

Video Surveillance in Power Substations

Harry Hsiao, Product Manager

Harry.Hsiao@moxa.com

Introduction

Power substations play a crucial role in delivering electricity to consumers by converting transmission voltage to the lower voltage used in homes and businesses. Since power plants are often located far from the population centers they serve, electricity needs to be transmitted across long distances at a higher voltage. Power lines deliver electricity from the plant to the power substations where it is converted before being distributed to the local community. It is therefore imperative that power substations are constantly monitored for safety and maintenance as they are often located near or in a populated area. This white paper explains the benefits of real-time video monitoring and IP video technology, as well as factors to consider in deploying an optimal IP video surveillance system for a power substation.

Video Surveillance Benefits

Since power substations are widely distributed and unmanned, remote monitoring is extremely crucial. Real-time video surveillance of power substations offers automatic monitoring and control capabilities in addition to enhancing remote monitoring applications with visual management. These capabilities not only save management costs for manpower, but also realize complete network automation.

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How to contact Moxa

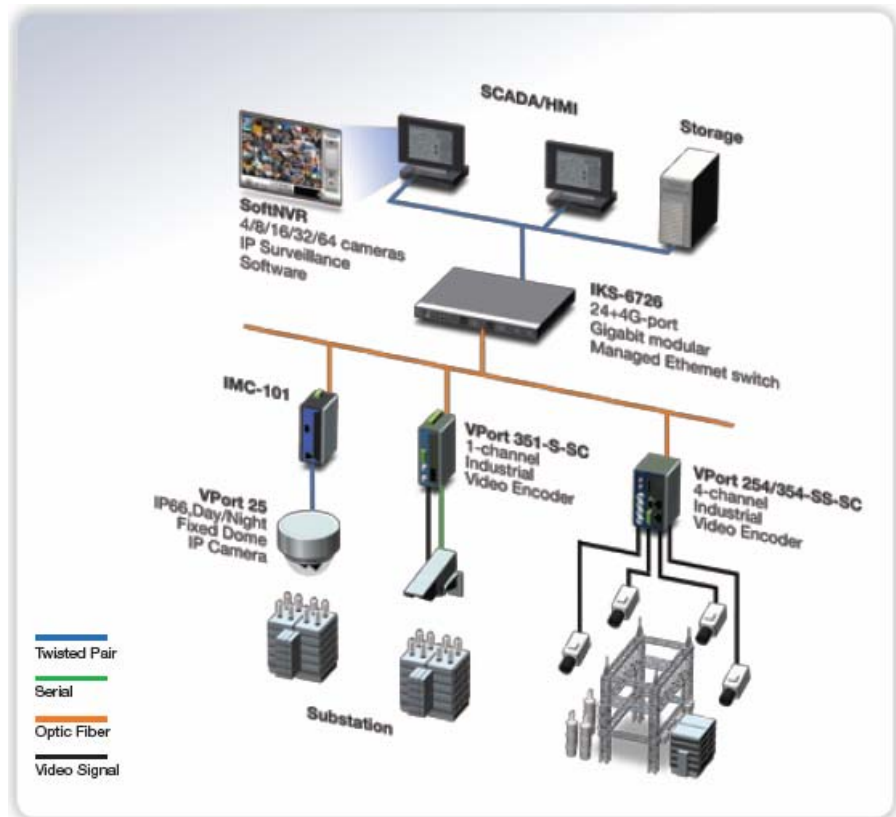
Tel: 1-714-528-6777
Fax: 1-714-528-6778
Web: www.moxa.com
Email: info@moxa.com



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Supervisory Control and Data Acquisition (SCADA) systems, which are already deployed in power substations to provide data about the system's status, can be easily integrated with video surveillance technology. By installing a real-time video monitoring system at power substations, system administrators are able to receive visual data to complement the raw SCADA data. Real-time video monitoring can help ensure normal operations for power equipment, protect against intrusion and tampering by unauthorized personnel, and prevent accidents. For example, intruders, physical obstructions, or smoke indicating a fire can be seen via video so engineers no longer need to visit the site in-person each time to diagnose an anomaly, saving both time and costs.

