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Internet iSCADA *Comes of Age*

By Donald Wallace

Use of the Internet as the basis for an enterprise SCADA system has finally moved from promise to reality.

Many companies are considering using the Internet for supervisory control and data acquisition (SCADA) to provide access to real-time data display, alarming, trending, and reporting from remote equipment. Using the Internet makes it simple to use standard Web browsers for data presentation, thus eliminating the need for proprietary host software. It also eliminates the cost and complexity of long distance communications because each piece of remote equipment is connected to a local Internet Service Provider (ISP). However, actually achieving these benefits through the implementation of an Internet-SCADA project is fraught with problems that require the attention of experts in the field.

Implementation Problems

There are three significant problems to overcome when implementing an Internet-based SCADA system. The first is that most devices used to control remote equipment and processes, such as gas production wells and power transformers, do not have Internet communications capability already incorporated in their operating systems. In fact, many do not even have an electronic controller let alone an operating system. The second is that even when equipped through retrofit or in the factory with the necessary communications protocols, the device still has to be physically connected to the Internet. These problems must be solved at low cost and high reliability before Internet-based SCADA can be implemented in industrial applications. The third is assurance of data protection and access control.

Solutions

PC Solution

One solution to these problems is to connect the device to a PC and have the PC make the connection to the Internet via an Internet Service Provider (ISP), using Secure Socket Layer (SSL). Unfortunately, this solution does not meet the low cost criterion and lacks the level of reliability that is demanded by industrial users. PCs, after all, are designed around the concept of regular human interaction--the PC operator can be relied upon to reboot the machine if a crash occurs. The major benefit of Internet-based SCADA is that it allows the owner to interact with the device from a remote location; so even if the cost was acceptable, pressing a reset button never will be.

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Embedded Solution

The only appropriate alternative to using a PC is an embedded solution: a small, rugged, low cost device that provides the connectivity capabilities of the PC but at a lower cost and higher reliability. This device (sometimes referred to as an Internet Gateway) is connected to the equipment via a serial port, communicates with the equipment in the equipment's native protocol, and converts the data to HTML or XML format. The Gateway has an IP address and supports all or at least parts of the TCP/IP stack--typically at least HTTP, TCP/IP, UDP, and PPP. Once connected to the Internet, the Gateway responds to an HTTP request with an HTML or XML file, just as if it were any PC server on the World Wide Web.

In cases where the equipment incorporates an electronic controller, it may be possible to simply add the web-enabled functionality into the existing micro-controller.

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It is possible to web-enable any piece of equipment today using either of these approaches; however, the physical connection to the Internet is still a problem. Many potential applications may not have the value to justify an individual ISP account, so it is often necessary to create a low cost Gateway network in order to share the ISP subscription cost among several pieces of equipment. The Gateway, with its embedded proxy server, controls these wired and wireless networks, supporting dynamic IP addressing (Dynamic Host Configuration Protocol or DHCP) and providing non-routable IP addressing to the connected equipment.

Security

The open nature of the Internet requires careful consideration of data security measures when implementing Internet-based SCADA systems. Processes, procedures, and tools must be put in place to address availability, integrity, confidentiality, and protection against unauthorized users.

Availability: System up time must be maintained at the highest levels through use of redundant servers. Firewall protection must be provided in the Gateway and servers along with automated monitoring to detect DNS attacks.

Integrity: System must ensure data is not modified or corrupted through use of encrypted data signatures, authentication to restrict access, etc.

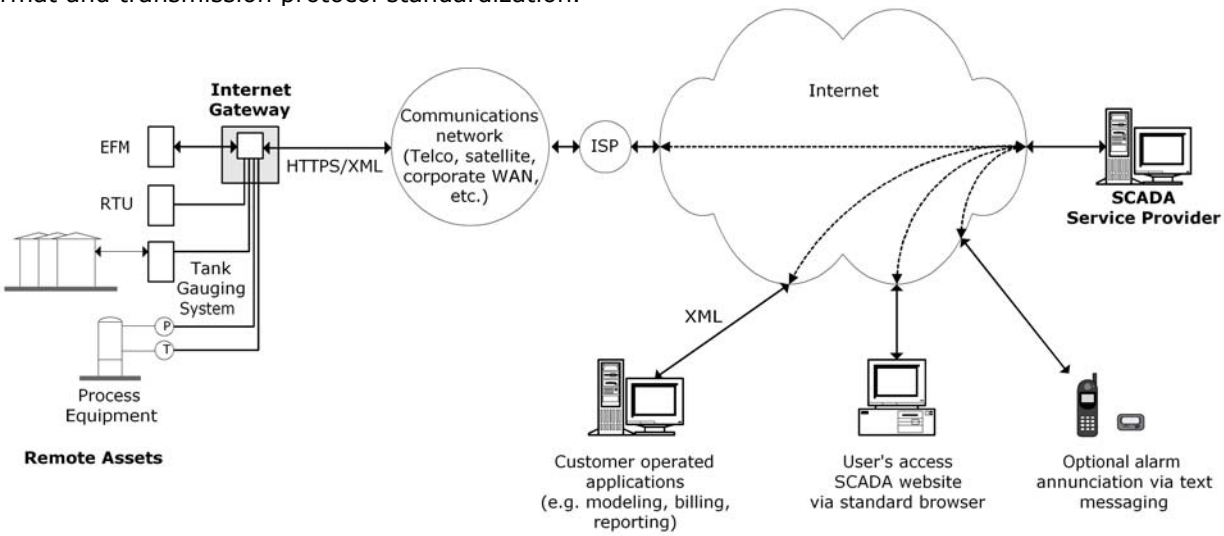
Confidentiality: System must ensure restricted access to data through use of encryption, and to the system by employing authentication such as Secure Socket Layer.

