



Mobile Network Computer Can Interpret the Terminals of Mobile Communication Networks

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Abstract

In March 1997, based on the research experience of narrow band mobile data communication system and the concept of “Network Computer - Terminal of Internet” first proposed in 1995 by Larry Ellison, the CEO of Oracle Corporation, the author Zhaoming Guo proposed the concept of “Mobile Network Computer - Mobile Terminal of Internet” in China. In this paper, the concept of mobile network computer has been elaborated by the author based on his many years of experience in the communication and computer software industry. The author points out that modern mobile communication networks should be known as mobile computer networks. He further clarifies that the concept of mobile network computer from the evolution of mobile communication networks and the exposition of IMS technology; this concept better defines modern mobile terminals and reflects the nature of many mobile terminals, which have the structure of an embedded computer and the technological ability of processing multimedia. Based on the general applicability of mobile network computer and the development of Internet of things, the mobile network computer may not just be integrating the functionality of a television set, audio-visual equipment, wireless household appliance, and mobile communication equipment, but it may also be used in manufacturing several intelligent devices in the near future. Thus, we would have intelligent foot rings, smart watches, smart glasses, smart shoes, smart coats, robots etc. in the near future. In conclusion, we have presented an outline of the future information age in terms of network computers and mobile network computers.

Keywords: Mobile Network Computer; Mobile Computer Network; Mobile Communication Network; IMS, 4G, 5G

Introduction

The world's first electronic computer was invented in 1945. Thereafter, there have been many developments in the field of computer technology, and these developments can be divided into three stages: the first stage of development included mainframe applications, the second stage of development included personal computers, and the third stage of development included network computers. Owing to the tremendous development of computer technology, people are digitally connected to each other in this information age [1,2].

The CEO of Oracle Corporation Larry Ellison first introduced the concept of network computers in 1995. Then, the concept of

mobile network computer [1,2] was first proposed by the Chinese scientist Zhaoming Guo in March 1997. Even after twenty years of inception, mobile network computer still attracts a lot of attention from computer and communication scientists. The concept of mobile network computer may be defined as follows: mobile network computer is a mobile terminal that uses internet protocol (IP) technology to perform various functions, such as mobile network communication and mobile network computing. It can transmit information through the media of voice, data, and video, and it represents the developing trend of mobile communication terminal. Undoubtedly, mobile network computer relies on mobile communication network in the multimedia age; therefore, the mobile communication terminal should not be termed as “mobile computer”

or “mobile phone” or “cellular phone”. The term “mobile network computer” is more apt for defining mobile communication terminal.

In this paper, we describe the development of mobile network computer from the evolution of mobile communication networks and the appearance of IMS technology.

The evolution of mobile communication networks

In the beginning, there were only three mobile communication networks: REFLEX [3], MOBITEX [4], CDPD [5]. These networks were commonly known as two-way paging. Mobile data was transmitted by these narrow band communication networks at a low data speed: these communication networks could only transmit mobile data, and not voice and video. They were used previously for monitoring and controlling the mobile network. Thereafter, the telecommunication market saw a major breakthrough with the invention of first generation (1G) and second generation (2G) technologies, which mainly improved mobile voice communication but not data and video. Because 1G mobile communication system was based on the core technologies of analog modulation and frequency division multiple access (FDMA), it has many shortcomings, such as the high cost of equipment, low rate of frequency spectrum utilization, and bad secrecy. Therefore, it could only provide low speed voice communication. There were three types of mobile communication systems: advanced mobile phone service (AMPS), total access communication system (TACS), and nordic mobile telephone standard (NMTS). Because the 2G mobile communication system was based on digital modulation technology, time-division multiple access (TDMA), and code-division multiple access (CDMA), it had high spectrum efficiency, good secrecy, and large system capacity. It completely met the demand for voice and low speed data service, so it was widely used all over the world. Some typical 2G mobile communication systems are as follows: global system for mobile communication (GSM), personal handy phone system (PHS), and personal access communication system (PACS) [6].

In those days, mobile communication networks would transmit either data or voice, but their transport protocols did not include IP; therefore, we consider them to be precursors of mobile computer network. In those days, the mobile terminals was approaching mobile network computers, and they were commonly known as two-way pager or mobile phone.

There has been tremendous development in the field of computers and electronics. Presently, mobile communication networks

are based on the following mobile computer technologies: IP, WAP, WIFI, 2.5G, 3G, 4G, and 5G. Due to these advanced technologies, people can now communicate with each other through the media of data, voice and video. Therefore, the mobile communication terminal should now be strictly known as “mobile network computer” and not “mobile phone”, “cellular phone” or “mobile computer”. Mobile communication networks now have high-spectrum efficiency as they are based on advanced mobile computer technologies. In addition, the capacity of mobile communication network has also increased tremendously with these advancements. The mobile communication technologies 2.5G, 3G, 4G and 5G were gradually transformed into mobile computer networks without compromising on high spectrum utilization and large network capacity.

