

# ZTE's CDMA 2000 1x Mobile Communication System

*Xu Yong / Hu Zhigang*

(Nanjing R&D Center of ZTE Corporation, Nanjing 210012, China)

With the operation of the CUC (China Unicom Corporation Ltd.) "New Horizon" CDMA network, the Chinese mobile communication market has entered a new stage of development. GSM and CDMA have joined hands to work fully and efficiently. The total capacity of the first phase CUC's CDMA network was designed to reach 15 150 000 users in China. Up to now, the CDMA 2000 1x system has been successfully constructed and implemented in seven cities in China including Beijing, Shanghai, and Haikou. The use of high technology and its cost effectiveness make it foreseeable that the system will be widely used in the Chinese mobile communication networks.

## 1 Structure of the System

The system consists of two parts: network side and wireless side. The former can be further divided into two: circuit field and packet field. The equipment in the circuit field includes ZXC10-MSC/VLR (Mobile Switching Center/Visitor Location Register), and ZXC10-HLR/AUC (Home Location Registers/Authorization Center). The major equipment in the packet field consists of ZXPDS-P100 (Packet Data Service Node), ZXPDS-A100 (Authentication/Account/Authorization Server), and ZXPDS-H100 (Home Agent). On the wireless side, the main equipment includes ZX3G1X-BSC (Base Station Controller), and ZX3GX-



BTS (Base Transceiver Station), as well as wide area macro base station used in "wide coverage" and "deep coverage," macro base station, common micro base station, super micro base station, remote radio frequency base station, repeaters and distributing indoor covering system.

The system's product series strictly follow the standards and protocols related to mobile communication industry on CDMA IS95 and CDMA 2000 1x mobile communication networks, as well as the CUC-related technical mechanism. It meets all the requirements as specified in the international IOS 4.0 standards. It is also compatible with Interface A of IOS 2.x standard and complies with CDMA equipment from various manufacturers. In terms of the wireless intelligent network (WIN) pro-

protocol, the system supports IS771, IS826 and other WIN-related standard protocol series. Its core network supports IS41E protocol and is fully compatible with IS41 protocol series. The packet data switching system strictly follows the standard IS835 protocol, which relates to the 3GPP2 packet network structure as well as IETF (RFC series) standard. When the system provides short message services on the network, it supports IS841 and IS824 protocols. In wireless-oriented services, the system follows the IS41 series, IS664, PN4747, PN4818 and PN4288 protocols. It also follows IS2000 protocol series and IS801 protocol on the wireless side, which is compatible with IS95 protocol.

### 1.1 Equipment on the Network Side

#### 1.1.1 In the Circuit Field

The equipment used in the circuit field on the network includes ZXC10-MSC/VLR and ZXC10-HLR/AUC.

ZTE's ZXC10-MSC/VLR products are composed of the central switch module (CSM), MSC/VLR/SSP processing module (MPM) and operation maintenance module (OMM). ZTE's ZXC10-MSC/VLR products consist of the public signaling processing part, and operation processor part, database part, and operation maintenance part. They have all adopted the modular structure. The module number can be flexibly and easily determined according to the requirements, which will help perform the networking function and easily expand its capacity.

Each of the following four parts uses high technologies and functions in its own way: the database part adopts advanced cluster technology, the memory equipment uses disk array of redundancy technology, the communication link has dual-network structure and the operation processor uses load dynamic equalization technology. All these technologies fully guarantee high reliability and excellent performance of the central data system.

#### 1.1.2 In the Packet Field

The packet field equipment includes ZXPDS-P100, ZXPDS-A100, and ZXPDS-H100. Two steps realize ZTE's packet data switching system.

In the first step, a small-size system is con-

structed in the single-board mode and centered on the network processor. The system's periphery is connected with the memory interface unit, PCI bus interface unit and Ix bus so as to achieve all the functions of the packet data service node and the home agent in the packet data switching system. It adopts cluster technology to realize the load equalization and intelligent packet data service node (PDSN) choice functions. It provides error-tolerance mechanism to guarantee the reliability and the stability of the system when running a large set of data. The system's hardware design supports a high-rate data link processing function, which can greatly improve the time delay and congestion specifications. The system focuses on the protocol processing capability of the board to construct the entire system in facilitating the system capacity-expansion in a cascade mode.

In the second step, the system centers on the switching network processor and relies on the diverse board processing modules to realize the function of packet data service node and the home agent service. The network switchboard of the system adopts 1+1 backup in order to improve the operational stability of the system.

### 1.2 Equipment on the Wireless Side

The equipment on the wireless side of ZX3G1X-BSS adopts packet switching in bus-sharing mode and modularized design to support multi-frame cascading capacity-expansion. It provides signaling processing modules with different processing capabilities while satisfying different networking and capacity planning requirements.

The system adopts a perfect redundancy protection mechanism and a reliability module with key modules adopting 1+1 protection mode. The network interface of the high-rate interconnecting route system (HIRS) switching shelf adopts an advanced  $N+1$  protection mechanism. As a result, the system can realize true seamless switchover protection, and accordingly, be able to improve the reliability of the system.

