibility issues arising among different interaction and content fruition modes.

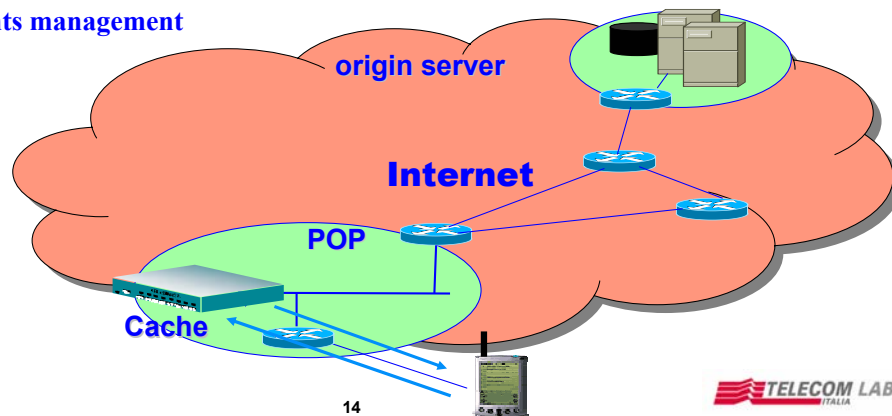
Delivering content

..... and content delivery networks

New conditions for ubiquity

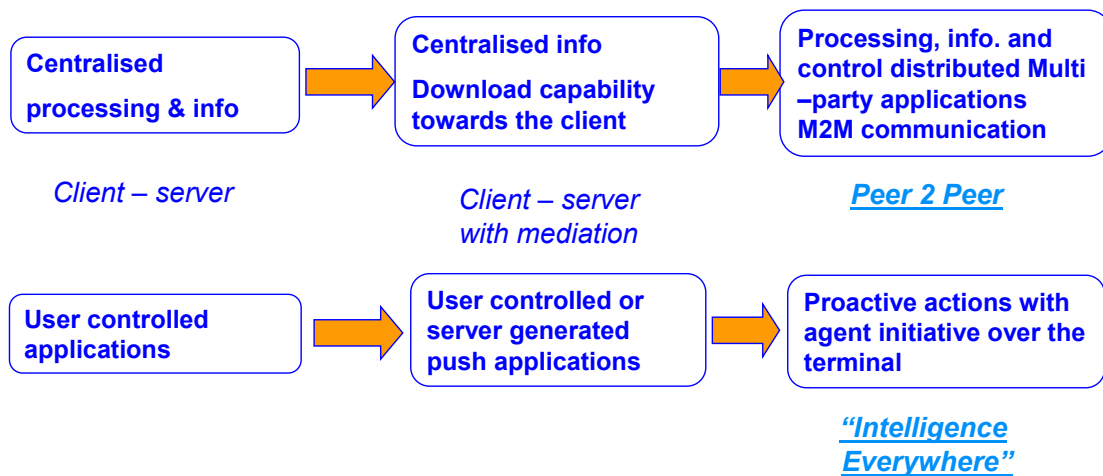
service performance affected by architectural choices performed on CDN:

- distribution, routing, monitoring
- content alignment with origin source
- digital rights management
- latency



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The relation terminal (SIM) – server is evolving

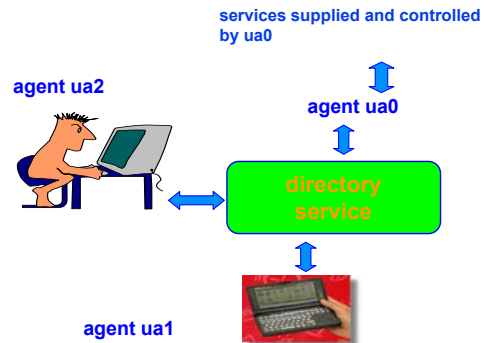


Peer to peer services

agent technology for completely new applications

New conditions for ubiquity

- machine - to machine services
- self – adapting processes
- context adaptation of the mobile content
- service personalisation (e.g. SIM-based)
- image compression and video streameng techniques

