

# Wireless LAN Access Technology

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## INTRODUCTION

During the last decade mobile communication networks follow the evolution of fixed networks in order to provide moving subscribers with all the services and applications of fixed subscribers. This however is unfeasible due to restrictions and limitations imposed by the hostile radio channel. The global system mobile (GSM) network, known as 2G technology (Mouly & Pautet, 1992), is adequate in meeting voice communication speeds of a typical subscriber since it offers limited communication capabilities ( $< 9.6$  kb/s). The ideal mobile network would be able to provide moving subscribers with continuous access to every possible voice or data network, leading to the realization of a “mobile office.” The result of this effort (although somewhat restrictive in terms of realizable bit rates) was another evolution in mobile networks, the general packet radio service (GPRS) network (usually referred to as 2.5G), with available data rates of approximately 40 kb/s up to 100 kb/s.

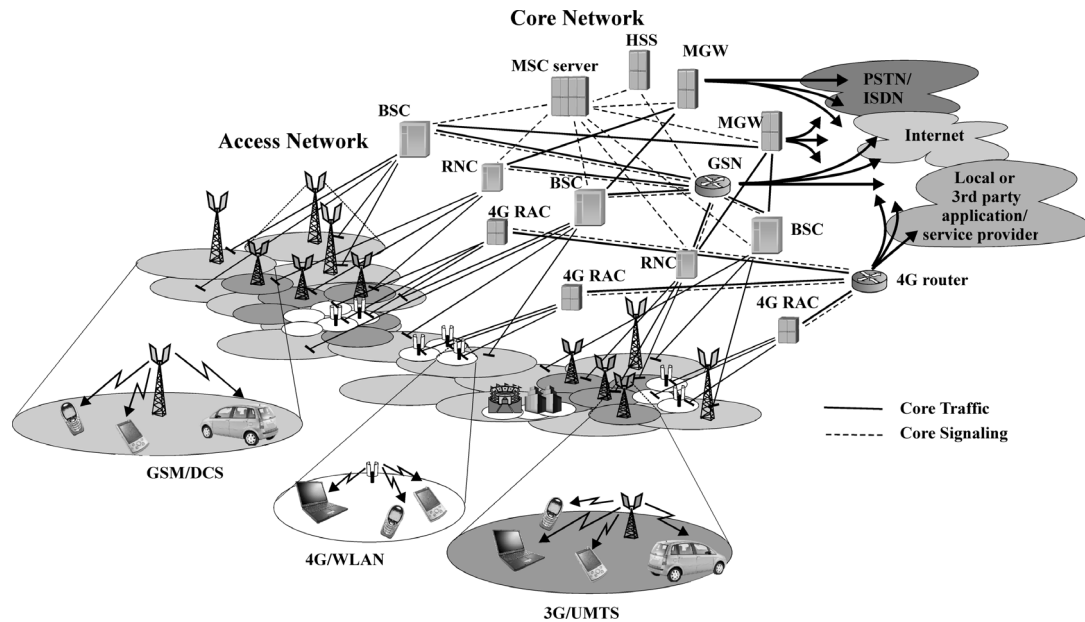
The universal mobile telecommunication system (UMTS) (usually referred to as the third-generation cellular network or 3G), with competitive rates of 300 kb/s and a future possible upgrade up to 2 Mb/s, is the realization of a new generation of telecommunications technology for a world in which personal services will be based on a combination of fixed and mobile services to form a seamless end-to-end service for the subscriber. Its realization at least requires provision of a unified presentation of services to the end user, mobile technology that supports a very broad mix of communication services and applications, and finally on-demand flexible bandwidth allocation reaching 2Mb/s per subscriber. Moreover the exploitation of pure (not tunneled) Internet protocol (IP) interconnection of network elements between each other for data exchange and operation and maintenance purposes should be available, along with the provision of flexible end-to-end all-IP connectivity in terms of user information.

