

Building International Gateway Offices with ZXJ10

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1 General

Economic globalization is resulting in rapid development of the telecommunication industry. It is now necessary for many countries to build new international gateway offices or expand their existing systems in order to become interconnected with their foreign counterparts.

International gateway offices are key components in the telecommunication network. Additional requirements are needed for international gateway offices when compared to national tandem offices and local offices, such as capacity, routing, charging, traffic control and so on. Good understanding of these requirements is a useful tool when building international gateways.

The ZXJ10 switching system is a new SPC system designed and manufactured by ZTE Corporation in the early 1990s, as shown in Figure 1.

In the following pages, particular requirements for international gateway offices and the corresponding characteristics of ZXJ10 will be covered.

2 International Gateway Offices and ZXJ10

2.1 Capacity, Reliability and Processing Capability

International gateway offices converge all international calls and transit them to destination countries. Large capacity, high reliability and strong processing capability are therefore

essential for an international gateway office. The ZXJ10 switching system meets all of the above requirements.

The ZXJ10 switching system adopts the largest and most advanced single-plane non-blocking $64\text{ K} \times 64\text{ K}$ switching network to build the international gateway. With the $256\text{ K} \times 256\text{ K}$ switching network composed of $64\text{ K} \times 64\text{ K}$ single-plane network, it can provide 250 000 digital trunk circuits.

ZXJ10 adopts hierarchical and distributed control architecture. Modular design methods are used in both hardware and software design. All key components, such as switching network, main processor, communication board (to process MTP-2 of SS7 signaling system, intra-modules and inter-modules communication), are all mutually backed up to work in Master/Slave mode. This ensures that the system is highly reliable. If the system fails, the watchdog automatically reboots the system within 40 seconds. Many advanced hardware design technologies such as FPGA, ASIC, DSP were deployed during its design to ensure high reliability. The design of ZXJ10 software architecture complies with the OSI reference model. Object-oriented philosophy is also deployed. All of these ensure stable and reliable



Figure 1. The ZXJ10 switching system.

It can route the traffic to different destinations according to three different periods of time and seven different days in a week through the rule of load-balance

running of the system.

The nominal lifetime of ZXJ10 is 20 years and the downtime is less than 3 minutes every year.

The ZXJ10 system has a strong processing ability of 216 000 Erl and 20 000 000 BHCA when employing P166 as the main processor. With 250 000 digital trunks working with a traffic load of 0.8 Erl, only 200 000 Erl is needed. When C333 or a higher speed CPU is adopted, higher processing capability will be possible. In ZXJ10, traffic load of digital trunk circuits can reach 0.95 Erl.

It should be noted here that ZXJ10 provides STM-1 electrical and optical trunk interfaces multiplexed of 63 E1/T1 and high-density digital trunk board MDT with 16E1 per board to lower the cost and increase the reliability of the system. To build tandem offices with the capacity of 10 000 digital trunk circuits with MDT, only one rack (0.5 square meters) is occupied and the power consumption is approximately 600 W. Furthermore, with the echo-canceling mechanism that is compatible with ITU-T G.165/G.168 recommendations, the ZXJ10 system can provide digital interfaces E1/T1 that are capable of long distance transmission or satellite relay.

2.2 Authentication and Interception

Authentication and interception are used to judge whether a subscriber has network access privileges. This practice is widely used in international gateways. International gateways must have adequate capacity to authenticate and intercept as many subscribers as required.

According to the A/B number, ZXJ10 can authenticate and intercept the area code, the office code, and the incoming/outgoing trunk circuits. Black/white lists with capacity of 1 500 000 subscriber numbers are also provided for authentication and interception.

2.3 Number Analysis and Routing Ability

Number analysis and routing are very important in an international gateway office. It should have the ability to analyze enough digits of the calling/called number to select the route. It should also have the ability to add, delete and translate several digits of the A/B number. Routing is also required according to

the incoming digital trunks, bearer services, the called number and the time of day to ensure balanced load is achieved in different routes and to avoid traffic congestion.

ZXJ10 has strong number analysis and processing abilities. It can analyze 40-digit A/B numbers and can add, delete and translate any digits from the subscriber number. It also can receive, store and forward 40-digit subscriber numbers.