Remote video surveillance systems can play an important role in monitoring equipment, detecting intruders, and responding to emergency situations. For example, video surveillance can be used to monitor the appearance of the power transformer and relay, fueling and flammable equipment, and the status of the isolation switch. Video surveillance can also monitor the security situation inside and outside the substation by detecting intruders through sound and visual monitoring. In addition, video surveillance can be integrated with the alarm system and RTU (remote terminal unit) over a SCADA system to provide real-time visual information to prevent accidents and assist emergency response personnel in the event of a fire.



Why IP Video?

In the past, video surveillance systems such as CCTV networks relied upon analog video cameras. Due to advances in video digitization and compression technologies, high quality digital video images can now be sent over Ethernet TCP/IP networks. By using such devices, system integrators can easily integrate video surveillance applications into their SCADA system. As a result, Internet Protocol (IP) video technology is the current trend in video surveillance systems. The benefits of IP video surveillance include:

One Network—Using the existing IP network saves cabling costs and increases installation flexibility, especially for widely distributed substations. Ethernet TCP/IP networks can accommodate a variety of I/O monitoring and control devices in addition to transmitting data, video, voice, and even power (PoE) over a single network.

One System—Integration with SCADA or alarm systems (such as fire, intrusion, etc.) increases monitoring efficiency and creates an event-driven video surveillance system. This means the video images can be displayed and recorded and real-time responses can be received when an event or alarm occurs.

Constructing an Optimal IP Video Surveillance System

Given the critical role played by power substations in our daily lives, it is important for the IP video solution to be well-designed to ensure that the video surveillance system works properly. System integrators should consider factors such as applicability, reliability, integration, and user-friendliness in order to construct an optimal IP video surveillance system.

Applicability—System integrators need to consider video requirements such as image viewing, recording, and analysis, as well as interoperability with other systems (such as SCADA, Access Control, etc.) when deploying an IP video surveillance system. They also need to know how many cameras are required for the system and whether IP cameras or video encoders are suitable for the application. Network transmission factors such as bandwidth, multicast, and IGMP requirements, and whether the project requires a single network or separate networks for data and video are also important. Central management concerns, including system resources (PCs, servers, cost, etc.), software requirements (pure video or video integrated with another system), storage capability and database management, and whether or not a decoder is required, should also be considered.

Reliability—Since video monitoring is used to ensure safety and security in remote and disperse locations, reliability is a key factor in designing an optimal IP video surveillance system. Factors for reliability include surge protection and fiber transmission to reduce electromagnetic interference. Redundancy, high MTBF (mean time between failures) and IP protection are also important factors to consider for optimal

reliability.

Integration—System integrators should consider integrating video surveillance into the central management system, as well as other systems, including SCADA/HMI, remote monitoring, and access control. This not only reduces cabling and network installation costs, but also makes central management and control easier to handle for system administrators.

Interoperation with other devices for event-driven video monitoring is another benefit. For example, the system can begin recording video once a card reader or sensor is activated.

User-friendliness—IP video involves new applications and technologies that power system administrators need to learn. For this reason, it is recommended that system integrators choose ready-to-use hardware and software solutions to reduce the time needed to set up an IP video surveillance system. Not only does this simplify the system integrator's task, but it will also be easier for system administrators to learn and use.

VPort Solutions

Moxa's VPort industrial video networking solutions include video encoders and decoders, IP cameras, and IP video surveillance software designed for mission-critical video surveillance applications. Since most mission-critical application environments are demanding, the rugged design features of Moxa's VPort solutions are particularly suitable for these kinds of applications.

