

## Research on key technologies and operation and maintenance of Shandong terrestrial network communication system

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**Key words:** Terrestrial network; GRE tunnel; Packaging technology; VPN technology; SDH special line; Efficient operation and maintenance;

**Abstract** The state land network project is China's "11th Five-Year" period included in the national high-tech industrial development project of the 12 major national science and technology infrastructure construction projects, this paper on the background of the state land network project and the significance of the project and the state land network communication system based on seismic network industry are briefly introduced, and explain in detail the technical scheme the virtual network system is built on the basis of the GRE tunnel, and to the application of the system, the key technology of VPN package. In this paper, several key technologies are studied in detail, and they are applied to the communication system of terrestrial network. Especially, the construction scheme of Shandong land network communication system is explained in detail. Combined with the author's practical experience, this paper summarizes the problems encountered in the operation and maintenance of the communication system of Shandong land network, and provides a reference for the later construction and operation of the land network.

### Project background

Mainland China tectonic environment monitoring network referred to as "lu state net", the project by the national development and reform commission (NDRC) in the "11th five-year plan" on the national major infrastructure construction projects of science and technology, and belongs to the national high and new technology industrial development projects. As the general responsible for the project by the China seismological bureau, the ministry of education, Chinese academy of sciences, China meteorological administration, the ministry of land and resources bureau of surveying and mapping, and ZongCan subsidiary construction. In after the completion of the project, our country has formed by the 260 base stations and 2000 continental tectonic environment monitoring network composed of regional station [2]. Project is the final request will be 260 benchmark station observation data, through the exclusive network platform in real-time transmission to the beijing-based China state lu network data center. The national earthquake industry data transmission task undertaken by China earthquake information network. The system consists of the national center in Beijing, more than 30 provinces, municipalities and autonomous regions in our country the provincial center and node of more than 300 seismic stations all over the country, and the communication network also includes a professional seismic data of satellite communication system [1], the system adopts the C band and Ku band, communication range can cover the and surrounding countries and regions in the country.

Shandong lu state using ground communication network base station, the ground communication system consists of the following main parts: channel planning, networking, security,

network security, network bandwidth monitoring such as key content. The whole network system, relying on network platform based on the industry to build virtual network system, if the earthquake information network with the state of lu network system in the overlapping part of a communication channel, the use of the existing industry network channel transmission, it can greatly reduce the cost of input to the system construction and operation [5], and can realize the request of long channel run independently.

## **Communication system design**

The system by setting up a firewall, hierarchical deployment details of the security policy, to ensure that the state of lu network into network independently, and the protection means of network center and node of each benchmark station, complete the independence and security of the system, at the same time guarantee with the existing seismic industry network and Internet to realize logical isolation.

### **Design thought**

In GNSS reference station and meet system under the condition of continuous gravity station data transmission, network system based on industry, the ground transmission way to realize various reference station and the lu state between center and the reference station network network connectivity to support a variety of professional services.

(1) In order to ensure the security of network and easy management, system management in the center of the office network under unified planning and construction; In order to avoid a single node fault causes the network interruption, to ensure smooth communication, should reduce transit node number and agency information network center to the site in accordance with the minimum number of nodes to achieve the channel access.

(2) To achieve ShengJu data center and the state of lu data sharing and exchange of network center, available ShengJu information network center and the state of lu SDH network center line. Similarly also available ShengJu data centre to data information and the entire province information node 2 m long SDH line, realize the GNSS reference station, continuous gravity station channel integration construction and sharing of [3].

(3) Using the China seismological bureau of industry network (VPN private network), realizes the communication line backup.

### **Design implementation**

According to the state of lu network project design requirements, the operation of the system to be independent as net, no exchange of visits between base station. Therefore, adopting the traditional mode of the GRE tunnel structures, a set of virtual network communication system, the implementation and industry network logic isolation.

(1) Land state network USES a class B network IPv4 network private address section, when the lu state network in access network equipment industry network industry network use special network IP address[3].

(2) ShengJu information network center distribution of three industry network IP address, used for VPN, IP telephone, monitoring server access; Base station USES a class B IP address, consisting of 28 subnet mask, 16 can assign IP addresses, all the disposable addresses.

(3) In the state of lu network center, ShengJu information network center and the reference station and equipped with a dedicated VPN equipment, use of certificate authentication, VPN equipment real-time online status and traffic statistics [3], at the same time also is attaining the unity of each datum station monitoring and various reference station and the state of lu one-stop point-to-point VPN network center docking.

