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Technology Infuses SCADA With Video

By Don Simoneau

NORWOOD, MA.–The oil and gas supply chain encompasses thousands of miles of assets spread across land and water. For many years, the task of monitoring wells, production platforms, gathering systems, refineries, terminals, pipelines and the varied facilities connected to them has been managed by field personnel and control room operators using supervisory control and data acquisition technology. Emerging technologies now are enabling operators to improve their operations by applying pervasive, but heretofore rarely integrated data: video.

Seeing, as the old saying goes, is believing, and the opportunities to provide better service, lower costs and higher security with video can be realized with relatively small capital expenditures. By integrating video with SCADA, operations are improved and past investments are leveraged.

Supervisory control relies on two forms of activity: continuous remote control and monitoring, in addition to centralized notification and handling of alarms and events. To support this, dedicated local-area networks (typically mid- and low-speed wireless) are employed that enable operators to access information over a geographically wide area. While emerging technologies (such as 801.11 WiFi and spread-spectrum radios) can deliver higher speeds, these systems are often limited by line-of-sight and cyber security issues.

A significant limitation is that SCADA systems can only control and respond to those items for which sensors have been installed. Even then, a sensor may act as a proxy for the actual "real-world" condition (for example, using pressure to determine the fluid level in a tank). Therefore, an emerging opportunity is to add actual video of the process area to supplement the interpretation of instrument readings and event messages. NASA's space shuttle, the most complex machine ever built, contains thousands of sensors in its sophisticated systems. Yet after the Challenger disaster, every flight now includes visual inspections through earth telescopes and in space to confirm the integrity and airworthiness of the spacecraft. Technologies now exist that enable long-range video inspection of field systems, even over existing network infrastructure.

An emerging and more significant need for the oil and gas supply chain is to provide security–methods for deterring, detecting and responding to outside threats. Certainly, video surveillance has been an important part of security systems used in local commercial applications in banks, casinos, business offices, department stores, etc. But the diverse deployment of assets, such as a producing oil and gas field spread across dozens of square miles or a pipeline system running hundreds of miles, poses a technical challenge in how to bring meaningful video back to a central station for threat detection and reaction.

FIGURE 1

Video of a Production Platform (with Intelligent Tracking of a Crane)

Unlike the heavily-wired "local" applications, the remote applications have limited access to high-speed or high-volume networks. While new networking technology can expand the bandwidth (size and speed) of this pipe, the demands of video transmission (especially for multiple remote locations) can quickly exceed the available bandwidth. Therefore, specific application software must address this limitation if adequate system expansion and performance is to be achieved.

The industry has recognized that integrating process, security and safety information across the supply chain is a necessary and effective method to reduce risk and improve operational performance. Only video verification of events provides the information needed to ensure the proper response to operational, safety or security-related alarms. Unfortunately, the available video solutions have, until now, presented a barrier to implementing this approach. New SCADA-integrated intelligent video technology provides a solution that removes those limitations.

Significant Opportunities

Faced with the rising cost of labor and a general manpower shortage, the oil and gas industry has a significant opportunity to contain its operating costs while maximizing its investment in SCADA systems by utilizing cameras rather than personnel for visual observation, alarms and verification. The potential productivity and cost savings of not having to dispatch personnel to sites that are difficult and costly to access can be significant.

For example, many manned platforms

in the Gulf of Mexico lack the staff with the expertise needed to solve difficult technical problems. For unmanned platforms, the challenge is compounded by the need to get personnel in place to do even rudimentary troubleshooting and service. In such cases, it may be possible to reduce unnecessary helicopter trips (which can cost tens of thousands of dollars round trip) by using video verification to record and transmit the necessary visual information to knowledge workers in expert centers. Figure 1 shows video of a production platform over a 38,000-bit Global System for Mobile communications (GSM) digital cellular network. The red box indicates the intelligent tracking of the moving crane.