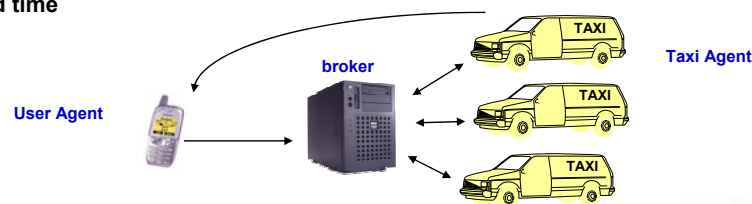


Many technologies now exist for building software and hardware systems in an "agent based" style. Engineers are expected to build individual systems with high degrees of autonomy and release these into a loosely constrained environment where they may interact with other systems about which they have little knowledge.

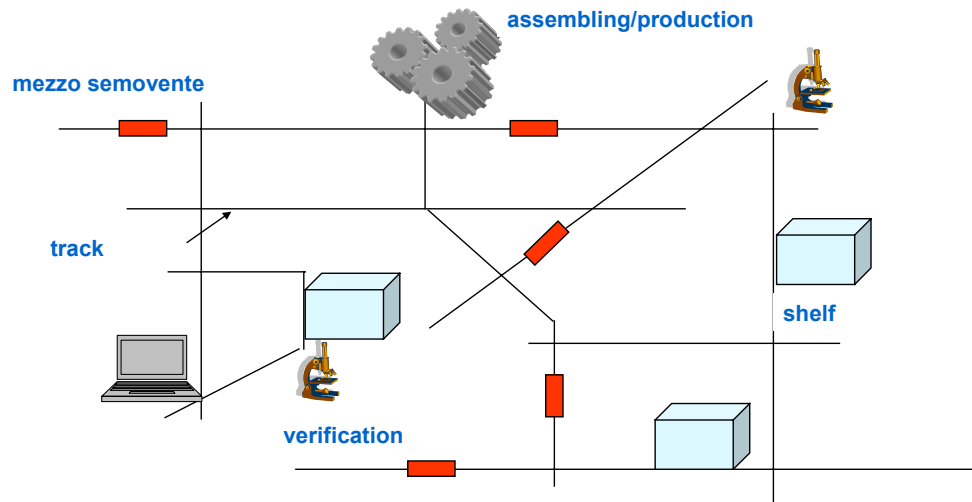
Taxi Organizer

an example of a peer-to-peer service

- The User needs a taxi. He specifies for his Agent:
 - His positioning (info recovered automatically through localisation)
 - Time (*now* if not specified)
 - Destination (optional)
- The request is sent by the Agent to the Broker, which contacts the appropriate taxi Agents; a negotiation is started between taxi Agents. Choice criteria:
 - Taxi – user neighborhood
 - Taxi scheduling
 - Path optimisation
- As soon as the negotiation is completed the Agent notifies the User the final taxi choice and the needed time



Coordination of autonomuos self-moving media and related production facilities



Embedding the content in P2P and P2C communication

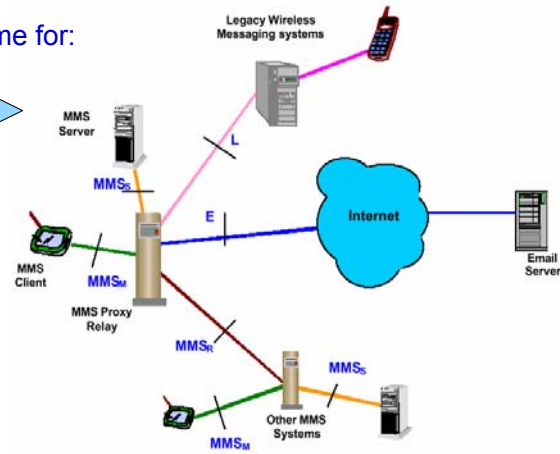
Mobile Multimedia Service a General scheme for:

