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Design and Research of Urban Video Surveillance System

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Abstract

This paper aimed to design and realized Qiqihar urban video surveillance system and use advanced design solutions to improve the traditional city video surveillance system based on EPON technology. Hierarchical design was proposed and a detailed analysis of each design was given. The system not only has expanded capabilities in the structure, but also has integrated application capabilities in the business, including image transmission, remote monitoring, remote centralized digital image data storage, remote real-time on-demand playback (stored data image). The result shows that the system can completely solve the digitization of the monitoring system and the process of networking bottlenecks.

Keyword: *video surveillance, EPON, digitization, networking*

1. Introduction

The video surveillance system plays an increasingly important role in our daily life, it is widely used in national defense construction, traffic control, smart security, as well as government agencies, banks, warehouses and other real-time monitoring of sensitive places.There are all kinds of surveillance system in the Europe and south america [1-3]. Traditional video surveillance systems do not have the scalability. Although our realized the IP network from analog to digital transmission, the function of front-end device and management system was simple, it has been difficult to meet the monitoring network requirements of expanding scope and increasing complex functional. EPON [4-6] can currently provide symmetrical 1Gbps uplink and downlink bandwidth, and with the development of Ethernet technology can be upgraded to 10Gbps, it broke through bandwidth "bottleneck" of the access partand.We chose H3C as the main equipment in Qiqihar safe city construction,including data transmission, image coding/decoding,monitoring equipment control, data storage, systems management and other aspects,. Therefore, the entire project of the system architecture design was based on the H3C product. So as to be able to effectively improve the level of social security administration and completely solve the bottleneck problem in the digital, network process of the monitoring system, reaching the real goal of the domestic advanced level.

2. The Overall Design Scheme of the System

According to the incidence type of Qiqihar City Police 110 Alarm, we found that the incidence types of the Qiqihar main included rob, robbery, fraud, theft and robbery.Thereinto, robbery behavior and part of the fraud and theft occurred on the road. This requires the appropriate sets dynamic security monitoring points in multiple road.

The center of digital video surveillance system is Qiqihar Municipal Public Security Bureau,and included 3 public security subbureau and 40 police substation for a total of 278 cameras.

The project has a main control center, 2 sub-control center, 40 police substation monitoring center, two remote monitoring center (Long sha and Tie feng district government). The control center and connected to sub-control center using Gigabit fiber-optic lines. According to the principles of administrative jurisdiction and proximity, the road surface monitoring area connected to the control center or the main control center using EPON line. Police substation monitoring center using the EPON line connected to the respective sub-control center, the remote Ethernet center connected to the control center by optical fiber.

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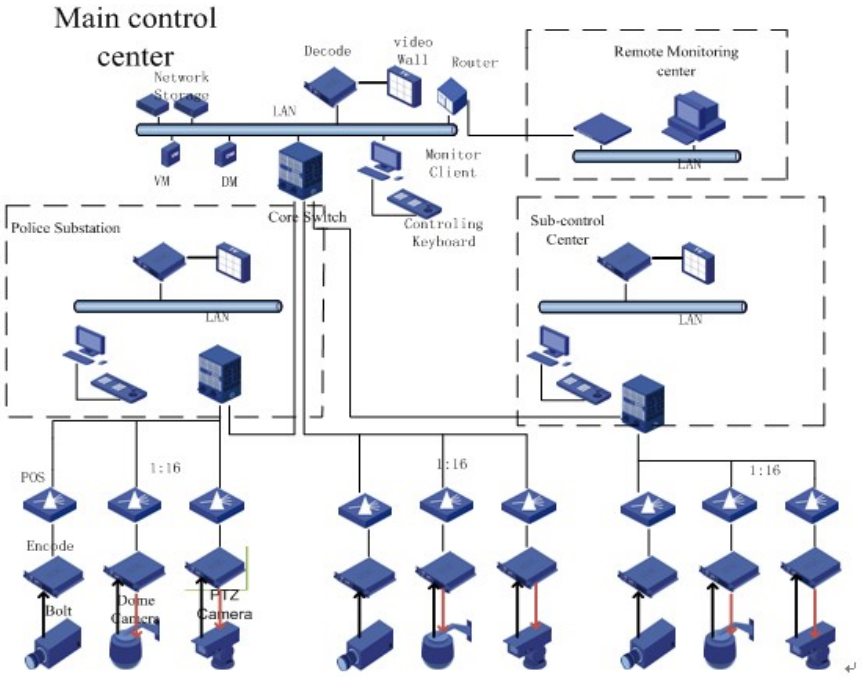

