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- Performance, roaming, mobility, security...

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WLAN vs. 2G/3G: Bit rates

IEEE 802.11 WLAN

802.11b:
11 Mbit/s (in practice 6 … 8 Mbit/s max.)

802.11a/g:
54 Mbit/s (in practice 30 … 40 Mbit/s max. over short distances)

GPRS

170 kbit/s theoretically (in practice much less)

3G (WCDMA)

Up to 2 Mbit/s (in indoor networks)

WLAN vs. 2G/3G: Coverage

IEEE 802.11 WLAN

Hundreds of meters (at best) around each AP

=>

Full outdoor coverage is difficult to achieve.

WLANs are optimised for indoor usage.

2G/3G

Macro/micro/picocell networks cover all kinds of environments (indoor, urban, rural)

=>

Full coverage even in remote areas.

WLAN vs. 2G/3G: Frequency bands

IEEE 802.11 WLAN

The 2.4 GHz ISM band (free for all) causes problems.

Interference from other WLAN networks, Bluetooth equipment, microwave ovens, etc.

2G/3G

Frequency bands are reserved for 2G/3G networks.

Interference is usually not a problem (good network planning).

WLAN vs. 2G/3G: Spectrum efficiency

IEEE 802.11 WLAN

The CSMA/CA access method is not very spectrum efficient.

Spectrum efficiency is given as

bits/Hz/area

2G/3G

Spectrum efficiency is better than for WLAN.

Various advanced methods for increasing spectrum efficiency.

WLAN vs. 2G/3G: Roaming

IEEE 802.11 WLAN

WLANs do not support roaming in a strict sense.

However, WLANs support portability.

2G/3G

International roaming agreements between operators

=>

2G/3G networks support roaming on a wide scale.

Roaming vs. portability

Roaming means that it is possible to use a terminal when moving from one network to another. Additional features (mobility, security) that involve cooperation between network operators or service providers are usually supported, due to roaming agreements between these operators or service providers.

Portability means that it is possible to use a terminal anywhere in a certain network (e.g. WLAN). However, when moving to another network, mobility or security features are not automatically maintained.

WLAN vs. 2G/3G: Mobility

IEEE 802.11 WLAN

Terminal mobility is not supported (except when moving within the WLAN).

2G/3G

Terminal mobility is supported (using techniques such as location updating, paging, and handover).

Personal mobility requires e.g. SIP (Session Initiation Protocol) and specialised network resources (SIP proxy, location server)

Terminal vs. personal mobility

Terminal mobility means the ability of the network to locate a mobile terminal, route incoming or outgoing calls (or packet sessions) regardless of the point of attachment to the network, and maintain connections while the terminal moves around in the network.

Personal mobility means that a person can be reached via any one of several terminals (that can be located at different places) using a single address (e.g. SIP address). This concept has not been widely used yet.

WLAN vs. 2G/3G: Security

IEEE 802.11 WLAN

No security as default.

WEP (if used) offers poor security.

WPA (if used) provides better security due to the support of key management.

2G/3G

Always supported:

- User authentication
- Encryption over the radio interface
- Key management.

3G provides additional security features.

WLAN vs. 2G/3G: Network planning

IEEE 802.11 WLAN

Usually no network planning (due to the inexpensive network parts).

This (+ usage of ISM band) may result in poor WLAN network performance.

2G/3G

Network planning is rather complicated (since equipment is expensive and should not be underused).

As a benefit => good coverage and spectrum utilisation.

WLAN vs. 2G/3G: Cost of equipment

IEEE 802.11 WLAN

Network infrastructure is inexpensive (existing LAN + additional APs) if no advanced network concepts are used.

End user equipment is also inexpensive.

2G/3G

Network infrastructure is expensive.

2G/3G terminals are not dramatically more expensive than WLAN cards.

WLAN vs. 2G/3G: Charging

IEEE 802.11 WLAN

Charging solutions are difficult to implement (specialised network elements required).

WLAN users are used to having “free” access in many places.

