



To understand the mobile Internet, therefore, we need to find out details about its enabling technologies, such as cellular networks and data networks, its current and future service requirements, and possible ways to achieve those requirements. The mobile Internet will be a network for all for many years to come and therefore we need to understand how we can design it so that it would be scalable and configurable enough for new applications and services.

One significant problem with current mobile Internet solutions is that usually they define the mobile Internet as a service to their customers while they are inside the geographical coverage of the system used by the mobile Internet service provider. This geographical zone could be borders of a metropolitan city or a country, or in its best approach a continent. The service is limited to the areas covered by the same system. As an example, if you receive the mobile Internet service from a GPRS service provider, your connection will be lost when you move out from that service provider's GPRS network. A complete answer to the mobile Internet should seamlessly handover the service to another network available after user's move, so that the user hardly feels any change in service reception.

To achieve such a goal, efficient inter-networking between heterogeneous networks, including wired and wireless systems, is necessary. Advanced 2G cellular networks such as GSM and cdmaOne with huge infrastructure already implemented are not going to disappear over night, when the 3G systems will be fully in service. An integration of different systems taking the common goal of providing Internet services to users would be the answer to the mobile Internet.

Such integration and collaboration requires better harmonization among separately designed systems. Internet has been developed mainly by computer engineers while other telecommunications and cellular networks have been completed by telecom engineers. For the future mobile Internet, supposed to have good quality of service, more harmonization in achieving the common goal will be a mandate.

So, what are the areas that require major attention in such implementation? Looking at the traditional Internet with unbelievably exponential increase in number of users over only a few years, we might come up with the traffic engineering as the first area of interest. We must accept that part of mobile Internet service has to be provided by the wireless channel and that the wireless channel for many years will suffer from less capacity compared with its wired counterpart. Even for the wired network, the enormous increase in Internet traffic volume in recent years has become a major problem resulting in long delays. Therefore, for the future mobile Internet, we must be very careful when designing our system.

We can use appropriate traffic modeling methods for an optimum design of the network. This method provides a high-level of accuracy in designing of any telecommunications network, as experienced in telephony systems. Many researchers around the world are working to find new traffic models that can illustrate the Internet traffic correctly, including long-range dependency and self-similar methods. If we can have a good traffic model, our system design will be very good, however, considering numerous Internet and network applications, achieving a single traffic model, similar to Erlang formulas in telephony networks, would be very difficult and unrealistic. Nonetheless, when new applications are available, the correctness of the past traffic models would be questionable.

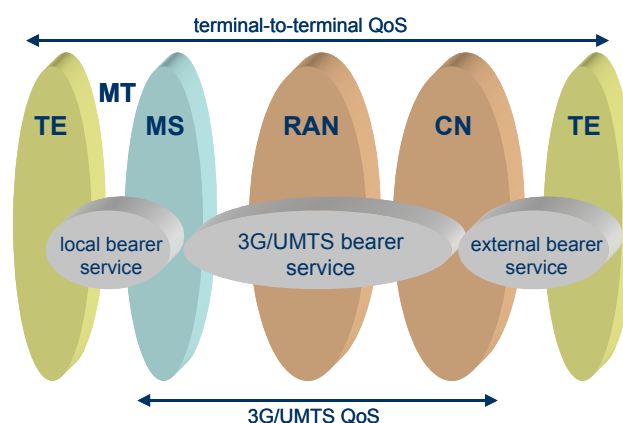
In case a precise traffic modeling is difficult to achieve in a given communication network, traffic management techniques would be the only choice in order to maintain the quality in that network. *Traffic management* is a set of policies and mechanisms that allow a network to efficiently satisfy a diverse range of service requests. Admission control, scheduling, buffer management and flow control all can be considered as forms of the traffic management. The main issue in traffic management is how to balance the tension between the *diversity* and

*efficiency*; both are necessary for providing the quality of service. In order to achieve this main objective, any traffic management scheme has to be efficient enough to prevent and recover from network congestion. Admission control techniques and specifically measurement-based admission control are among those methods that can stabilize the network service by limiting the number of users in the network at any single period.

Since the mobile Internet has the mobility in its nature, mobility management becomes the next important issue for the network designer. The user of a mobile cellular network may experience two types of mobility in the network. The first one is a terminal mobility that means the mobile device frequently changes its network point of attachment during the movement and while an active session is ongoing. Continuous telephone conversation during a cellular user's travel time is an example of this type of mobility. Some cellular systems such as GSM also provide a personal mobility, which is realized by the inclusion of a subscriber identity module (SIM) card in their systems. The user can remove the SIM card from one terminal and insert it to another GSM-compatible terminal and still receive the same type of services from the cellular network. Therefore, in addition to the terminal mobility, here the user has the access to a kind of personal mobility.

Therefore, the issue of mobility management in mobile networks, including cellular and wireless Internet, goes back to finding appropriate mobility models that could illustrate the users' movement pattern and the suitable network point of attachment at each time, that is the location management. Efficient location and mobility management schemes significantly decrease the amount of signaling traffic in networks and the delay encountered in routing a packet from a source to a destination.

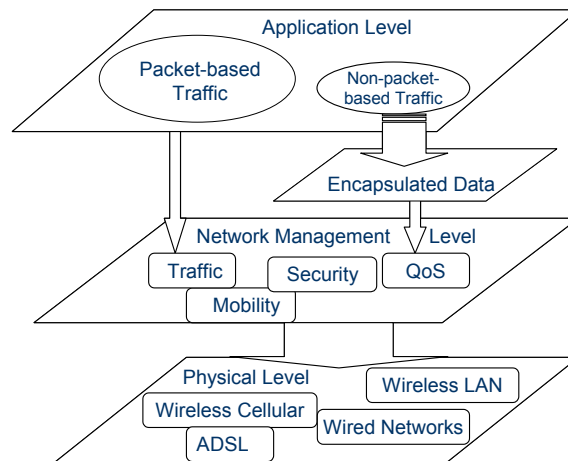
The next issue in implementation of future mobile Internet is the quality of service (QoS). The quality of service can be defined as a set of specific requirements for a particular service provided by a network to users. Quality of service must be seen as an end-to-end process. Assume for example that you want to establish a video conferencing over the Internet using the UMTS as the access network for your communications. At the two very end points of this communications process we have the end user terminals, for example a cellular phone at one end and a desktop computer connected to the wired Internet at the other end. The access technology here thus comprised of several systems: The local bearer service providing the service to the cellular phone user, the UMTS bearer service, and the external bearer service



providing service to the desktop user. Without a proper QoS mapping among those individual networks, the end-to-end QoS would not be achievable.

Finally, the architecture design of the overall mobile Internet requires particular attention. The architecture will include many different networks with individual characteristics, QoS measures, and traffic flow transportation. The future mobile Internet needs to consist a flexible core network, connecting all heterogeneous networks, complementing services of one

network by another one, and roams users seamlessly from one network to another. The final solution in mobile Internet design and implementation lies in appropriate layered network architecture similar to the one realized the Internet in the first place. The management techniques will be the keys in such layered architecture. Transport and network protocols also need to be modified and optimized to support this architectural advancement.



Written by Abbas Jamalipour author of the book “The Wireless Mobile Internet – Architectures, Protocols and Services”. Published February 2003.

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