Discussion on the Planning of Intelligent Bearer Network Construction for Wired Smart Cities (Postprint)

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Abstract

As living standards continuously improve with economic development, people have also set higher requirements for their living environment. Traditional networks can no longer meet the construction demands of smart cities. Therefore, an increasing number of people have begun to place higher demands on the construction and planning of wired smart city intelligent bearer networks. However, China faces numerous challenges and opportunities in the process of smart city construction. This paper conducts a comprehensive discussion on the construction planning of wired smart city intelligent bearer networks.

Full Text

Discussion on the Construction Planning of Wired Smart City Intelligent Bearer Networks

Abstract: As economic development continues to improve people's living standards, demands for better living environments have increased accordingly. Traditional networks can no longer meet the requirements of smart city construction, prompting growing demands for the development and planning of wired smart city intelligent bearer networks. However, China faces numerous challenges and opportunities in its smart city development process. This paper provides a comprehensive discussion on the construction planning of wired smart city intelligent bearer networks.

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A new wave of technological revolution is gradually developing toward intelligentization. Technologies including “big data,” “cloud computing,” and the “Internet of Things” are triggering an increasing wave of intelligence that profoundly transforms people’s lifestyles and production methods, constructing a promising vision of digital life. The concept of the “smart city” is becoming widely recognized, with governments and industry authorities at all levels actively promoting smart city planning initiatives.

1. Research Background

During urban development, many cities have firmly grasped the major development opportunities presented by the “Internet+” and “smart city” initiatives by fully utilizing industry development strategies, thereby playing a significant role in the development process. Only by comprehensively achieving transformation and upgrading based on the “smart city” foundation can informatization and intelligentization be fully integrated. By coordinating and sharing various information resources, cities can effectively enhance their development capabilities and public service levels. This paper primarily discusses the planning of wired smart city intelligent bearer network construction.

2. Overall Framework Overview

Currently, wired intelligent bearer networks in most cities primarily involve intelligent hubs in government, community, household, transportation, school, and other sectors, enabling effective universal access and ubiquitous network connectivity to ultimately achieve smart city development goals. The entire wired intelligent bearer network is guided by smart city implementation policies, effectively integrating IP architecture, SDN architectural concepts, broadband construction, converged facilities, and pervasive network infrastructure to provide high-bandwidth, low-latency, and reliable IP bearer services for smart cities. The overall network structure is based on a three-tier architecture of province, city, and county, enabling effective interconnection and interoperability with governments at all levels, the Internet, and operators during operation, thereby allowing collaborative networks to function better in high-bandwidth interconnected environments and providing unified services for more users.

[Figure 1: see original paper] Smart City Network Overall Deployment Architecture Diagram

3.1 Access Layer

The access layer plays a crucial role in the intelligent bearer network, primarily enabling effective integration with fiber access. Technologies dominated by WLAN and 4G allow users to complete access tasks anytime and anywhere, while effectively adjusting the capabilities of both wired and wireless access so that all users can experience consistent interface and process services. As the

first layer of the intelligent bearer network, the access layer primarily serves as a service window for users.

3.2 Backbone Layer

Following the completion of tasks by the access layer, the backbone layer continues to play an important role. It can better connect provincial, municipal, and county-level urban networks through large-capacity high-speed fiber networks, enabling the entire bearer network to function more effectively.

3.3 Platform Interconnection Layer

The platform interconnection layer can connect with smart city innovative cloud service platforms through dedicated lines, allowing better integration and functional performance between government information and surrounding systems. All systems can perform better under the enabling role of the platform interconnection layer.

3.4 Operations Support Module

The operations support module can simultaneously fulfill network resource management, network operation and maintenance management, security access control, user authentication, and a series of other functions during operation, maximizing the effectiveness of these capabilities.

4.1 Backbone Network Overview

The backbone network has always played a vital role in intelligent bearer networks. By combining ASON technology with OTN technology, a provincial-municipal-county trunk network can be constructed. The national upstream trunk lines and other operators' backbone networks connect to various urban area networks and access networks, effectively covering 13 cities across the province. Only by giving full attention to intelligent backbone network construction can the goals of high-capacity, high-security, and high-intelligentization be achieved.

The backbone data network primarily exists to construct logically clear IP data networks and urban area networks, effectively developing related services. Flat networking architectures can generally be adopted for more intelligent operations, thereby better constructing and developing provincial data networks. Flat structures enable greater capacity, fewer nodes, and more extensive network coverage in backbone networks. Intelligent operation modes can also provide differentiated services of various levels for more users.