In order to be backward compatible with the IS95 CDMA mobile communication system and guarantee the profits of operators and

users, the system's base station inherits all the service functions of the IS95 base station system. Its objective is to optimize the network quality and solve the problem of signal coverage in some shadow areas such as high buildings, pilot frequency pollution areas, and other special areas like metro, tunnels and hotspot occasions in downtown. In order to achieve these purposes, ZTE Corporation puts forward the "Deep Coverage Solution" to provide a relatively larger system capacity to satisfy the traffic load in hotspot areas and thus reduce the interference to adjacent base stations. It eliminates severe pilot frequency pollution and noise pollution caused by wireless repeaters in downtown areas.

Another set of objectives includes improvement of the signal coverage in plains, adjacent sea areas, villages and towns, highways, areas along the railway, and poor and remote areas such as deserts or grasslands or other wide areas. In doing so, ZTE Corporation provides the "Extensive Coverage Solution" by combining the system's product series including wide-area macro base stations, macro base stations, micro base stations, super-micro base stations, remote terminal radio frequency base stations and repeaters. Using these combinations, ZTE's CDMA 2000 1X system is able to offer a perfect coverage in areas with low traffic, and ensure the operators there get maximum investment returns.

## 2 Exposition of the System's Network Construction in Hainan

Besides basic services, the system provides rich short message services, wireless location services, wireless intelligent networks, wireless data services and wireless Internet network services, etc.

Figure 1 shows the networking scheme of

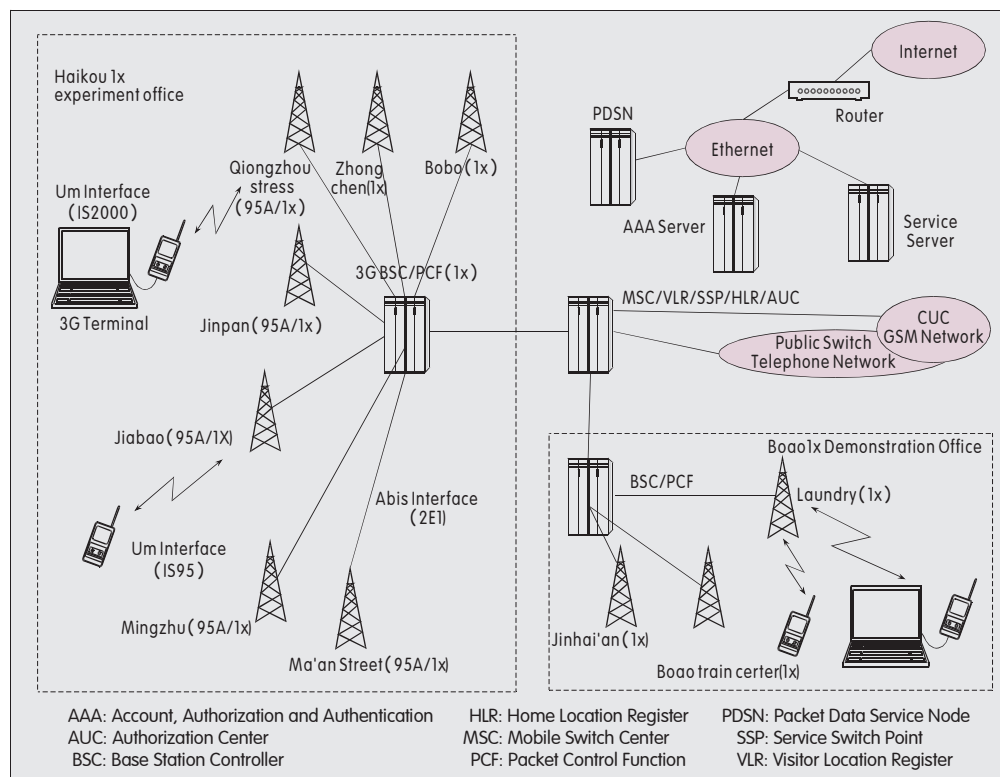


Figure 1. The network structure of CDMA 2000 1x system in Haikou and Boao.

the system deployed in the cities of Haikou and Boao, both of which are located in Hainan Province of China.

Since August 2001, ZTE's CDMA 2000 1x mobile communication system has been successfully implemented in the cities of Haikou of Hainan Province and Shantou of Guangdong Province of China. During November 2001 when the Ninth National Sports Games were held in Guangdong, the system provided coaches, athletes, referees and reporters with high-quality broadband and high-rate data services such as wireless real time image transmission, wireless VOD and wireless high-rate network access, etc. Practically the highest rate for these services have reached 153.6 kbit/s.

In April 2002, the system provided services for "Boao Asian Forum" including broadband data services for the forum participants. High-rate data services were also achieved for the forum, including but not limited to, e-mail transceiving, real time image transmission, network accessing, video on demand, mobile wireless virtual private network, mobile office, mobile security, mobile bank and mobile commercial business.