FIGURE 2

Video of Armed Intruder at a Remote Facility

With the deployment of emergency shutdown systems (ESDs), oil and gas companies can shut down asset operations when sensors indicate a safety issue may be imminent. Video verification of such indications has the potential to eliminate unnecessary shutdowns and maximize system uptime performance. For plant personnel, the availability of portable plantwide visibility can enable remote diagnosis and resulting productivity increases. Some video is being used by personnel today to monitor flare stacks today. With intelligent SCADA-integrated video, reducing this human requirement is possible.

Real-time and historical video also provide a tremendous opportunity for enhanced safety. Prior to arriving at a site or entering a facility, an advance view can provide warning of a hazardous situation. When accidents do occur, historical video can support process forensics for improvement of processes and provide a permanent record of safety compliance or violation.

The security of the oil and gas supply chain following the 9-11 terrorist attacks has become a focus for industry associations and federal agencies. Copper and equipment theft and the associated disruption of operations also is a rising problem. Video surveillance has long been recognized as a cornerstone of physical security. The remoteness of assets such as wells, production platforms, refineries, terminals, pipelines, pump stations, compressor stations, gate stations and custody transfer points have presented challenges. Typically, these sites have no high-speed communications nearby.

TABLE 1

Benefits of Integrated Video

✔ Avoiding unnecessary shutdowns	✔ Advanced view of hazards before arrival
✔ Avoiding unnecessary trips to sites	✔ Process forensics following accidents
✔ Remote diagnosis of operational issues	✔ Root cause analysis of safety violations
✔ Optimizing uptime performance	✔ Tracking of trucks during loading/unloading
✔ "Expert centers" to manage more assets	✔ Flue stack monitoring
✔ Portable plant visibility	✔ Leak or oil spill detection
✔ Reduced staffing ratios	✔ Liability risk mitigation
✔ Reduced site inspections	✔ Security and theft prevention

The newest generation of SCADA-integrated intelligent video technology addresses this by utilizing the existing control network for security event and surveillance purposes. Figure 2 shows a perpetrator with a rifle at a remote facility captured on video. He was apprehended by police nine minutes after breaching this storage facility's perimeter fence.

Video also is an important mechanism for monitoring potential liability and indemnification situations. Companies have recognized the benefit of recording movement in areas that have a record of safety violations or employee injury. The ability to easily archive and retrieve information has the potential to head off expensive litigation actions or verify injury claims. By generating video clips and notifying first responders, operators can minimize or prevent problems before it is too late.

The oil and gas industry has made massive investments in instrumenting and automating processes. Integrating video into process management can be the next step to addressing existing and emerging problems. Table 1 identifies potential benefits of a SCADA-integrated intelligent video solution.

Breaking Down Barriers

Installing and managing traditional video surveillance systems presented significant cost barriers to many companies after completing vulnerability studies of their widespread enterprises. This has been caused by a number of factors, including the requirement for high-speed networks, specialized training to use additional systems, and significant effort to integrate multiple surveillance sites.

Traditional video systems stream video from cameras over a (typically high-speed, high-bandwidth) network to a monitor and storage device. Their design presumes that the network and associated components are always available. They also rely on personnel to monitor activities continuously in real time. When events occur, tedious searching of archived video is sometimes necessary. While advancements in intelligent video systems that identify events provide the promise of easier video management, the delivery of that video to the appropriate knowledge worker has remained difficult.

Traditional video surveillance solutions come with software and tools to enable viewing of video, but these systems are separate from the SCADA systems that operators use to make decisions. This means that plant operators need to pay attention to multiple display consoles and use very different methods of interaction for command entry and alarm acknowledgement. This can cause confusion, errors and increased operating costs.