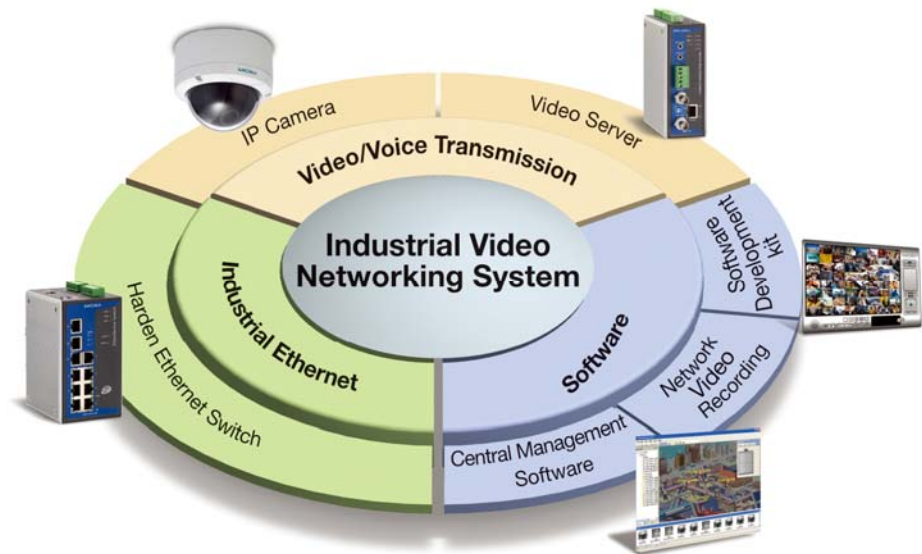
Video servers—Digital video images require large data files, so video compression (reducing the quantity of data used to represent video images) is required for transmission and storage. Video servers include encoders and decoders. Encoders are used to convert analog video images from cameras into an easy to transfer digital format such as MJPEG or MPEG4. Decoders are used to convert images from compressed formats (MJPEG or MPEG4) back into analog for

use with legacy monitors or displays.

IP cameras—IP cameras bypass the need for video encoders because the images are automatically encoded into a digital format (MJPEG or MPEG4) by the camera itself, and are easily transferred via Ethernet/Internet. Moxa's VPort series of IP camera offers a wide operating temperature range of -40 to 50°C without the need for a fan or heater, IP66-rating for rain and dust protection, one camera lens for both day and night use, up to 30 frames per second at 720 x 480 resolution, and direct-wired power input and PoE (power over Ethernet) for power redundancy. Moxa's industrial-grade video servers offer 12/24 VDC or 24 VAC redundant power inputs, DIN-Rail mounting and panel mounting accessories, IP30 protection, -40 to 75°C operating temperature range for T models, and RJ45 or fiber optic Ethernet ports.

Software—Moxa's SoftDVR Surveillance Software, which includes SoftDVR Lite (4-ch) and SoftDVR Pro (16-ch), is designed for IP-based video surveillance systems. The client/server-based network infrastructure makes it easy to build a user-friendly video surveillance system. SoftDVR offers multi-screen viewing, event-driven recording, easy to use search and playback, data storage to network hard disks, scheduling feature for recording and alarm activation, and remote access by web browser.

SDK—Most video surveillance systems require customized video management functions, or must be integrated with other applications such as SCADA, access control systems, and fire alarms. For this reason, a user-friendly SDK (software development kit) is a good tool to have available for building customized video management systems. Moxa's VPort SDK, which includes CGI Commands, ActiveX, and a C library, is available free of charge to system integrators and third-party software developers. Learning to use the Moxa VPort SDK is easy, and detailed documentation and sample code is provided for quick reference.



Summary

Transmitting video, voice, and data simultaneously over Ethernet/Internet is becoming a standard feature due to the ever-increasing popularity of IP networks. Versatile and advanced video digitizing and compression technologies, such as MJPEG and MPEG4, are also making it possible to migrate analog CCTV surveillance systems to IP-based platforms. Power substations play an instrumental role in delivering electricity from power plants to end-users, so managing and ensuring the safety and security of these installations through an optimal video surveillance system is imperative. Since power substations are unmanned and widely distributed installations, video surveillance grants system administrators visual management capabilities in addition to data management provided by existing central control systems that only provide raw quantitative data. The versatility of IP video technology and its ability to be integrated with existing central control systems make it an attractive option for remote video monitoring in power substation applications.

NOTE: Moxa provides a rich selection of remote video monitoring solutions for industrial applications. For details, check our website at www.moxa.com, or contact the author, Harry Hsiao, at harry.hsiao@moxa.com.

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