Protection against unauthorized users: Multi-layered password protection must be provided at all levels in the system.

Other Issues

Integration and Interoperability

The open architecture of an Internet-based SCADA system combined with appropriate field equipment makes it possible to develop an integrated SCADA system. However, interoperability requires data format and transmission protocol standardization.



Scaling an Internet-based SCADA system from a few to thousands of assets, while marinating near real-time performance.

The preferred data format is Extensible Markup Language (XML). XML was developed to bring greater flexibility and interoperability to web applications. It is a meta-language for describing markup languages and therefore does not specify semantics or a tag set. In other words, XML provides a facility to define tags and structure. XML provides flexibility not available from HTML because the programmer has the freedom to create tag sets and semantics. The simpler alternative markup language, HTML, has undergone continuous development to support new tags and style sheets. However, these changes are limited by the requirement to be backwards compatible and to what the browser vendors are willing to support.

The preferred data transmission protocol is HTTP (or HTTPS when security is required) because it is firewall friendly and allows web servers to be used to control data transmission. The alternatives, TCP/IP or UDP, require the cooperation of the customer's IT department to open ports on servers and thereby introduce potential for cyber attack.

Scalability

Scaling an Internet-based SCADA system from a few to thousands of assets while maintaining near real-time performance, requires a system architecture that enables data to be pushed from the remote equipment without host system polls. This approach has been implemented in systems supporting simultaneous 20-second updates from 3000 devices.

Data Presentation

As the acronym implies, the purpose of a SCADA system is to allow asset owners and operators to monitor and control remote assets, therefore the presentation of data is a critical component of any SCADA system. The use of Internet protocols and services to collect data makes it simple to use standard web browsers for data presentation.

The technology chosen for development of the web page user interface (UI) must support development of sites that are highly dynamic, incorporate animation, and provide a high level of usability. Standard web page technologies such as HTML, JavaScript, and Macromedia FLASH are ideal for the development of SCADA presentation pages.

Implementation Options

Implementation of an Internet-based SCADA system is a complex project that may be handled in one of three different ways: owner may purchase components and either act as integrator or hire one; contract for a turnkey SCADA installation; or contract for turnkey subscription-based SCADA services.
Experience indicates that complex SCADA projects are generally best handled by a single vendor acting as system architect with responsibility for the total solution.

The use of Internet-based SCADA systems to monitor and control gas production wells has been proven to improve production and lower maintenance costs.

An important alternative to this traditional approach is to simply contract for SCADA services on a subscription basis. For a monthly fee some vendors design the system, install field hardware if necessary, operate secure servers to host the data, and provide customers access to their data via a standard web browser.

A Simple Example

The use of Internet-based SCADA systems to monitor and control gas production wells has been proven to improve production and lower maintenance costs. For example, a field operator installed proprietary gas flow computers at nine wells to record flow data and store it for collection once every twenty minutes via a SCADA subscription service.

The operator estimated that operational efficiencies achieved through use of the SCADA service resulted in production increases of 7% per year. The subscription service fee was $25 per month per well for a period of 36 months and the cost of field automation equipment was $30,000. Using a discount rate of 10% and $1.50 per mcf gas price, the project RoI was calculated to be in excess of 500%.

Conclusion

Internet-based, secure, real-time SCADA is now a reality and offers many benefits:

- Provides corporate-wide solution that integrates new and legacy SCADA equipment
  - Flexibility: choose equipment and systems based on price/performance rather than compatibility with installed base
- Scales quickly from a few sites to thousands
  - Single solution is suitable for both local and enterprise-wide applications
- Subscription service contract option available
  - Reduces SCADA project risk – customer pays only upon commencement of service
  - No capital investment is required

About the author

Donald Wallace, a graduate of the University of East London, is a Professional Member of the British Computer Society (www.bcs.org). He is a past Director of the HART Foundation (www.hartcomm.org), an industry group formed to standardize sensor data communications, and he holds two patents for wide area telemetry (SCADA). He has over 30 years experience in the design, marketing, and sale of complex systems for industrial automation and data communications applications. He is currently Chief Operating Officer of ***M2M Data Corporation*** *(www.m2mdatacorp.com), a Denver, Colorado company specializing in the provision of Internet-based SCADA services in oil and gas, power, and government markets.*