In addition, the networks available at most remote sites were built for control and data transfer, not video. They are low bandwidth in capacity, encounter periodic loss of communications (e.g. satellite), and often speak network protocols that cannot support video files. Even cellular telephone networks are optimized for downloading (from the central to the remote), rather than uploading (from the remote to the central.) Therefore, applying video surveillance at remote sites for process management or security de-

mands particular attention to unique requirements of the application.

The principal purpose of SCADA systems is to control and monitor the operation of remote assets at disparate geographic locations. These systems were originally developed as an alternative for locating operating personnel at remote locations. With integrated intelligent video technology, SCADA real-time data monitoring and control information is combined with video monitoring and surveillance to create an integrated approach to asset management. The system provides proactive intelligent video to knowledge workers generated by alarms, stored video for historical review, and full-motion video on demand.

Low-Bandwidth Networks

Unlike stand-alone security systems that use closed-circuit or broadband networks for transmission, an integrated intelligent video system can utilize existing SCADA low-bandwidth communications networks to transmit video. Until now, installing video surveillance at remote facilities required new, separate and expensive communications networks to incorporate available technology. The technology utilized in integrated intelligent video was developed by a group of SCADA industry veterans determined to deliver video over existing communications networks and provide it in the same system they make decisions with today: the SCADA system. The resulting technology is being utilized at sites across the country to monitor remote assets in the utility, water and wastewater industries.

FIGURE 3

Surveillance System Components

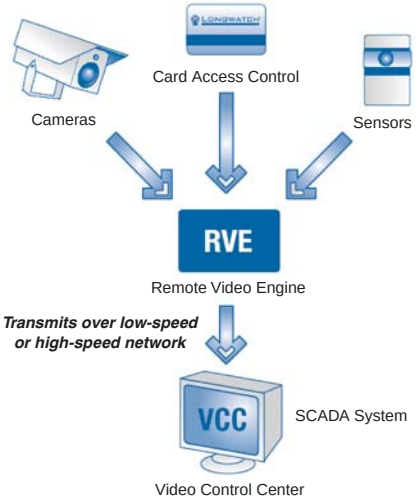
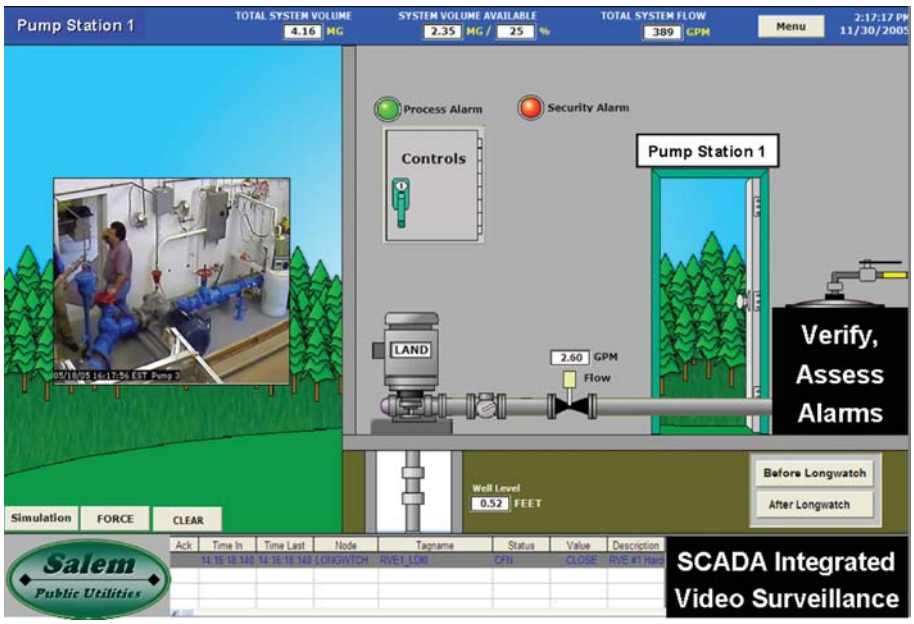