## Transmission scheme

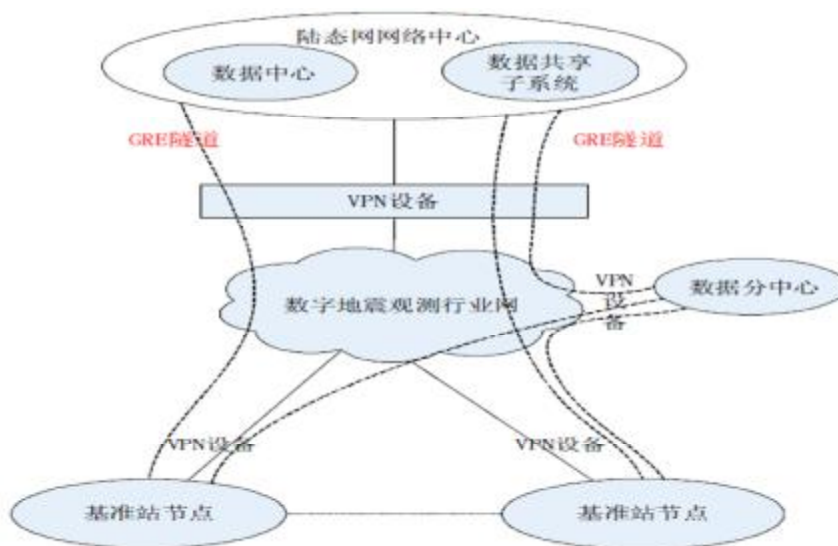


Figure 1 network base station channel access land State falls map

Lu tai communication network USES the GRE tunnel mode to realize the channel transmission, also accord with the earthquake industry network status of both the land state network communication system design requirements. Tunnel protocol to other data frames or package to encapsulate and then sent through the tunnel, the Internet channel transmission load data is encapsulated, because the new frame head can provide routing information. Use tunnel passing data (or load) can be a different protocol data frames or package, because the tunnel technology is a kind of through the use of the Internet infrastructure and transfer data between network mode of transmission. Encapsulation tunnel through the earthquake industry Network state lu channel transmission Network system of data information, realize the Network center and each benchmark station node in the system of one-stop point-to-point VPN connection (VPN (Virtual Private Network) is a Virtual Private Network. VPN can provide a high level of security protection, to prevent data theft and other unauthorized users contact with this data, you can use advanced encryption and identification protocol can prevent data snooping on [4].

Lu state ground network communication system by earthquake industry network channel virtual network across the country, the system and other systems are independent of each other operation, realize the isolation. Network node is in the center of the core layer and access layer, which is divided according to the function of the system and structure. National data center, the five data sharing subsystem formed network center, all the base station node belong to the access layer (1). System of data terminal equipment, is through the system - which is the benchmark station at the end of the node to access network lu state. The benchmark station according to the following two ways to access networks: one is the way to access seismic stations; 2 as a way to access earthquake industry area center; Base station node device adopts the RJ45 Ethernet interface mode connection [7]. Base station can be divided by function type and GNSS reference station and gravity datum station, to make it at the same time to realize the remote transmission of data and local storage backup functions, and also for improving the security of system redundancy and data (2), each base station equipped with storage module at the same time.

## Construction and operations

ShengJu data center and each base station node communication channel bandwidth is not less than 2 m, each reference station node communication channel can provide no less than 4 m breaking flow

ability. Data center unified integration construction is mainly composed of data exchange module, data management and processing module, data acquisition module, monitoring module and database management of Shared services and information release module platform, responsible for the GNSS reference station and the continuous gravity station database platform of management and storage and backup, in order to improve the efficiency and security of the data storage equipment, set up a data store for the professional services; Compressed storage and unified data management and data security backup.

### implementation plan

Located in the shandong province lu eight GNSS reference station in the network project and a continuous observation of gravity station by seismological bureau of shandong province is responsible for the communication system of the construction, operation and maintenance. According to the state of lu network project of shandong nine stations (including eight GNSS reference station and 1) gravitational observatory site of geographical distribution and the composition of our province "11th five-year plan" earthquake industry network, for each network node situation analysis, solution to its connection with central site can use two kinds of communication solutions.