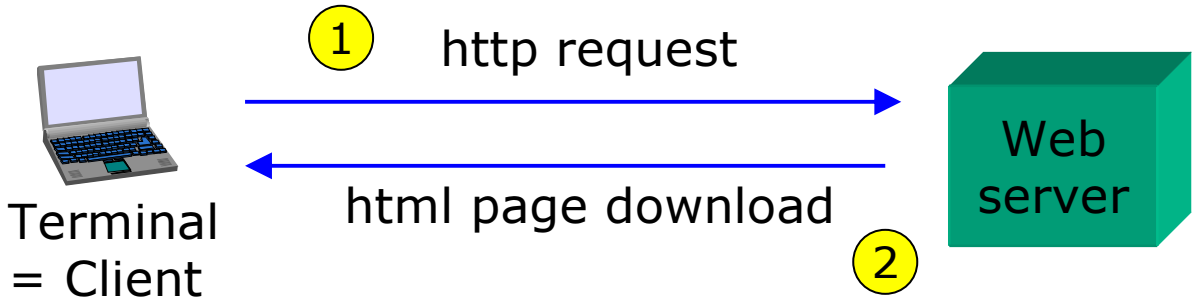
2G/3G

Charging is part of the system infrastructure.

Without charging, the expensive 2G/3G network infrastructure would not be economically viable.

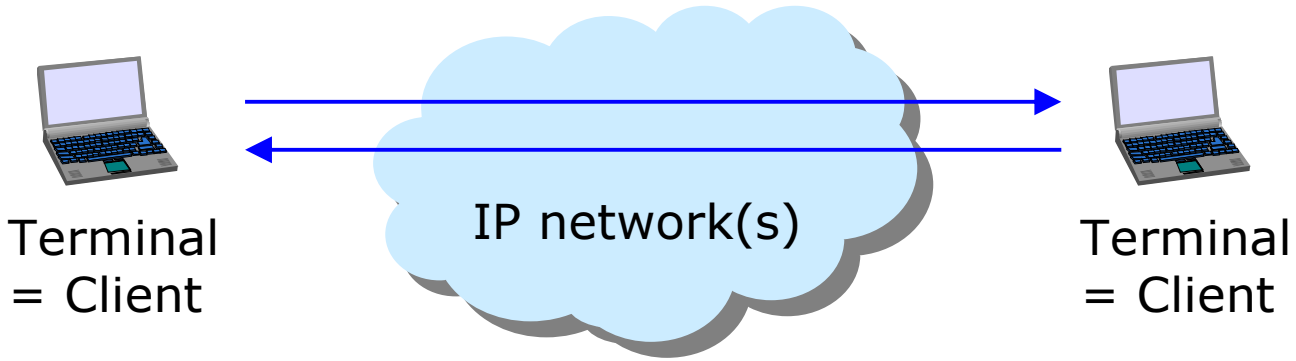
Services: Web browsing

Web browsing applications are of client - server type. 802.11 WLAN and 2G/3G networks are equally well suited for such applications (disregarding differences in bitrates, coverage, etc.).



Services: VoIP

If reachability is an important issue, a client - client type of communication system requires some IP layer or application layer mobility solution => new network elements are required both in 2G/3G and in WLAN.



Services: E-mail (1)

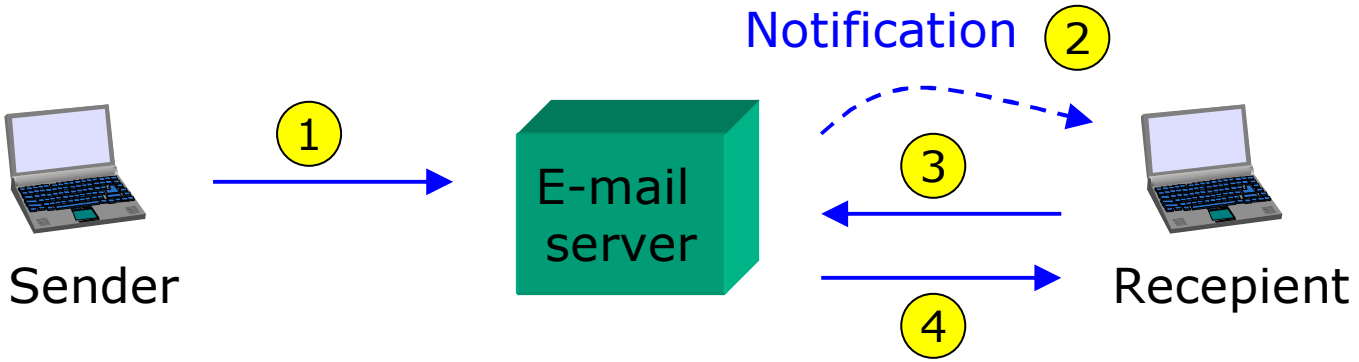
E-mail is a store-and-forward service. Messages are sent to a server (using e.g. the SMTP protocol), from which the recepient of the message can fetch it any time (using e.g. the POP or IMAP protocol).