In the field of mobile computer network, the technology 2.5G was a milestone, because its transmission speed was about 10 times more than that of GSM. Moreover, 2.5G could be completely online unlike its predecessors [7]. Thus, 2.5G was extensively used in various commercial applications, including corporate email, information service, remote LAN access, file transfer, web browsing, static image, file sharing, online chat, voice and data transfer, etc.

With the advent of 2.5G technology, mobile terminals could transmit voice, data, and video at a low speed. At this time, mobile terminals could transit voice, data and video with low speed, and IP technology began to be used, mobile terminals had been become elementary mobile network computers.

With the advent of third generation (3G) technology, mobile communication networks provided better service quality; data, voice, and video could now be transmitted at a high speed and with higher reliability. Some of the most attractive features of 3G technology were as follows: higher bit rate, reliable and fast data transmission, and better spectrum efficiency. The theoretical maximum transmission rate could reach 2 Mbps with the help of 3G technology. When broadband CDMA technology was applied in 3G mobile networks, there was higher bandwidth and higher bit rate in the multimedia (voice, data, and video) as well as in integrated and personalized features [8-10]. In summary, 3G networks were advanced mobile computer networks that could transmit voice, data and video at high speed. At the same time, IP technology was completely integrated with 3G networks.

Because 3G networks became relatively advanced mobile computer networks, naturally, 3G networks transformed the existing

mobile terminals into relatively advanced mobile network computers.

Presently, fourth generation (4G) networks are being used all over the world. With the advent of 4G networks, mobile computer networks can now provide better services at a faster rate. The existing 4G technology supports a transmission speed of 100 or 150 Mbps. Thus, it was 35 times faster than TD-SCDMA (3G) technology. Moreover, it is 25 times faster than WCDMA (3G) technology [11]. The asymmetric transmission capacity of 4G technology is more than 2 MB/s in mobile distribution networks having broadband access. In addition, 4G technology also increased the broadband internet speed from 2 MB/s to 100 MB/s. One of the unique qualities of 4G technology is that it can automatically switch to different rates of transmission. Therefore, 4G is considered to be an integrated broadband communication system with multifunctional features and capabilities. It can transmit high quality 3D images, because its internet access is more than 50 times of that of 3G.

With the advent of 4G technology, mobile terminals have improved tremendously in terms of functionality: the sound quality has become clearer, and the transmitted images have high resolution. Based on FDMA, TDMA, and CDMA, scientist introduced the advanced technology of space division multiple access (SDMA). When 4G technology was combined with SDMA, the capacity of the mobile terminal became 5 - 10 times greater that offered by an average 3G network. Therefore, mobile network computers should be developed with 4G terminals either theoretically or experimentally.

The most important advantage of 4G technology is that it is compatible with broadband integrated services digital network-(B-ISDN) and asynchronous transfer mode (ATM), which bring about wide band multimedia communication and form comprehensive wide band communication network. Thus, 4G technology offers a wide range of services and applications by supporting interactive multimedia services, such as video conference and wireless internet. Subscribers can use several mobile devices to access 4G system, because mobile network services are usually diversified. This clearly proves that 4G is a more advanced mobile computer network that can operate mobile terminals with better clarity and efficiency. Therefore, mobile terminals operated with 4G technology have more advanced features.

The fifth generation (5G) of mobile communication technology is being developed currently. It is important to note that 5G

technology is an advanced form of its predecessor technologies 4G, 3G, and 2G; therefore, it cannot be considered as an independent and new wireless access technology but just an evolution of existing wireless technology. Thus, 5G technology integrates some new complementary features with the existing wireless access technology. Thus, 5G will be a truly integrated network as it incorporates the novel and existing standards of wireless access technology. Therefore, 5G would provide high-speed, safe, and free data connectivity for people and objects. Most technologists have predicted that data traffic will increase by 1, 000 times from 2010 to 2020 year; therefore, 5G technology would be required to satisfy the ever increasing demand of mobile communication, including communication architecture, wireless networking, wireless transmission, and new antenna. We also anticipate the introduction of some key technologies for the development and utilization of new spectrum in 2020.