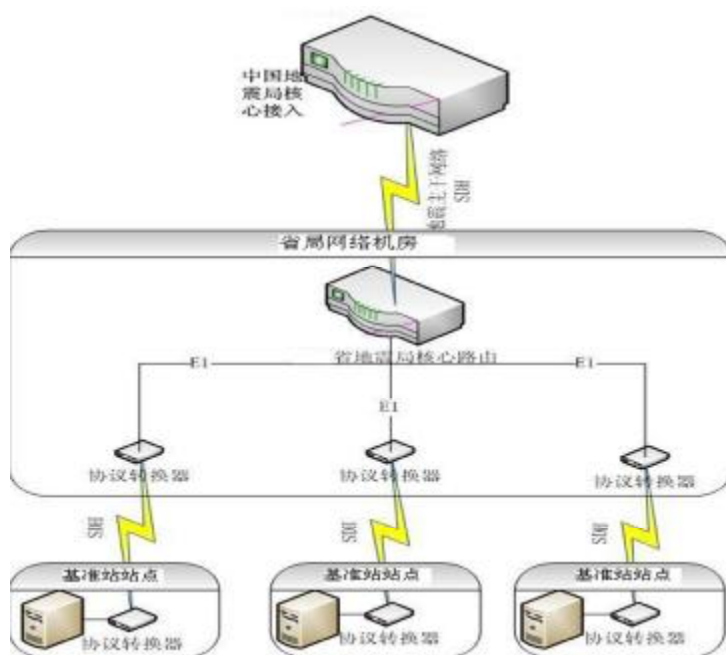


Figure2 data transmission scheme of GNSS reference station network design

SDH is a kind of high efficiency based on time division multiplexing synchronous digital communication technology, shandong nine stations adopt the rent SDH line connection ShengJu center site. Because the SDH has automatic routing selection ability, maintenance, control and management function is strong, unified standards, and convenient circuit, so it as a new generation of ideal transmission system, easier to transmit high rate of business, and can well meet the needs of the rapid development of communication network [6].

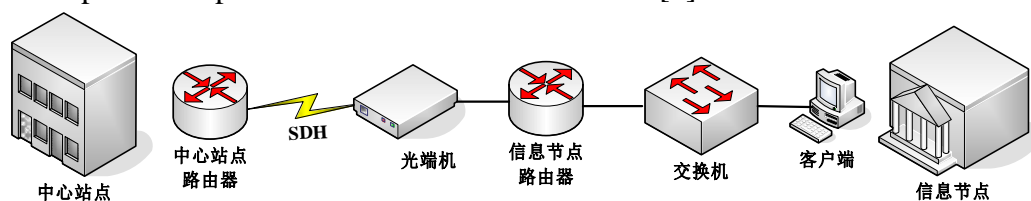


Figure3 SDH connection dedicated line access user map

Shandong nine with ShengJu industry web site is located city seismological bureau established industry dedicated channels, therefore, shandong 8 GNSS reference station and a gravity stations are permitted to use the ground of GNSS and gravity observation data transmission on the virtual private network. Eight GNSS reference station and a continuous gravity observation stations have four station is run by seismological bureau, the other five station is working with the ministries management. Overall, due to reasons such as management system and site conditions, managed by seismological bureau of site operations is significantly better than by the ministries and commissions outside management site.