Services: E-mail (2)

WLAN and 2G/3G networks are equally well suited for this kind of task, since both transactions are of the client - server type (in other words a mobility solution is not required).

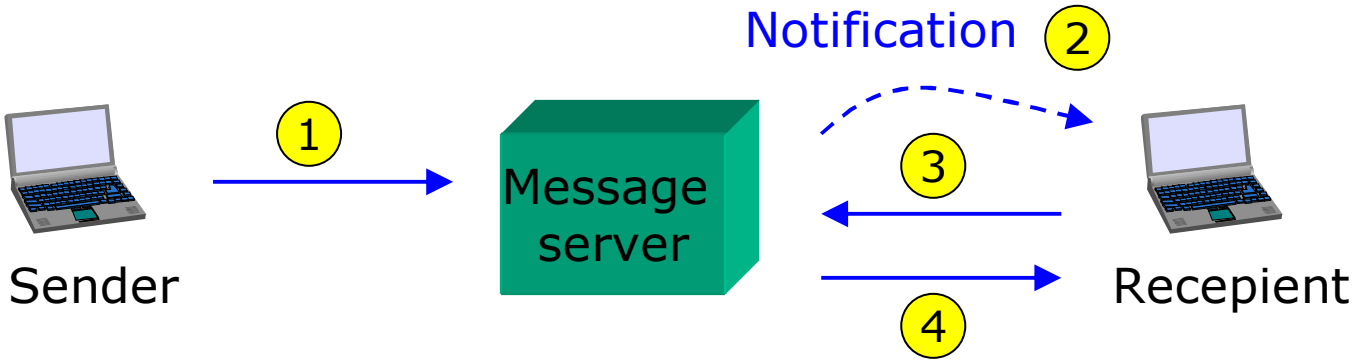
Services: E-mail (3)

However, if the recepient wishes to be notified about incoming messages, this requires IP layer mobility (inherent in 2G/3G but not in WLAN).



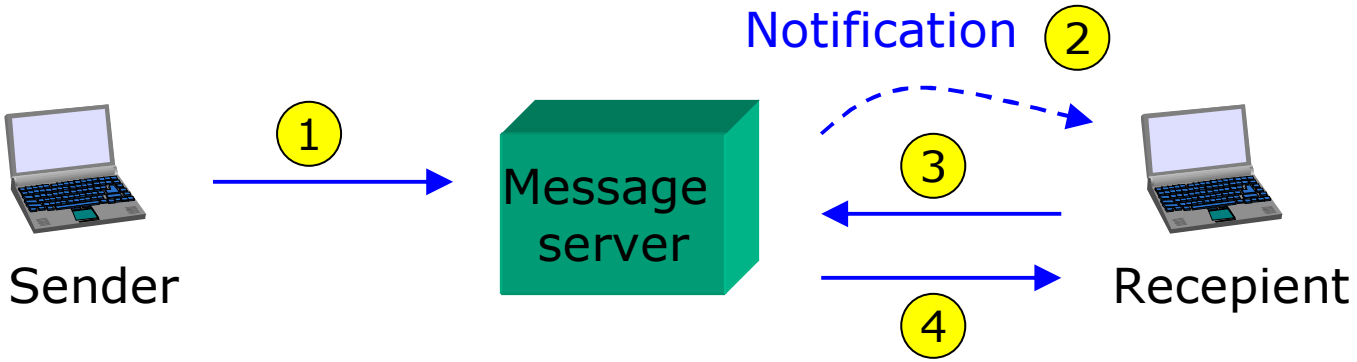
Services: Messaging (1)

Messaging (short messages, multimedia messaging) is a typical 2G/3G service, also of store-and-forward type (messages are stored in a message server).



Services: Messaging (2)