FIGURE 4

Integrated Card Access Control



The use of low-bandwidth networks as low as 2,400 baud is accomplished by fundamentally transforming video files into SCADA network-compliant data. This technology allows the system to operate effectively on networks from 2,400 baud data radios, to 19.2k phone lines, to 56k satellite networks, to high-speed mega-bit fiber connections. No matter the speed of the network used, this technology can improve the throughput and load handling. The system is designed to be communication network indifferent, and can also be deployed in mixed environments to allow for seamless migration to higher-speed networks as they become available. Simple SCADA integration is accomplished utilizing industry standard technologies that include Microsoft Active X and OPC.

The surveillance system is composed of both a hardware and a software component (Figure 3). The remote video engine (RVE) hardware component constantly records high-quality video from multiple cameras. It can be configured to transmit video event clips from remote sites to a central plant using the existing communications structure. Event clips are triggered by physical event triggers, such as proximity switches or motion detectors, process alarms generated by PLCs, or intelligent video analysis. It can also be configured to capture event clips at preset times without an electromechanical initiating device. The RVE communicates by emulating a programmable logic controller or remote terminal unit and appears to the SCADA system as another PLC on the network. The RVE supports protocols including Allen-Bradley, Modbus, Bristol Babcock, RS232/485 serial, TCP and UDP.

The video control center (VCC) is a software application designed to integrate with popular SCADA system human machine interface (HMI) packages. The VCC can reside on the same computer as the SCADA system, or as a separate stand-alone system. When the existing HMI is utilized, one system can be used to monitor and control the integrity of the whole system as operational and security information is integrated. Video images sent by the RVE are displayed in the SCADA system or as a Web page. The VCC also displays a number of useful tools such as an alarm summary display showing alarms and the associated video clips in an easy-to-use interactive display. The system is designed to allow the user to forward video clips to designated contacts by e-mail or as cell phone displays either automatically or on demand. This enables first responders, employees and others to determine if an event needs a response, and if so, how best to respond.

Card Access Control

The system also features integrated card access control. With the addition of card access control, operators can add an additional level of security at remote fa-

cilities without the installation of a new communications network (Figure 4). Operators may verify entry to card holders with video verification or record the entry and exit of personnel for future reference. They can also identify the last know locations of personnel.

SCADA-integrated video surveillance technology was designed specifically for monitoring remote locations found across the oil and gas industry. Sites may be on the periphery of a facility, hundreds of miles away at a compressor station, any point along a pipeline, or a thousand miles out to sea on a producing platform. Video verification can be applied to address any point in the supply chain. The technology is being used by facility operators as a security, process, safety and environmental monitoring tool. The value delivered in each case is an effective and economical solution for video surveillance of remote locations.

When evaluating the return on investment for video, many firms overlook the opportunity to reduce or even eliminate man-hours needed to physically go to a site to verify information related to process, safety or unwanted intrusions. In addition to manpower savings, the potential loss in revenue from process interruption must be considered, since incursions at remote locations may result in theft, vandalism or even sabotage.

Integrating video and SCADA over existing communication networks has opened a broad set of opportunities for oil and gas operators. The benefits of deploying the technology include better decision making because real-time and historical video can complement instrumentation readings, faster and more appropriate responses to alarms and events (including intrusions), reduced operating costs because needless field trips and false alarms are reduced or eliminated, and lower cost of ownership by using existing infrastructure and working seamlessly with existing operator interface and monitoring consoles. ❐

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Don Simoneau is president and chief executive officer of Norwood, Ma.-based Longwatch Inc., which provides intelligent SCADA-integrated video solutions for oil and gas applications. With 20 years of experience in high-tech enterprises, Simoneau has held senior and executive level positions in the SCADA industry, and is an expert in the application of video surveillance to solve both security and business problems. He has been called on at the local and national levels to address homeland security concerns regarding the protection of national infrastructure. Simoneau is a graduate of Boston College.