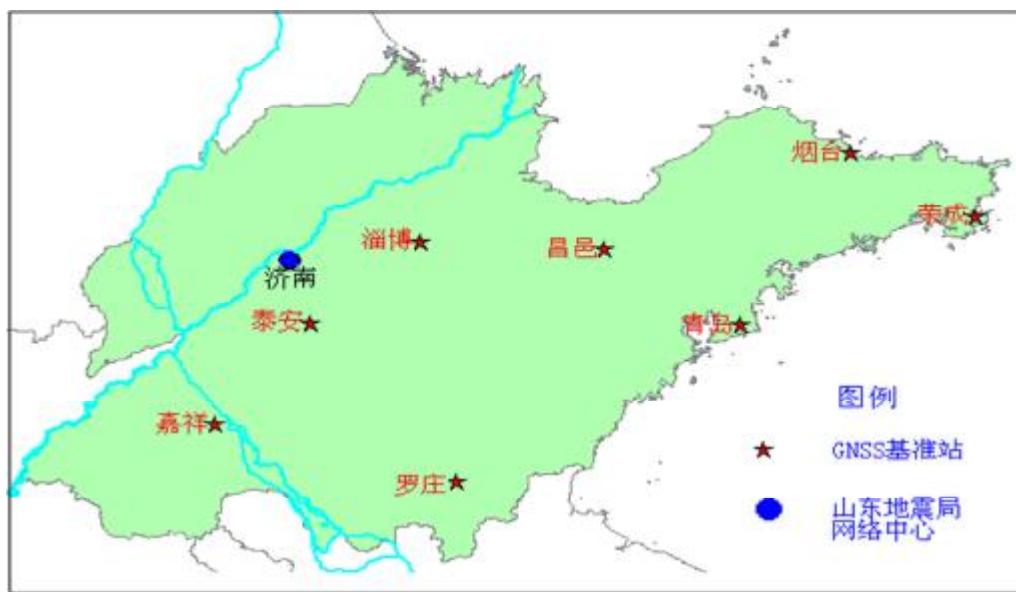


Figure 4 GNSS reference station distribution in shandong province

#### Line access seismostation of base station operations

Taian and RongChengTai jinghang canal, currently has 2 m SDH access ShengJu regional centers, and the GNSS reference station distance of the three places are three earthquake monitoring stations, so use by laying optical fiber network access stations to access the earthquake industry way that line access way of seismic stations.

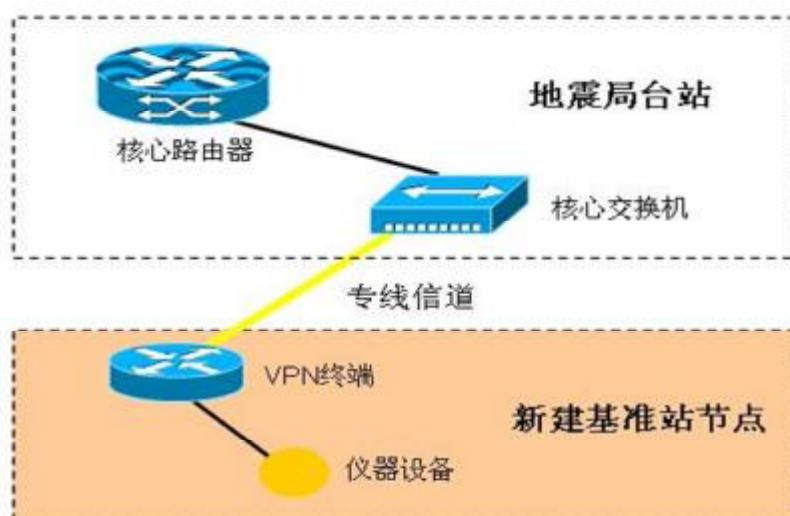


Figure 5 base stations through dedicated line access station design

The three stations due to the earthquake stations on itself, so the operational environment is good, unless there is a massive power failure or operator link failure, few interruptions, the annual average



network connectivity rate above 99%. So, the three stations should strive for a higher operating ratio in the future.

### 3.3 Earthquake area center access to the base station operations

Because nearbu, yantai, zibo, Luo Zhuang and without seismic station near Qingdao base station and gravity station, so only by using SDH network line access to their home city earthquake industry network regional center city node, and then into the provincial regional center.