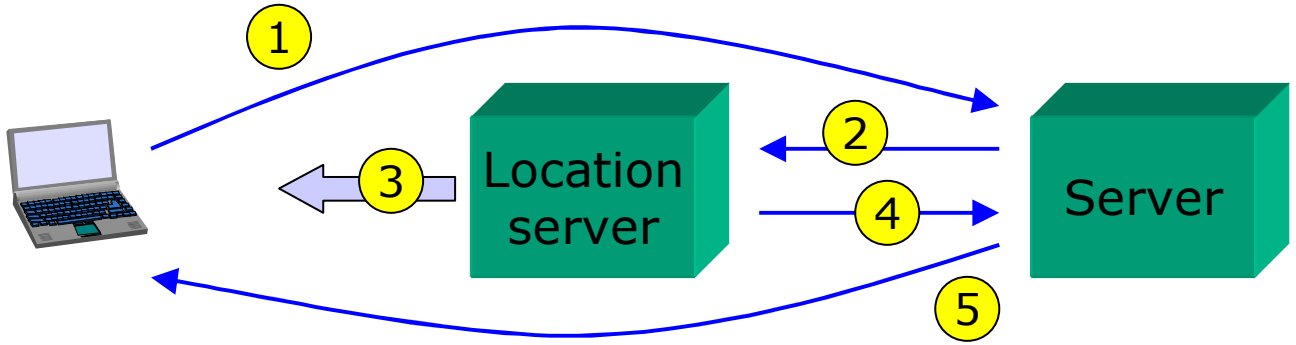
In this case, notification is essential. Again, 2G/3G systems have notification inbuilt into the system, whereas WLAN networks require some IP layer mobility solution.



Location based services (1)

Location based services require knowledge about the location of the terminal. A typical service scenario is shown below:

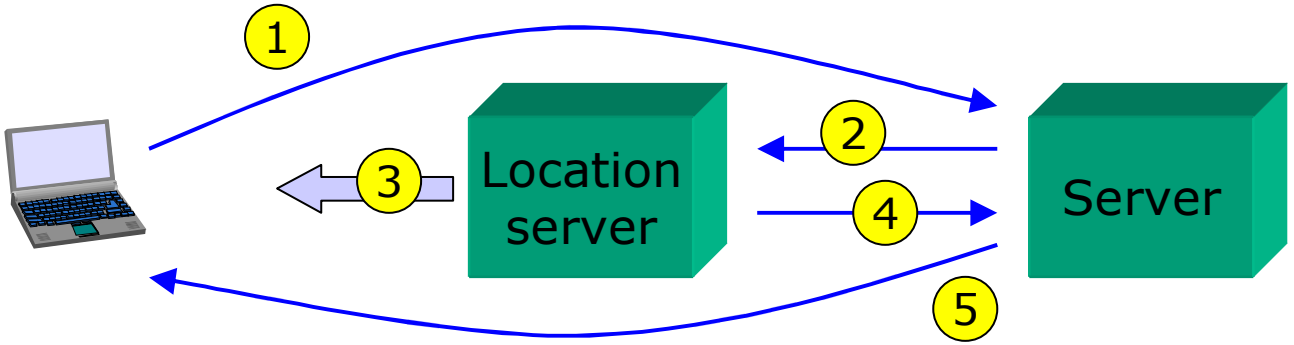
1. User sends enquiry to server (containing relevant data)



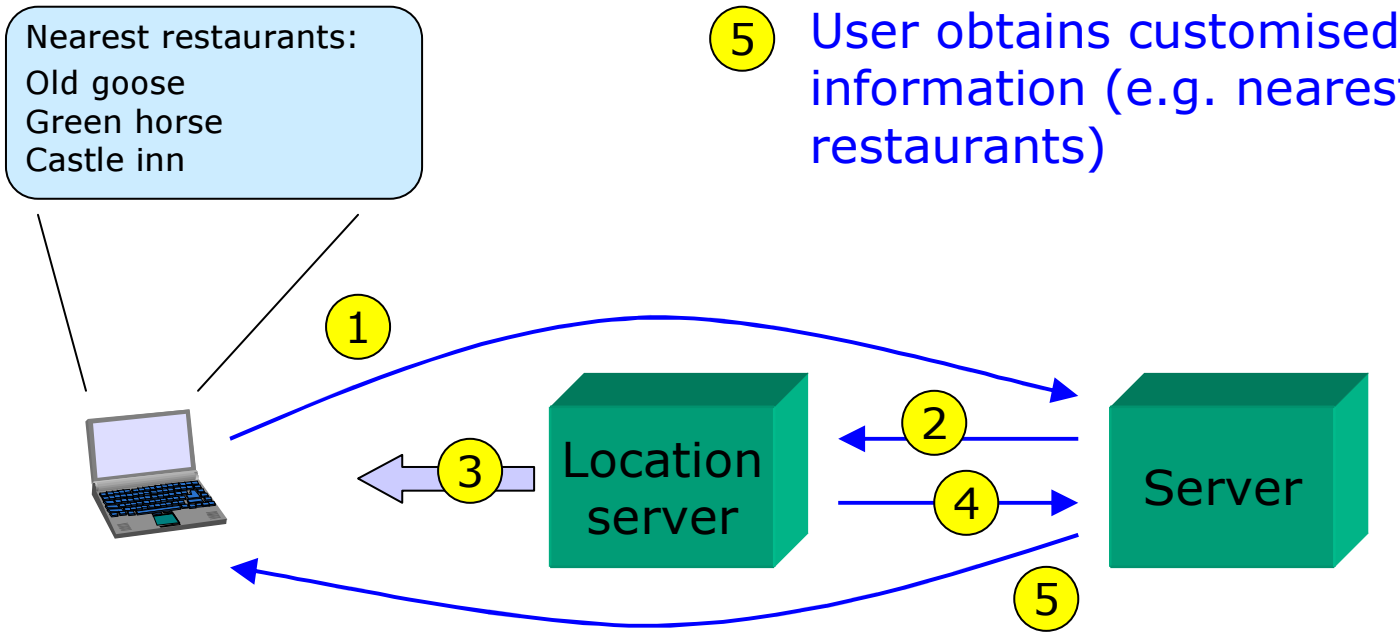
Location based services (2)