- person to person
- content to person



Multimedia Messaging Service:

- a messaging system providing the user with a rich set of contents
- a personalisation tool adapting the content presentation mode
- store-and-forward model
- web-centric model, interworking with existing messaging systems (e.g. e-mail)

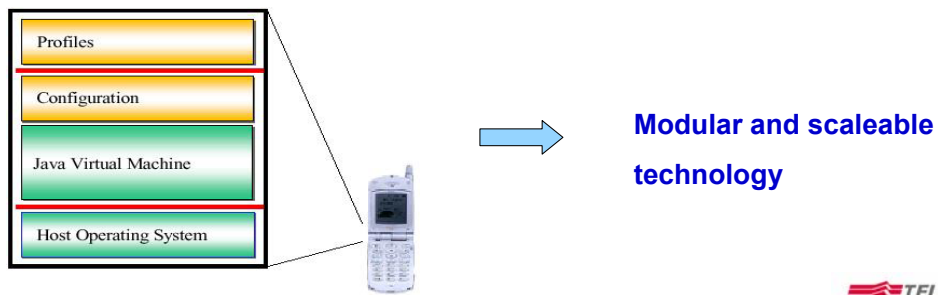


Flexible programming tools...

Java 2 Platform Micro Edition

A layered architecture:

- Java Virtual Machine Layer adapting upper layers to the specific OS
- Configuration Layer (minimum library set for terminals using this edition)
- Profile Layer (minimum set of APIs extending a given configuration over a vertical application segment)

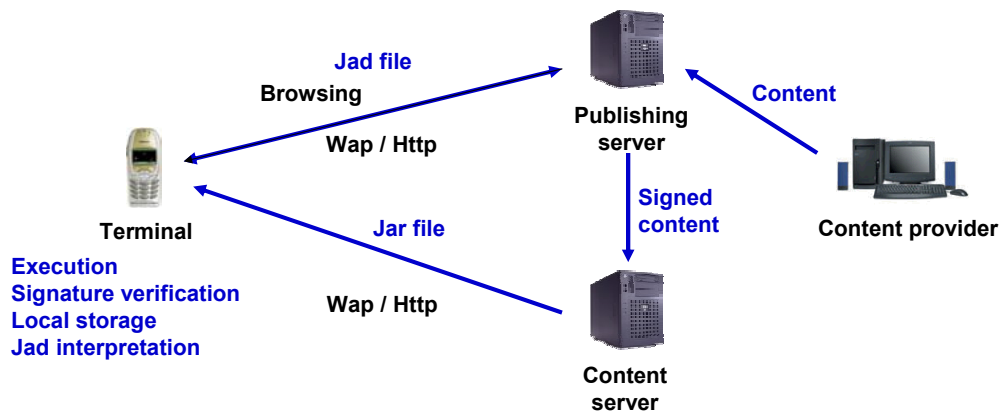


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...even enabling the application download

JAVA2ME Mobile Information Device Profile



Mobile broadcast services

Mobile

Mobile Voice

Mobile text

Mobile Video

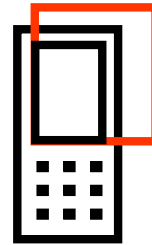
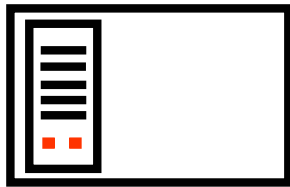
M B Services