ZXJ10 can select traffic routes according to the A/B number, the incoming trunks, the time of the day and so on. It can route the traffic to different destinations according to three different periods of time and seven different days in a week, through the rule of load-balance. It provides 12 routes, each with different priority (from the first route choice to the twelfth route choice) to a destination. The traffic can be transited to 65 535 different routes, and each route can be composed of all the physical digital trunk circuits in a single module, and there are more than 7 680 digital trunk circuits.

2.4 Signaling System

To become interconnected with their counterparts in other countries and national long-toll offices, international gateways must have the ability to provide multiple physical interfaces and signaling systems. The capability of supporting multiple SS7 signaling point codes and providing more than 4 096 digital trunks for a destination office is also necessary for international gateways. Other capabilities of the SS7 system including global title translation (GTT) ability and MSU processing ability are also crucial.

The ZXJ10 switching system can now provide many physical interfaces such as E1/T1/STM-1 and E&M. CAS signaling systems such as R1, R2, C5, 3-bit R2, R1.5, and China NO.1 and CCS7 signaling that are compatible with different national specifications are all provided. With regard to the CCS7 signaling system, ZXJ10 now can provide a number of CCS7 signaling systems including ANSI CCS7, ITU CCS7, China No.7, and Russian CCS7. All signaling systems incorporated in ZXJ10 are compliant with ITU-T latest recommendations. Integrated SSP functionality (PSTN, GSM, CDMA) specified by Q.12 xx is

also supported in ZXJ10 and can interconnect with the SCP system. If a signaling system is not available in the ZXJ10 system, it can be provided very quickly if the specification of the signaling system is provided.

The followings are important features of the ZXJ10 SS7 signaling system:

- Capacity of GT: more than 200 000
- GTT ability: 30 000 GTT/S
- Signaling links: 1280 links
- MSU ability: about 300 000 msu/s

ZXJ10 can work as the signaling end point (SEP), signaling transfer point (STP) and signaling transfer and end point (STEP) in the CCS7 network. When working as STEP/STP, it supports screening of the incoming link set, outgoing link set, DPC, OPC, SIO and the combination of the above factors. It also supports SCCP screening such as GT and DPC + SSN.

ZXJ10 can also provide 2 Mbit/s SS7 signaling links. The 2 Mbit/s-signaling link now has practical application in the Shanghai China Mobile short message system.

The ZXJ10 switching system has been successfully interconnected with EWSD, NEAX, S12, E10B, AXE10, 5ESS, DMS, F150 and other main switching equipments in the world.

ZXJ10 supports GSM MAP protocol and CDMA MAP protocol. It can work as GMSC of GSM and CDMA network to implement integrated addressing of mobile subscribers. It also integrates INAP, CAPII and WIN protocol to work as an integrated SSP for PSTN, GSM and CDMA network.

ZXJ10 is widely used as an integrated GM-

SC for GSM and CDMA network and integrated SSP for PSTN, GSM and CDMA for China Unicom, as shown in Figure 2.

2.5 Charging

Charging is an important factor in international gateway offices. Multiple charging methods, reliable storage methods, adequate capacity and real-time output interfaces to the billing center should be provided in order to meet the system requirements.

The ZXJ10 switching system can provide multiple charging methods. It can provide multiple-metering tables and detailed records for all incoming/outgoing digital trunks simultaneously. In the detailed record, the calling number, called number, calling category, start and end time of a call, bearer services category, terminal services (telephone, 2/3/4 fax, video telephone and so on) will all be recorded. Thirty-six 4-byte-long metering tables will be allocated for each trunk group. The tariff rate can be decided on the incoming trunk group, called number, the bearer service and so on. The tariff rates of a single call can vary within four different periods during the day.

ZXJ10 can provide enough information for both PSTN subscribers and mobile subscribers. For mobile subscribers it will record the calling or called subscriber HLR number, the roaming number and all the necessary information for a mobile call, which provide enough information for inter-network accounting of operators.