The entire provincial trunk optical transmission network is based on OTN technology for network transmission. As shown in Figure 2 [Figure 2: see original paper], the network primarily consists of three rings: the north ring, south ring,

and urban ring. The C-band 80-wave system plays an important role in backbone network transmission. Currently, with continuous network integration, related services are being further promoted. The utilization rate of wavelength division multiplexing resources exceeds 80%, effectively covering 13 prefecture-level and county-level cities across the province. Figure 2 also demonstrates the extensive coverage of the backbone network.

[Figure 2: see original paper] Backbone Transmission Network Architecture Design Diagram

4.2.1 Construction of Transport Second Plane

As network integration accelerates, various smart city businesses continue to grow. However, current trunk resources within provincial and municipal networks will inevitably affect province-wide business development. Therefore, optimizing transport network construction using a transport second plane is particularly important.

4.2.2 Effective Optimization of Network Structure

Currently, most trunk transmission networks consist of ring network structures internally. Due to some unreasonable network structures, if multiple faults occur within ring network lines, they cannot be addressed promptly, creating numerous operational risks. If network structures can be effectively optimized at this point, business transmission and selection processes can become smoother, enhancing network disaster recovery and self-healing capabilities. This represents an important trend for future transport network security development.

4.2.3 Effective Optimization of Site Structure

In most trunk WDM transmission systems, the distance between sites is excessively large, causing significant loss during operation. Simply adopting optical-electrical-optical transmission methods would unnecessarily extend business activation cycles. Currently, the signal-to-noise ratio in many services is generally low, affecting overall system quality and stable operation. If existing site structures can be effectively optimized, the distance between sites can be shortened and transmission quality improved.

5. IoT Perception Network

The IoT perception network has always played an important role in smart cities and can be called the “peripheral nerve” of smart cities. While backbone networks play a very important role in smart city construction, the Internet of Things can utilize short-range communication technologies through devices including RFID components, infrared sensors, positioning systems, and other equipment to effectively exchange information within the Internet, ultimately

achieving intelligent positioning, intelligent identification, intelligent monitoring, and intelligent management.

Connectivity, perception, and application are the three major application elements in the IoT perception network. In practical operation, various sensors can be used to access the Internet, followed by data analysis and processing using cloud computing and big data information technologies. Figure 3 [Figure 3: see original paper] effectively displays the structure of the IoT perception network.

[Figure 3: see original paper] Main Architecture of IoT Perception Network

The IoT perception network primarily consists of two structural layers: First, broadband data networks, wireless local area networks, and industry dedicated line networks together constitute the network access layer, which can effectively transmit and exchange information collected by sensing terminals for better application in back-end systems. Second, electronic tags, cameras, smart home appliances, and other components together constitute the terminal intelligent perception layer, which then accesses the network access layer content through short-range communication terminals and other devices.

6. AAA Support System

A stable, efficient, and secure network AAA support system platform can be established first, using multiple access methods that better integrate with business terminals. The AAA support system lays a solid foundation for smart city construction.

The AAA support system can effectively unify devices, users, and services during operation, integrating more network devices. Various smart community services can be better combined and authenticated, enriching business operation packages and providing users with multiple choices. From a long-term development perspective, the AAA support system can effectively achieve centralized management across the entire province, ultimately enhancing the intelligent management capabilities within smart communities.

[Figure 4: see original paper] AAA Platform Architecture Diagram

The entire AAA platform architecture primarily consists of two structures: First, the system's basic core layer is mainly responsible for system operation, management, and maintenance, primarily consisting of log management, system role definition, system management, and other functions. Second, the business functions within AAA can comprehensively handle multiple services, effectively implementing functions including authentication and authorization, data collection, service provision, business management, and various other functions. The system can first effectively expand interfaces through the business function layer, then better expand various business functions. Currently, content in the business function layer—including smart communities, VPN services, content services, and dedicated line leasing services—can all perform better.

Conclusion

In summary, this paper first describes the concept and framework of the "wired smart city," then analyzes the backbone network, IoT perception network, and AAA support system. Cloud service platform operators and application aggregators can better leverage network advantages, making the entire network more secure and reliable. It is believed that in the future, intelligent bearer networks will play an increasingly important role in "smart city" construction, promoting comprehensive improvements in government services, public services, and various other services.

[1] Wang Zhengjun, Song Xuhong, Luo Jianghai. Smart City Application Construction Ideas Based on NGB [J]. Cable Television Technology, 2017(5): 139-145.
[2] Sun Jiaqi, Xu Xiaoliang. Smart City System Construction Based on Cable Television Networks [J]. Youth Journalist, 2016(5): 89-96.
[3] Zou Jiajia, Ma Yongjun. Connotation and Construction of Smart Cities [J]. Wireless Internet Technology, 2016(5): 139-145.

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Note: Figure translations are in progress. See original paper for figures.