The internet speed will increase tremendously with the introduction of 5G technology. Currently, the peak speed of 4G/LTE is 100M per second, while the peak speed of 5G is predicted to be 10G per second [12]. Some of the most notable features of 5G technology are as follows: high-speed transmission, large bandwidth, high capacity, high dense site, and high reliability. Moreover, 5G technology would be accessible at anytime and anywhere. In the near future, 5G technology would enable us to develop green energy networks; these would be ubiquitous, intelligent, integrated, and wide-band networks, providing high-quality communication experience to subscribers at anytime and anywhere. The primary transmission techniques of 5G technology are as follows: cognitive radio spectrum sensing technique, millimeter wave mobile communication, 3D massive MIMO system, orthogonal frequency division multiplexing (OFDM) system, filter bank multicarrier (FBMC) system, non-orthogonal multiple access (NOMA) system, spatial modulation (SM) and frequency quadrature-amplitude modulation (FQAM), ultra-dense network, heterogeneous network fusion, multi-carrier aggregation technique, etc [13]. At the same time, 5G technology would also provide cloud computing, flexible resource management, and network intelligence.

Owing to its excellent features and enhancements, 5G technology should be known as intelligent mobile network, and the mobile terminals of 5G technology should be known as intelligent mobile terminal.

Based on the above discussion, we conclude that mobile communication networks would always be based on mobile computer networks regardless of the changing trends in mobile communication networks. Furthermore, mobile terminals would be operated with the latest mobile network computers regardless of changing trends in mobile terminals. Mobile communication is improved by further enhancing mobile computer networks and mobile network computers.

It is important to note that mobile communication network is a mobile computer network, and a mobile communication terminal is a mobile network computer. With this distinction in terminologies, mobile developers can clearly understand the changing trends of mobile communications. Thus, they can get rid of the traditional modes of mobile communication. At this same time, mobile developers can further develop mobile communication networks and applications using the artificial intelligence of computers. Likewise, the latest computer software can be used to develop new mobile communication network and applications. Thus, we can synchronize the developments in mobile communication network and applications with the latest developments in computer technologies. In other words, traditional computer developers would ensure that the embedded computer systems are connected with the mobile communication network in a much better way so as to improve the efficiency of all kinds of mobile network computers. In the telecom industry, these developments would help the operators of mobile communication network to reinforce their collaboration with the producers of mobile terminals. Thus, mobile communication networks and mobile network terminals would now provide maximum benefits. In the commercial sense, subscribers will be able to better understand various mobile communication networks and mobile communication terminals. Thus, people will realize that 3G, 4G, 5G and subsequent mobile communication systems are improving the mobile computer network significantly. In the near future, intelligent foot rings, smart watches, smart glasses, smart shoes, smart coats, robots, etc. would be operated with various types of mobile network computers. Thus, the applications and terminals of mobile communication would be useful in diverse fields.

Owing to the complexity of mobile terminals, we cannot expect all mobile terminals will function with mobile network computers; however, mobile network computers reflect the nature of many mobile terminals in terms of the hardware structure and the technological ability of processing multimedia. Figure 1 is the diagram of mobile communication network.

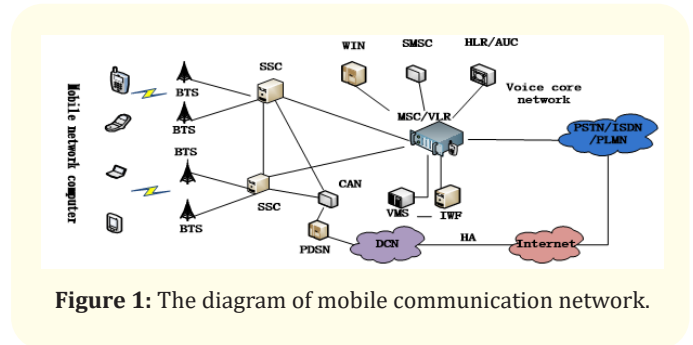


Figure 1: The diagram of mobile communication network.

IMS technology further changes mobile communication networks into mobile computer networks

The technology of IP Multimedia Subsystem (IMS) is considered to be the core technology of next generation network (NGN), because it further transforms mobile communication networks into mobile computer networks. With this innovation, we will be able to provide customers with more sophisticated and diverse multimedia services. This is because IMS technology would enable us to integrate mobile networks with fixed networks. Using IMS technology, we have today completely transformed mobile communication networks into mobile computer networks.