ZXJ10 provides accurate, reliable and large-capacity storage medium for billing in-

formation. The time of a recorded call will not deviate by more than 10 milliseconds from the correct time. It provides four-level storing mediums for billing data with reliability greater than 99.99%. With maximum capacity of 504 Giga bytes, the billing server can store enough billing data for any international gateway. The billing server can also be equipped with standby hard disk, tape,

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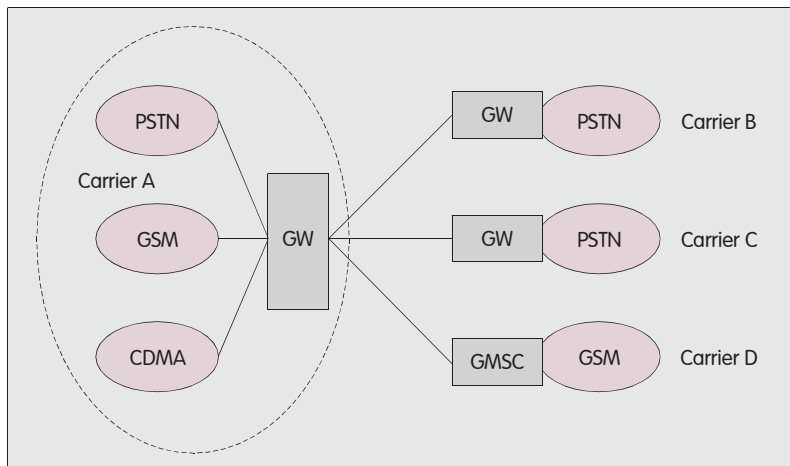


Figure 2. Diagram of integrated gateway offices with ZXJ10.

The traffic control system allows ZXJ10 to set a four-level control threshold regarding the CPU load, system resource occupation and BHCA.

CD, and MO to backup the billing data. In the case of the billing server being disconnected from the switching system, the main processor in the switching system will safely store the billing data on its hard disk in time (with a capacity of 2.5 Giga bytes) until the communication with billing server recovers.

The ZXJ10 system provides online and off-line charging methods and provides real-time output interface for the billing center. It can also provide FTAM/CMIS interface over the X.25, TCP/IP system to connect to the billing center.

2.6 Traffic Statistics and Traffic Control

International gateway offices have additional requirements on traffic statistics and traffic control system to provide clear knowledge about the system running status and ensure reliable running.

The ZXJ10 system provides multiple traffic statistics appropriate for international gateway offices. It can compile traffic statistics on incoming trunks, outgoing trunks, destination number, destination number in incoming trunks, destination number in outgoing trunks about call attempts times, trunk-seizure times, switching equipment congestion times, answering times, etc.

ZXJ10 can work as integrated gateway offices for PSTN, GSM and CDMA, so it performs the functions as SSP of PSTN, GSM and CDMA. It also collects traffic statistics on IN service, GSM services and CDMA services.

It can also record traffic statistics on authenticated and intercepted subscribers. With these statistics displayed on a screen in the form of diagrams or tables, a clear insight into the status of the international gateway offices can be gained and a further detailed analysis can be made to adapt to the existing telephone network.

The traffic control system allows ZXJ10 to set a four-level control threshold regarding the CPU load, system resource occupation and BHCA. Four-level warning with the four-level control threshold is presented to the system administrator of the switching system.

2.7 Synchronization

International gateways must have a clock sys-

tem with high accuracy and high reliability. It should also have the ability to accept different clock inputs and work in different synchronization modes.

The ZXJ10 clock system can provide multiple control clock input interfaces such as 8 kHz, 2 MHz (BITS) and 5 MHz.

The ZXJ10 clock system supports the following clock synchronizing mode: Master/Slave mode, mutually-synchronized mode and pseudo-synchronous mode. It can also work in free-running mode, holdover mode and locked mode.

3 Applications

The ZXJ10 switching system has had many practical applications in gateway offices. It allows interconnection between China Telecom, China Unicom and China Mobile. It has also served as international gateway offices in New York U.S.A, Hong Kong, Congo and Somali. The following examples illustrate the international applications of ZXJ10:

In 1998, the ZXJ10 system served in New York as an international gateway office. It provides R1 and ANSI SS7 signaling systems with about 5 000 T1 digital trunks circuits, interconnecting with Hong Kong and Yantai, China.

In Hong Kong ZXJ10 provides 64E1+81T1 to connect to Guangzhou China, USA and Singapore. CCS7/R2/PRI/IDA-M signaling system is used in this application.

In Congo ZXJ10 works as an international gateway office with a capacity of 400 E1 to connect to Belgium; R2 and CCS7 signaling systems are used in this application. **ZTE**

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Biographies

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