Interactive TV

Pay TV

TV

Broadcast



Mobile broadcast services

Mobile

Interactive

Personal

to One

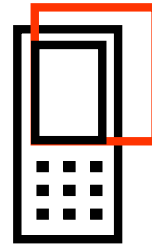
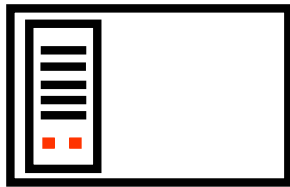
M B Services

to Many

Shared

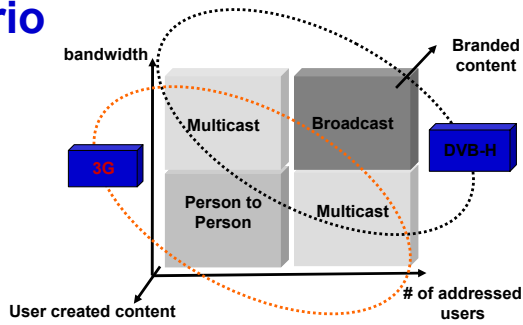
Content

Broadcast



The Broadcast scenario

- ▶ The TV and the mobile words are approaching: mobile phones receiving TV channels (UHF and VHF) are (almost) available
- ▶ The TV can be seen in **streaming over the mobile network**. However the **most important perspective will come from the DTT**, the Digital Terrestrial Television, which multiplies by 4 the number of available channels and, in addition, enables **interactive services**, by using the telephone networks as return channel (fixed or mobile)
- ▶ New business opportunities are created, tied also to the traffic on the return channel (e.g. poll services). At the same time, brokering services can be offered to the **broadcasters** directly, taking advantage from the mobile control and management systems as well as from the available authentication, tariffing, security systems.

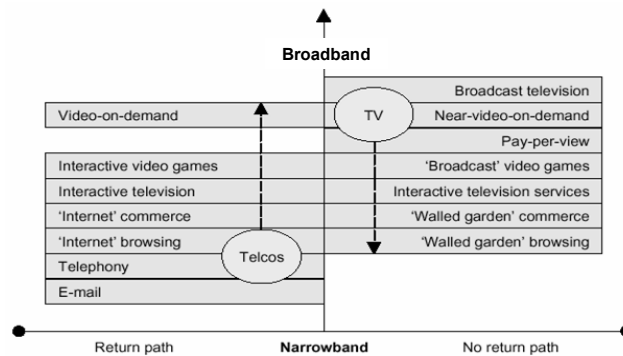


- ▶ The scenario offers another possibility: the use of the TV network as a **broadcast channel devoted to the mobile terminals directly**, as an alternative to 2.5/3G networks.
- ▶ The technology which can enable these services is the **DVB-H** (Digital Video Broadcasting – Handheld), the version of the DVB-T explicitly optimised for the mobile context (low energy consumption, handover between the frequencies, interference reduction and encoding efficiency (MPEG4))

The Broadcast scenario – Mobile Network

- ▶ **DVB-H and 3G** are **complementary** and not alternative: the TV network is suited for broadcast unidirectional transmissions towards a great number of users while the mobile network has its strength in the channel symmetry, allowing for bidirectional communications between users or user groups.
- ▶ However, **overlapping zones** exist, that could create competition between the two techniques and related services. Different players are converging in this business.

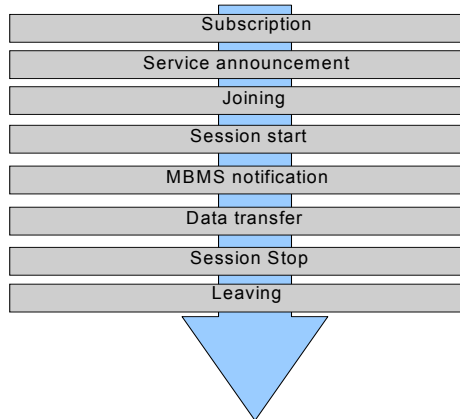
- ▶ The convergence scenario are under study
- ▶ The ad hoc **DVB-H** and **DVB UMTS** groups, have identified 5 possible integration scenario
- ▶ Starting from 2003 many initiatives and alliances have been created between broadcasters, operators, vendor, content and service providers).