3.5G and 4G (Esmailzadeh, Nakagawa, & Jones, 2003) systems are already under investigation. Aiming to “context-aware personalized ubiquitous multimedia services” (Houssos et al., 2003), 3.5G systems promise rates of up to 10Mb/s (3GPP Release 5), while with the use of greater bandwidth, these rates may raise even more in 4G (Esmailzadeh et al., 2003). On the other hand, the last five years a standardization effort has started for the integration of Wireless local area network (WLAN) in order to support higher bit rates in hotspots or business and factory environments, with a cell radius on the order of 100m. In any case, 4G and WLAN technology are going to be based on an IP backbone between access points (APs) and access controllers or routers and the Internet. Mobile IPv4 and IPv6 are already under investigation (Lach, Janneteau, & Petrescu, 2003) to provide user mobility support for context-type services.

## BACKGROUND

In Europe, the delay of 3G cellular networks deployment and the large investment demand for a new spectrum led mobile operators to search for innovative ways to improve the current offerings to customers with services similar to those of 3G. Today cellular networks seem to offer data services to customers using GPRS as the global and successful solution. However GPRS has the main disadvantage of the limited potential of supporting high data rates, required in business and multimedia applications. Therefore, since 2.5G technologies are insufficient to meet market needs and 3G cellular data technology is not yet (with moderate future employment) available, mobile operators are becoming interested in the WLAN technology. This recent interest of mobile operators is justified because of the recent global evolution and successful deployment of WLAN networks. This worldwide approval of WLAN networks is a result of very high data rates providing superior bandwidth compared to any

Figure 1. Integrated cellular/WLAN network architecture



cellular technology. As a result, IEEE 802.11 variants face data rates of up to 11Mb/s (802.11b) and 54Mb/s (802.11a/g), while rates in excess of 100Mb/s have already been acknowledged (Simoens, Pellati, Gosteau, Gosse, & Ware, 2003). On the other hand a GPRS handset offers a theoretical data rate up to 172 kb/s (typically 42 kb/s) and the third-generation terminal up to 2 Mb/s (typically 144 kb/s). The future mobile operator networks shall be a combination of several radio communication technologies, such as GPRS/UMTS/WLAN.

WLAN penetration is expected to be widely deployed in public locations such as hotels, commercial centers, airports, ports, and enterprise buildings. The architecture of deployment is based on the hotspot solution. In order to increase the revenue, operators must provide a seamless experience among current cellular and WLAN access networks. The target is to utilize infrastructure investments of existing cellular networks and interconnect the WLAN network architecture into the core cellular network. The operator WLAN system should maintain compatibility with the existing GSM/GPRS mobility management procedures (location update, authentication, roaming, and billing functions), minimizing the investment in the merging network deployment. A universal subscriber identity module (USIM) (Spiros, Louvros, & Iossifides, 2004) is a natural choice for WLAN subscriber management, since it is widely deployed and enables roaming to existing GSM/GPRS handsets and networks. Moreover, subscriber identity should be used in all access networks to enable seamless service availability.

An example of future mobile network architecture, engaging almost all forms of aforementioned technologies, is presented in Figure 1. All the technologies will coexist in the next decade, and smooth transfer of end user services and information rate among them has to be considered carefully (3GPP is already under a standardization process of interoperability between GPRS/UMTS and WLAN) (ETSI TR 101 957), (3GPP TR 22.934 v1.2.0).

## INTERWORKING SYSTEM ARCHITECTURE

### Presentation of the Idea

The general idea is that a cellular data customer can use the resources of WLAN whenever possible in order to increase its data rates and to make use of all the available multimedia services without delays. Of course the deployment of the WLAN network is based on Hotspots architecture. Hence the coverage of a WLAN network will be limited in special places, where most of the customers can use a laptop or a PDA to use the offered services. Such places are commercial centers, city center areas like cafeterias or hotels, enterprise buildings or airports, and finally crowded domestic areas. There is no need for full coverage of the whole geographical area of a city or a country, since in the areas of no WLAN coverage, GPRS solution is enough to provide the mobility freedom to

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