2 The server needs location information to customise the service and contacts location server

3 Location server determines location and 4 returns the location information to the server

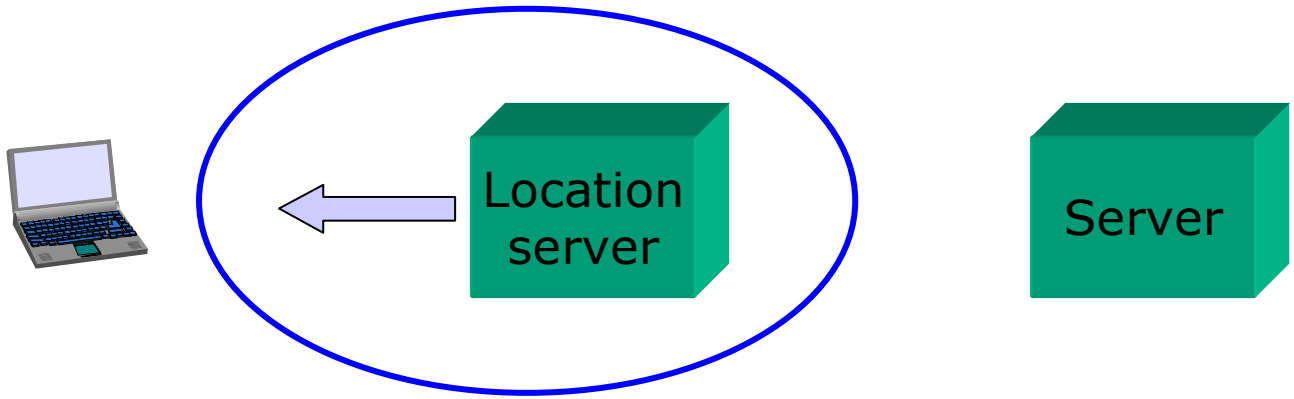


Location based services (3)



Location based services (4)

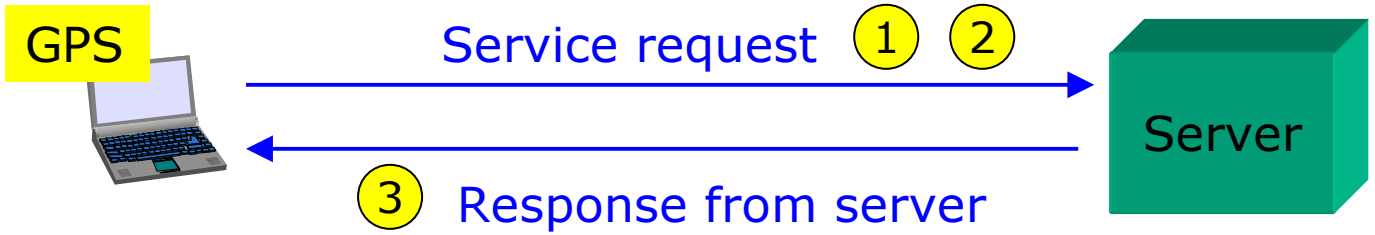
Location based services require specialized network elements (location server, positioning equipment) usually available in 2G/3G but not in WLAN networks.



Location based services (5)

If the wireless station in the WLAN is equipped with a GPS receiver and supporting software, location based services may still be possible (?)