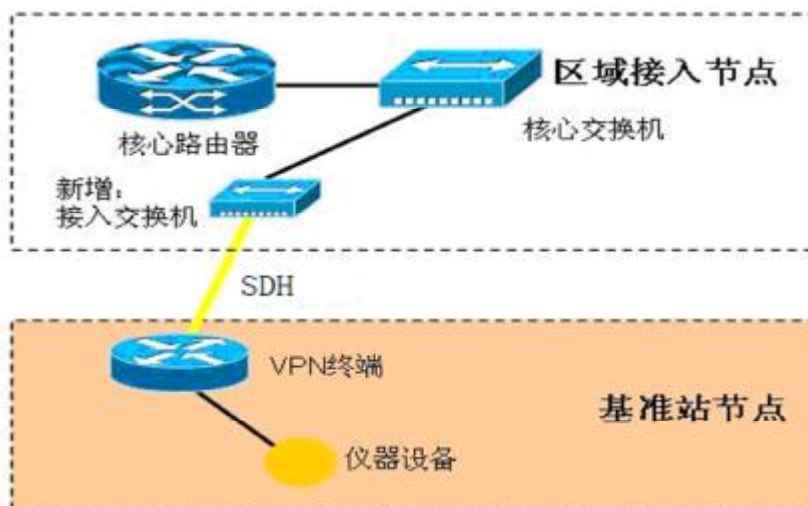


Figure 6 reference station access earthquake regional center

Nearbu, although is the site of seismological bureau management, construction site is not on station, but in the wild, so the number of interrupt significantly more than the other three sites, most of the interruption due to power outages, the annual average network connectivity rate can reach 98%. The remaining five managed by the ministries of site connected of the lowest rates (and the lowest in all nine site) is Qingdao GPS station and Qingdao gravity station, the two site is also the most bad treatment after failure. Mainly the following two reasons:

1. The two sites are managed by forces, every once in a while, head of the base station will be replaced, so after failure, not easy to contact, head and units in and out of the limited, gravity station in a remote mountainous area power supply security is far worse than the city.
2. Qingdao city subways have been more than three years time, there are other municipal construction caused by digging through cables phenomenon often appear, troubleshoot and repair of this kind of failure time is longer.

Zibo and Luo Zhuang also several interrupt occurred, being able to contact to the base station, so whether it's a power outage or operators fault caused by interruption can be processed in a timely manner. In all site operations is one of the best the yantai, reason can be summed up in the following two aspects:

1. Yantai seismological bureau network operating ratio is high, performance is good, in the province's 17 cities in 2013 made information science the data comparison "cities and counties in series" first.
2. Yantai site is located in the city bureau of meteorology, due to the similar nature of work units with our seismological bureau, from management to maintenance is more attention on the site, such as fault reasons such as power outages and operators can be processed in a timely manner.

## Conclusion

Seismological bureau of shandong province of shandong province nine stations (including 8 reference station and a gravity station) the communication system of construction, installation,

debugging. Due to the design and construction process are perfect, so all sites in the process of the communication system operations, does not appear larger technical problems. According to my years of state lu network communication system of operational experience, will now communication system common fault is summarized as the following.

1. the operator to causes such as internal network debugging link break;
2. municipal construction, caused by the fiber optic cable to dig into;
3. Optical transceiver or protocol converter from lightning, or the device itself quality problem caused by the unstable communication (data packet loss, delay too long).
4. A receiver or network storage devices such as causes of data receiving is not successful.

When the station attendant after receive a call from a communication failure, can follow the steps below to troubleshoot:

- (1) check the station power supply is normal, the equipment without electricity.
- (2) Such as power supply is normal check router indicator light is normal, do you have any red or orange light is flashing.
- (3) Check the router's Ethernet port (so) if there is a loose connection.
- (4) Check station (metro) room and optical transceiver at the ends of the base station or protocol converter with or without abnormal blinking, such as bright red or orange light (this can be as the basis of running business some troubleshooting).
- (5) If the above checks all without exception, shall file a declaration to the local unicom fault, with unicom technical personnel after some troubleshooting.

In operational process, technical problems are not difficult, more outstanding management problems, especially working with the ministries ops site. Lu state in network operations in the future, how to coordinate relations with outside the ministries and commissions, distinguish responsibility, establish a good contact current is an urgent need to consider to solve the problem.

## References

- [1] Liang Hui, 2008, On the construction of environmental monitoring network engineering in mainland China .J. Shanxi earthquake, 135 (3) :24–26.
- [2] He Anhua et al. 2007, Application of wireless network based on VPN technology in seismic precursor network .J. Geodesy and geodynamics, (27) 6:47 - 51.
- [3] Fu Rong guo et al. Mainland China tectonic environment monitoring network system design [J], jiangsu modern computer, 2014 preceding (top) : 36 – 40.
- [4] He Baohong.2012,IP virtual private network technology.M. Beijing: People's Posts and Telecommunications Press.
- [5] Wu Chen et al. 2012,The construction of the Shandong sub system for the construction of the network monitoring system for environmental monitoring in China .J. Geodesy and geodynamics, 32 (6): 138 – 140.
- [6] Wu Chen, 2013 The application of GPON optical fiber technology in Shandong seismic information network.J. Earthquake disaster prevention technology, 8 (1): 104 – 111.
- [7] Wu Chen et al. 2015 Research on the high availability of Shandong seismic data center .J. Computer application and research,32(12): 19 – 20.