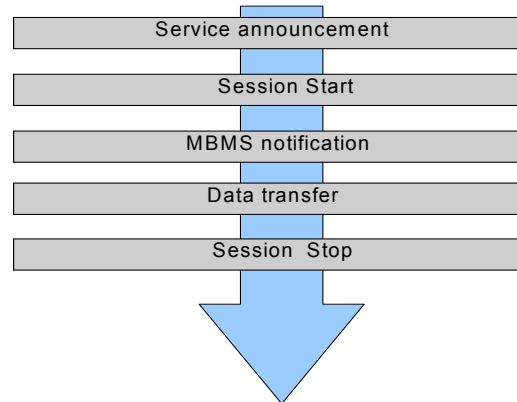
MBMS service provisioning and service delivery

The connection procedure

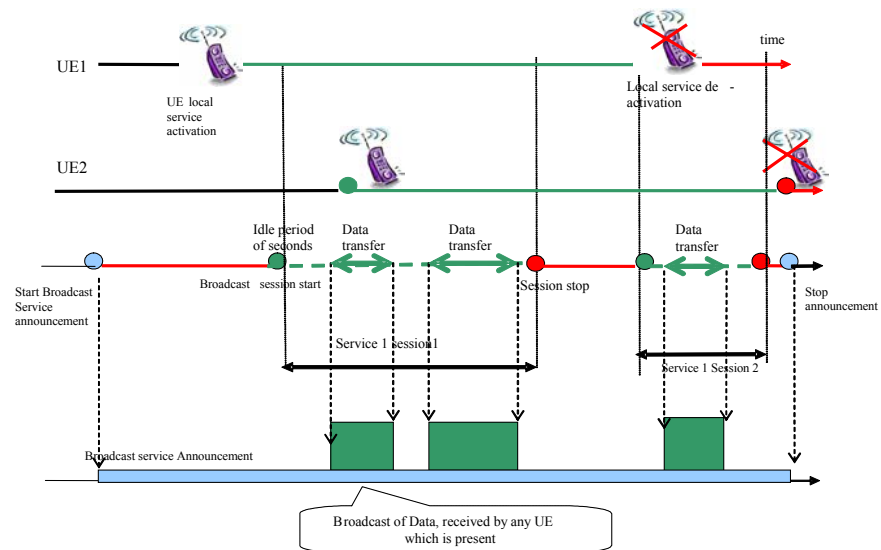
The multicast mode



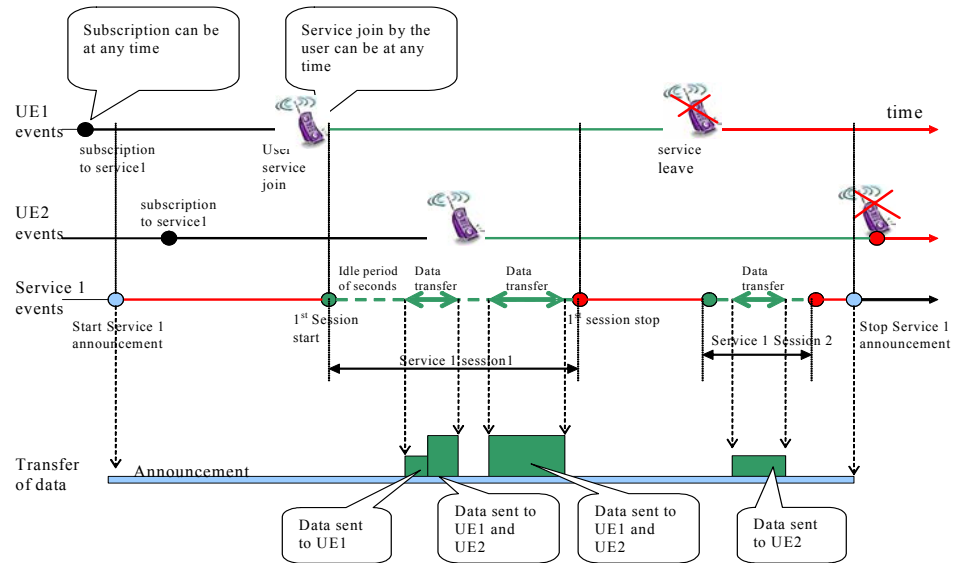
The broadcast mode