The IMS technology is based on an IP core network standard; therefore, it maximizes the reuse of internet technology and agreement. The session initiation protocol (SIP) is used by IMS in the session control layer; moreover, internet protocol version 6 (IPv6) has enough address space to improve the performance in the net layer of IMS, while domain name system (DNS) protocol is reused to resolve the relevant signal. Common Open Policy Service (COPS) protocol is used to establish the network security of IMS. Furthermore, internet protocol security (IPSEC) technology and transport layer security (TLS) protocol are used in the operations management layer of IMS. The actual operational needs of operators are completely assessed by IMS technology. Based on this assessment, IMS formulates relevant specifications for the network framework, quality of service (QoS), security, billing, and intercommunication with other networks. Both network computer and mobile network computer can better share all these characteristics of IMS technology.

In mobile communication, IMS technology further supports the thought that service is separate from the control and the control is separate from the bearing in soft switching structures [14], but IMS technologies are more clear and reasonable than soft switching structures.

During the development of a communication network, there is continuous decomposition of all the layers of a network. Software define network (SDN) is a developing trend. In addition, the network tends to aggregate at different levels to tackle the decomposition of different networks. This tendency is known as the process of network convergence. A fixed network and a mobile network are both integrated into a computer network through network convergence.

In conclusion, IMS technology further transforms mobile communication networks into mobile computer networks. Moreover, it provides communication capability to mobile network computers. Figure 2 is the diagram of IMS and mobile communication network access.

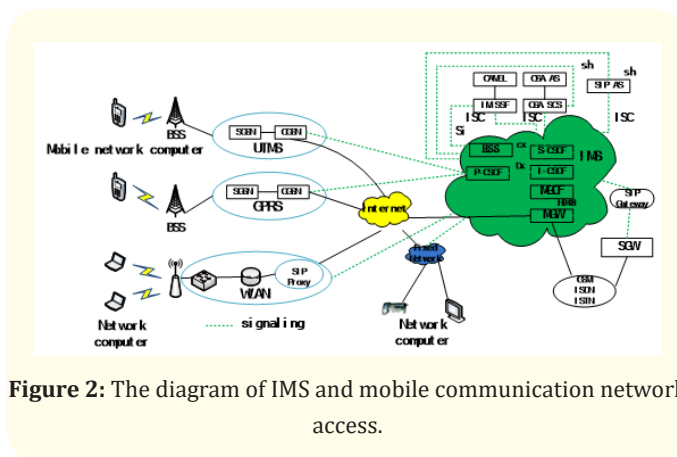


Figure 2: The diagram of IMS and mobile communication network access.

Conclusion

From the above discussion, we conclude that mobile communication networks may be termed mobile computer networks because they have the ability to transmit and process multimedia. Since mobile terminals depend on mobile computer networks, mobile terminals should be now be referred to as mobile network computers. Mobile network computer is a better term to define modern mobile terminals, and it reflects the nature of many mobile terminals, which have the structure of an integrated computer and the ability to process multimedia. Owing to mobile network connection, we cannot refer a mobile communication terminal as “mobile computer” or “mobile phone” or “cellular phone”, etc. The term “mobile network computer” is more accurate in terms of the technological perspective.

With the fusion of communication and computer technology, mobile internet inherits many technologies of the fixed internet. At

the same time, it also introduces many new features, such as roaming information, locating information, business innovation pattern, etc. With the help of mobile internet, we have connected mobile terminals with the consumer electronics terminals to form the united mobile network computers. The boundary between telecommunications and internet service providers is getting blurred completely. In the future, the information services provided by operators will include the collection of information, multimedia, entertainment, advertising content, etc. Using the concepts of network computer and mobile network computer, we described these services completely in terms of technology. The concept of mobile network computer not only helps people understand the changing trends of mobile communications but it also helps people in understanding personal communications far more clearly. By integrating the development of mobile communication network, we have been able to develop highly perfect products of mobile network computers. Therefore, we should definitely popularize mobile network computer to improve the connectivity of mobile terminals.

Just like the Internet of things, we will witness a diversified trend of mobile network computers in the near future. Just like cloud computing, SDN and IMS technologies will also become more advanced. Owing to these imminent developments in technologies, the telecommunication network, internet, and television network would merge into one platform. This implies that television, mobile phone, pad and computer would be combined together to give us a far more productive experience. This is because mobile network computers will become far more intelligent and advanced. In the future, mobile network computers would be used to produce intelligent foot rings, smart watches, smart glasses, smart shoes, smart coats, and robots, etc. Based on mobile network computer, we can imagine the future of information services and products. In the future, the technology of network computers and mobile network computers would be interoperable through computer networks and mobile computer networks, respectively. Therefore, perfect connectivity is promised in the near future of information age.

In summary, mobile terminals have the structure of an integrated computer; therefore, they have the ability to process multimedia. The concept of mobile network computer not only reflects the nature of mobile terminals, but it also helps us to clearly understand the information age in the near future. In the information age, the terminals of mobile communication system should be mobile network computers.

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