

Architectures and Protocols for Wireless Mobile Internet

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The number of subscribers for mobile communications has increased much faster than predicted, particularly for terrestrial use. In 2000 the number of mobile subscribers was higher than 400 million worldwide and for the year 2010 nearly 2000 million mobile subscribers are anticipated.

The majority of traffic is changing from speech-oriented communications to multimedia communications. It is also generally expected that due to the dominating role of mobile wireless access, the number of portable handsets will exceed the number of PCs connected to the Internet. Therefore, mobile terminals will be the major person-machine interface in the future instead of the PC. Due to the dominant role of IP-based data traffic in the future, the networks and systems have to be designed for economic packet data transfer. The expected new data services are highly bandwidth-consuming. This results in higher data rate requirements for future systems.

The major step from the second generation to 3G wireless or 4G mobile was the ability to support advanced and wideband multimedia services, including e-mail, file transfers, and distribution services such as radio, TV, and software provisioning (e.g., software download). These multimedia services can be symmetrical and asymmetrical, real-time and non-real-time. External market studies have predicted that in Europe in the year 2010 more than 100 million mobile subscribers will use mobile multimedia services and will generate about 70 percent of the traffic in terms of transmitted bits. In Asia, this number will increase to over 200 million.

In 3G wireless and 4G mobile, the combination and convergence of the worlds of information technology (IT), media, and telecommunications will integrate communications with IT. As a result, mobile communications together with IT will penetrate the various fields of society.

In future communications, two economically contradictory demands will arise: ubiquity and diversity. Open, global, and ubiquitous communications free people from spatial and temporal constraints. Versatile communication systems will also be required to realize customized services based on diverse individual needs. The flexibility of mobile IT can satisfy these demands simultaneously. Therefore, mobile IT can be seen to play a key fundamental role in the 21st century.

User expectations are increasing with regard to a large variety of services and applications with different degrees of quality of service (QoS), which is related to delay, data rate, and bit error requirements. Therefore, seamless services and

applications via different access systems and technologies that maximize the use of available spectrum will be the driving forces for future developments.

In addition, many types of objects as well as people will have network functions and will communicate with each other through networks. Therefore, different communications relationships such as person to person, machine to machine, and mainly machine to person and vice versa will determine mobile and wireless communications in the future.

Given the increasing demand for flexibility and individuality in society, the means for the end user might be assessed. Potentially, the value would be in diversity of mobile applications, hiding the complexity of the underlying communications schemes. This complexity would be absorbed into an intelligent personality management mechanism, which would learn and understand the needs of users, and control the behavior of their reconfigurable terminals accordingly in terms of application behavior and access to future support services.

The trends from a service perspective include integration of services and convergence of service delivery mechanisms. In particular, three pillars (triple-C or CCC) can characterize from a service perspective these trends of integration of services and convergence of service delivery mechanisms:

- Connectivity (provision of a pipe, including intelligence in the network and terminal)
- Content (information, including push-pull)
- Commerce (transactions)

These trends will result in new service delivery dynamics and a new paradigm in telecommunications where value-added services such as those that are location-dependent will provide enormous benefits to both end users and service providers.

Convergence of wireless and Internet will be one of the hottest topics in coming years. Wireless mobile Internet (WMI) and its devices are coming to the market in ever increasing numbers all over the world. The investment in this business will be over \$100 billion within the next several years.

Wireless mobile users will not just want to access all the information available on the Internet via a phone. It therefore makes better sense if the operator selects an appropriate service portfolio tailored to mobile subscribers. It is also impractical to deliver the content to a phone in the same manner as supplied to a PC. The graphics and hyperlinks need to be stripped out, but this only represents a Band-Aid approach to the problem. What's needed is a wireless equivalent to the Web, which is where the WMI protocol comes into the picture.

The WMI architecture should support the following emerging business goals:

Significant cost reduction

- Data communications cost curve
- Multivendor procurement
- Modular and incremental infrastructure growth

Accelerated time to market

- End-user services
- Infrastructure

Variety of services with an open service creation environment

- Faster services and applications development
- New business development opportunities
- Alignment of data services and the Internet

Grow Internet services business

- Take advantage of wireline investment in Internet, VoIP, and IP-based services and applications

To empower all these revolutions and evolutions, the new improved architectures and protocols for WMI become emerging topics. Therefore, this feature topic is very timely and significant, and attracted wide discussion among experts from all over the world.

The first issue for this wireless mobile Internet is the new architecture on radio access networks (RANs). Most current RANs treat each protocol separately and require a separate RAN control protocol for each. [Parviz Yegani et al.](#) proposed a new architecture called the OpenRAN architecture, which is based on a distributed processing model with a routed IP network as the underlying transport fabric serving as the basis for an integrated next-generation 4Gmobile RAN.

WMI requires the core wireless network infrastructure to change from circuit- to packet-switched where voice and data are transported using IP as the common protocol. However, how to run the key Mobile Application Part (MAP) signaling protocols over IP is an important issue. MAP defines the application protocols between mobile switches and databases for supporting mobility management, security management, radio resource management, and mobile equipment management. [The second article](#) by Robin Cher Nung Chiang *et al.* introduces a new protocol to transport MAP in the migration path from the circuit-switch-based Signaling System No. 7 (SS7) to IP, which is significant for WMI implementation.

3G wireless is evolving toward a versatile IP-based network that can provide various real-time multimedia services to mobile users. Two major challenges in establishing 3G wireless networks are:

- Support of fast handoff
- Provision of QoS over IP-based WMI

In [the third article](#) by Weihua Zhuang *et al.*, a differentiated services (DiffServ) resource allocation scheme is proposed for 3G wireless and 4G mobile. Furthermore, an adaptive assured service is presented for the stream class of traffic, where resource allocation is adjusted according to the network condition in order to minimize handoff call dropping and new call blocking probabilities.

Security will become one of the most critical topics in the convergence of wireless and Internet. To compromise this end-to-end security in WMI, [Markus Dillinger et al.](#) propose a new scheme that allows the coexistence of IPsec and performance-enhancing proxies over 3G wireless through adding an intelligent module in the node where the security is implemented.

To apply IP to wireless mobile applications and provide an end-to-end direct wireless signaling mechanism is not an easy job. IP should take full support from the underlying wireless network architecture to achieve optimal performance for handover and paging protocols. [Behcet Sarikaya et al.](#) from Alcatel evaluate cdma2000 support for this emerging IP issue.

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Biography



[Willie W. Lu](#) [SM], is a senior principal wireless architect at Siemens-Infineon and a member of the Technological Advisory Council of United States Federal Communications Commission (FCC). He is also an internationally recognized senior expert in emerging wireless technologies and has been a technical advisor for over 20 wireless communication authorities in more than 10 countries. He is an independent technical examiner for lots of high-tech venture capitals in the United States, Europe, Asia, and other places, and is listed in major Who's Whos in the world. He has guest edited around 25 special issues on emerging wireless communications in IEEE, IEICE, ACM, and other major publications, and has had over 130 papers published in major professional publications. He has been chair of numerous IEEE conferences including GLOBECOM, WCNC, VTC, and WWC, and wireless feature editor of *IEEE Communications Magazine*, *IEEE Transactions on Wireless Communications* (former *J-SAC Wireless*), and others. He is a frequent keynote and featured speaker at lots of global technical fora, and a well-known wireless pioneer in Silicon Valley. He is a member of IEEE, ACM, IEICE, CIC, and Sigma Xi, and an adjunct professor at many world-class universities in the world.