Figure 1. The Overall Network Topology of Video Monitor

Table 1. The Device of Main Control Center

device name	Equipment Type	Equipment number	remark
Switch	S7500	1	
IP-SAN Array	VX1500	2	7 Expansion enclosures
Video management server	VM3.0	1	
Data management server	DM3.0	1	
4-channel network video decoder	DC2004-FF	3	
Web Client		some	Need to install IE7 browser

H3C S7500 switch connected to the control center by a gigabit fiber optic lines, this H3C S7500 switches constitute the core switching network of main control center, and other control center equipment (VM8500, DM8500, VX1500, WEB customers end, DC2004-FF) connected to the core switch by Fast / Gigabit cable, the DC2004-FF connected to the TV wall monitor using coaxial cable at the same time.

Table 2. The Device of Remote Monitoring Center (city hall)

device name	Equipment Type	Equipment number	remark
Web Client		Some	Need to install IE7 browser

Web client to connect to the LAN switch, and then the switch connection to the control center routers via a 100 Mbps fiber.Routers connection to the network control center by 100 megabytes cable.

Table 3. The Device of Sub-control Center

device name	Equipment Type	Equipment number	remark
switch	S7500	1	
Decoder	DC2004-FF	3	
Web Client		some	Need to install IE7 browser

S7500 switches constitutes the aggregation switching network of sub-control center, the sub-control center equipment (WEB client the DC2004-FF) connected to the aggregation switches by Fast / Gigabit cable, DC2004-FF at the same time connected to the control center video wall monitors by coaxial the cable. S7500 switch connected to the S7500 switches of the main control center via Gigabit fiber link.

Table 4. The Device of Police Substation Monitoring Center

device name	Equipment Type	Equipment number	remark
ONU	ET254	1	
Web client		1	Need to install IE7 browser

ONU constitutes a the access switching network of the police station monitoring center, and other devices in the control center (the WEB client-side) connected to the access switch by fast cable, DC2004-FF connected to the police substation monitoring center monitor by coaxial cable. ONU connected to the S7500 switch of the respective sub-control center by EPON link.

The devices of road control area have a number of cameras (including bolt camera, pan-tilt cameras, dome), some EC1101-HF (video encoder), some EC1101-HF on the monitoring area of the road of the sub-control center connected to the S7500 convergence switch of the sub-control center by EPON link. Each camera connected to the EC1101-HF by the coaxial cable, the pan-tilt of the control line was connected to the RS485 interface EC1101-HF.

3. Subsystem

Qiqihar video surveillance system used H3C IVS IP intelligent monitoring system. According to the control and management, the system divided into monitoring access layer, carrying exchange layer, control management layer, video application layer.

3.1. Monitoring Access Layer

The front-end monitoring media terminal (EC1001) was responsible for analog image over the video source transmitted,and then conversion and coding into IP data streams over IP networks transmitted, supporting for UDP multicast data stream and storage iSCSI unicast data stream.

According to the actual situation in Qiqihar, a 24-hour monitoring image quality requirements under normal conditions 50 meters can identify facial characteristics.The mounting height of the camera should be more than 6 meters, upright tube or with the help of a light pole, should guarantee video image stabilization for 24-hour. Therefore, we have chosen the low-light cameras which can work in low illumination environment (such as dawn, dusk, dark, light), minimum illumination of 0.1-0.5Lux, supporting a wide temperature range (-40 to 55°C). The camera supports BNC video output interface.

Video encoder used the coding algorithm of MPEG2/MPEG4 which supported D1 resolution; encoder chip used ASIC or DSP chip which supported high stream. Video encoder control unit required to support ISCSI protocol, the device can be set to the destination address, which can support clock synchronization, remote management and other functions.

In addition, the front-end equipment work in the outdoor and the design of lightning protection installed power arrester at the entrance of the power cord; the entrance of video signal line and communication control line fitted on the signal arrester. The outdoor front-end equipment is properly grounded and the grounding resistance is less than 4Ω, high soil resistivity areas can be raised to<10Ω.