1. Wireless station sends location information with service request
2.

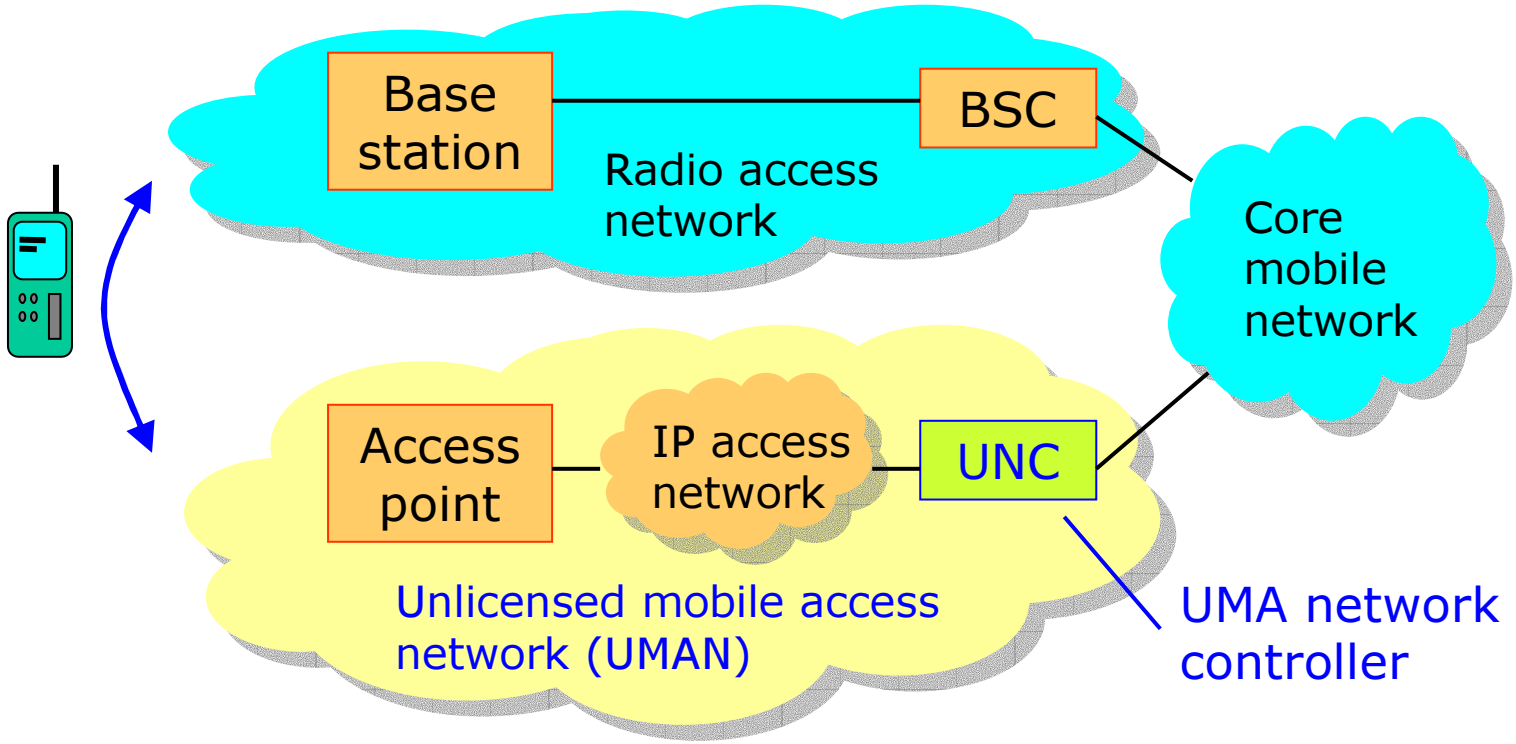


Unlicensed Mobile Access (UMA)

Unlicensed Mobile Access (UMA) technology provides access to GSM and GPRS mobile services over wireless networks based on unlicensed spectrum technologies, e.g. Bluetooth and IEEE 802.11 networks.

By deploying UMA technology, service providers can enable subscribers to roam and perform seamless handovers between cellular networks and public and private unlicensed wireless networks, and to use for instance SIM/AuC authentication also in the wireless networks, using dual-mode handsets.

UMA architecture



UMA standardization

In order to promote the widespread adoption of UMA technology, a number of companies within the cellular & wireless industry have jointly developed a set of open specifications.

See: www.umatechnology.org

What is needed to implement UMA infrastructure?

1. UMA-capable terminals
2. UMA network controller
3. Protocols that offer secure transport of GSM/GPRS signalling and user plane traffic over IP.