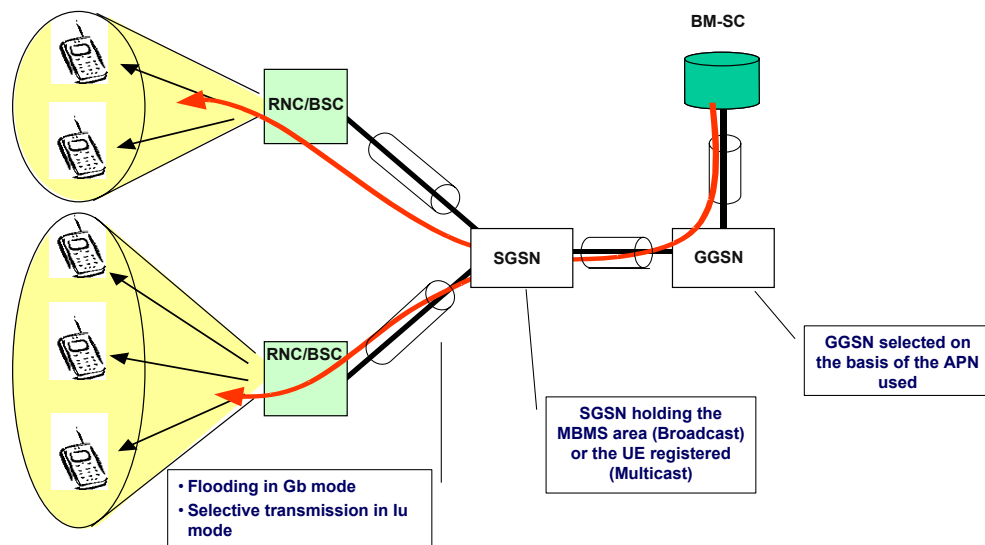
MBMS - the broadcast mode



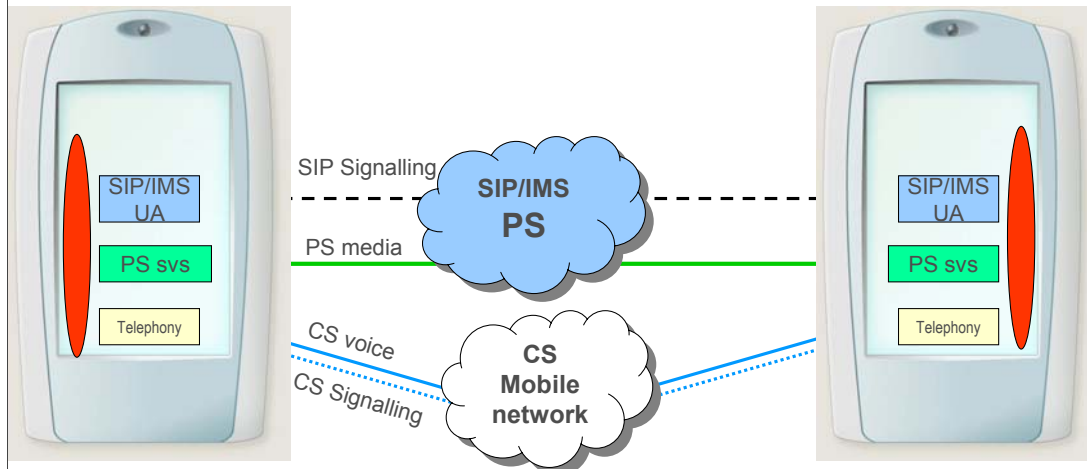
MBMS - the multicast mode



Multimedia Broadcast Multicast Service



Combinational services



Combinational services (full SIP-based approach)