3.2. Carrying Exchange Layer

Headquarters control center have a high-end Ethernet switch S7500 and the high-end Ethernet switch S7500 as core switch of system, it can converge many video streams (or the police station upload video streams), the control center can watch the any sub-control center surveillance video signal, while in the case of authorized among the sub-control center also receives other video multicast streams. The S7500 is also responsible for the access video

management server VM, DM data management server and video decoder DC, DC is responsible for receiving multicast video streams and live view on the TV wall.

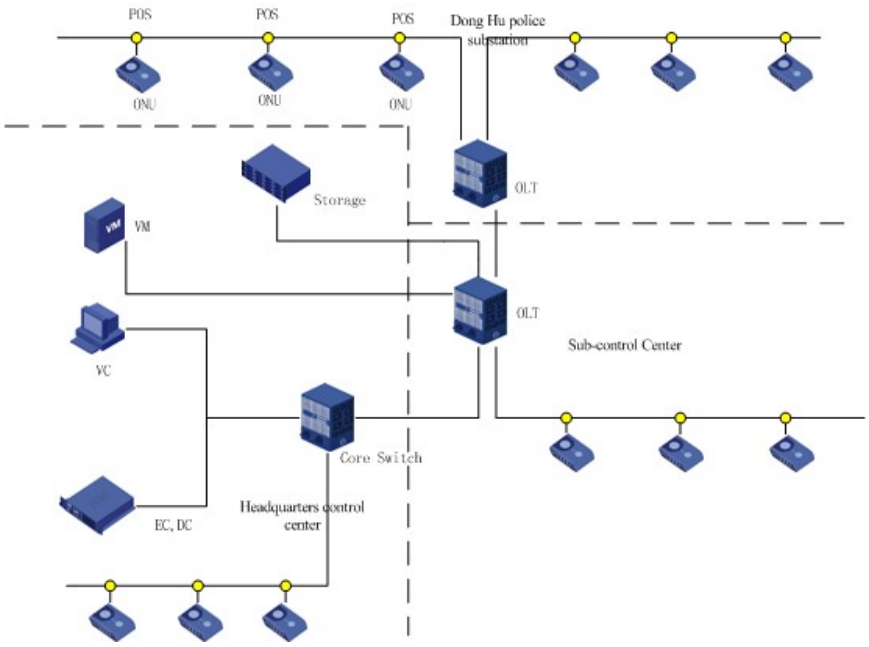

Figure 2. The Topology of System Network

High-end Ethernet switch S7500 Ethernet switch is placed in the sub-control center of the Jian hua subbureau and East Lake police substation. High-end Ethernet switch S7500 as the core switch of the system, it can converge within the jurisdiction of camera accessed, including EPON access.The module-SFP-GE-(RJ45) interface is responsible for accessing DC. DC is responsible for receiving multicast video streams and live view on the TV wall.

Main control center of the municipal public security bureau connected directly the sub-control center of East Lake police station and Jianhua subbureau by using Gigabit single-mode optical fiber.

3.3. Control Management Layer

The system management platform was constituted by the following unit:a video encoder (EC), the video management server (VM), the video data management server (DM), the video decoder (DC), video monitoring client (VC).

The solutions of security video surveillance system used NGN (Next Generation Communications Network) architecture, the separation mechanism of the video stream control and carrying exchange can achieve a variety of high-quality business of monitoring, including real-time monitoring, video information storage and historical video stream playback; the VM video management server is the center of signaling control and management of the entire system, a VM server can manage up to 1000 video source, all monitoring control stream processed by the VM video management server.

Data management server as the core of the storage system management, the storage resources of storage devices of distributed network can be unified managed for storage resource. it can flexibly achieve a variety of applications; the stream of real-time monitoring in system is distributed exchanging and processing through the IP network.

Real-time streaming have accidental and large convergence ratio, the distribution function of the real-time image stream through the layout of the MS8000 streaming distribution server to support large-scale monitoring, which reduce bottlenecks of the traditional project and delay of the image.

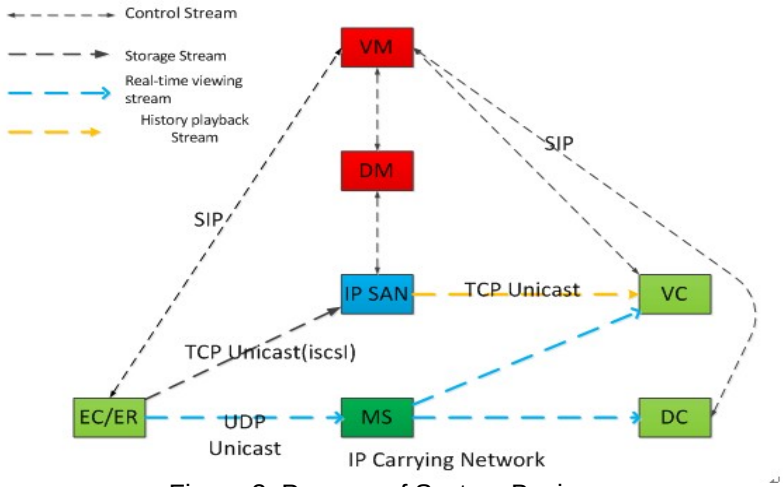

Figure 3. Process of System Business

Video storage stream file is written directly in IPSAN network storage devices. it give full play to the efficient, reliable and scalability of local storage and network storage, solving the bottleneck problem of the mass storage middle server.

Video management client and decoder access EC encoder by UDP unicast, introduced the corresponding monitoring scene of audio and video stream, so as to realize the function of real-time check different monitoring scenario.

The management server and the software of the video surveillance system includes: data management (DM), video management server (VM) and video management client (VC), and the interaction information of between them and the system terminal device by controlling stream exchanged.

3.4. Video Application Layer

The digital video surveillance system video image quality requirements legible, by comparing the CIF (352 × 288) images and D1 (720 × 576) resolution of the image, we can draw the conclusion that clear images must be saved using the D1 format.

Development of storage technology has gone through SCSI, FC, IP generations technical processes. In this project, we use IP network combined with centralized SAN storage mode operation to ensure network efficiency. IP SAN is a high-speed Ethernet-based SAN architecture, via iSCSI (Internet SCSI, Internet Small Computer System Interface) protocol to achieve store data between servers and storage devices in high-speed transmission. It inherited the IP network advantages of open, high performance, high reliability, easy to manage, scalable, self-adaptable, it realized performing storage networking and applications network seamless connection, it provided excellent remote data replication and tolerate disaster characteristics.

As extension of the storage period ,the latter video quality will improve, the number of cameras will increase and the storage capacity will be doubled, in addition, since the multi-camera monitoring real time data is written concurrently, it have higher requirements the bandwidth, sustained write performance and controller handles performance. The control performance of storage device and sustained read and write bandwidth is also required simultaneous improvement as capacity expansion in order to meet the needs of bandwidth and performance of the monitoring systems. The selection of equipment shall not have the bottleneck of internal bandwidth and performance.

According to the business needs of the storage subsystem, storage subsystem equipment selection is the IP mass storage device which based on multiple distributed controller architecture. Based on distributed switching architecture IP storage system can achieve nearly unlimited storage capacity that can be used to build thousands of TB-class data center in theory. With number of disk and storage capacity increasing too much, each unit increases in capacity expansion, while simultaneously increasing the distributed storage controllers. By increasing the number of controllers, to ensure the capacity expansion, storage system read

and write for bandwidth and the performance of read and write expand. Not only meet the increased number of cameras, but also meet storage system capacity expansion, bandwidth expansion, performance and capacity expansion requirements.

4. Based Business Implementation

4.1. Real-time Monitoring Image

To show a flexible and practical real-time monitoring function, the user can view multiple cameras filming scenes in multiple panes at the same time.

Figure 4. Real-time Monitoring

4.2. Video Playback

The database of video management server recorded the correspondence of device, channel, time and alarm with the physical location of storaged image, by the device, the number of channel and time (optional) or by the alarm information, the user can retrieve a recorded history image list, double-click to play. With the iSCSI protocol, IP-SAN readed from the history of recorded images, the recorded image was decoded and played out.

Figure 5. History Video Image

During Image playback, the decoder and the client only awarded the "read" permission, in order to prevent important video information being malicious or unintentional tampering.

In addition, the user can choose to pause, continue, specify times speed play, screen capture when video playing.

5. Conclusion

Qiqihar video surveillance system uses advanced design programs to solve video surveillance transmission traffic and bandwidth requirements based on EPON technology. The intelligent video surveillance system [7] can real-time dynamic control public order, and detect criminal phenomenon all day long. The system is able to integrate monitoring information stored within the network, in order to provide a favorable technical support for quickly finding criminal. The scalability of the system to ensure the future development needs 5-8 years.

Acknowledgements

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