LonWorks over the Internet: Technical Issues and Applications

David Gaw, President
Coactive Aesthetics, Inc.
Sausalito, CA
(415) 289-1722
(15) 289-1320 (FAX)
dgaw@coactive.com
http:\\www.coactive.com

Abstract

The growing ubiquity of the Internet and corporate Intranets makes it an attractive connectivity option for a variety of LonWorks applications which involve remote monitoring or control of any type. Using Internet/Intranet communications can avoid long-distance charges, increase the flexibility, and lower the cost of installing large, distributed monitoring and control systems.

Recent developments in business networking and device network connectivity make such use of the Internet possible. These developments include device, operating system, and network infrastructure support for LAN to LAN connections and LonWorks/IP Servers. LAN to LAN connections allow two or more geographically separate LANs to transparently appear to applications as a single "virtual" LAN. Business applications for these capabilities include linking the LANs of multiple offices of a corporation, and providing network access for telecommuters. LonWorks/IP Servers provide seamless connectivity between LonWorks networks the Internet/Intranet.

This paper details how these new technologies can be leveraged to create Virtual Device Networks (VDNs) that link device networks across the enterprise or across the world. Specific architectural solutions and technical issues for connecting LonWorks across the Internet are presented.

1.0 The Problem - How to Leverage the Internet for Distributed Monitoring

Business networks and device networks are very different. Control and monitoring applications have many requirements that differ greatly from those of business applications. Device network protocols such as LonTalk exist because of these very differences. There are also some common requirements between control and business applications, for example security, reliability, and flexible wide-area and remote access. The business networking solutions are addressing these requirements in a complete and expanding manner. Device network developers can take advantage of these capabilities by properly interconnecting the device network with business network components.

The ubiquity and cost structure of the Internet makes it an attractive option for implementing wide-area, distributed monitoring systems. Using the Internet can avoid long-distance charges and provide a more uniform, reliable platform for delivering a wide range of remote monitoring functionalities.

Applications increasingly include the requirement that access to the device network

information be provided from several locations or indeed anywhere in the enterprise. Internet access is increasingly available and affordable, and along with the "Intranet" is the backbone of modern enterprise computing. There are a wide range of types of service available ranging from simple low-cost, low-performance dialup connections to full-time, high-speed dedicated lines. These connection options can be mixed-and-matched within a single application to provide Internet connectivity to each remote location.

LonWorks is increasingly used as a data collection and control network for remote sites. It provides networked intelligent I/O and controllers which make it a powerful, expandable solution that replaces many hardwired PLC or RTU solutions. Connecting these remote LonWorks networks to the Internet can provide a powerful, integrated, distributed monitoring system.

2.0 The Solution - Transparent LonWorks/IP Connectivity

It is now clear that IP (family of Internet Protocols including TCP/IP), is *the* integrating network for the enterprise. This makes it the obvious choice for integrating (remote) device networks with business networks via the Internet. By basing LonWorks connectivity solutions on IP, the Internet can be directly used for remote monitoring applications. This approach also allows seamless integration of remote parts of a system with local enterprise subsystems via the enterprise LAN. Depending on the applications scenario there are several ways to leverage the Internet infrastructure.

By connecting LonWorks via IP multiple sites can be simply integrated into a seamless "Virtual Device Network" (VDN). The VDN includes one or more remote sites connected with one or more monitoring/control applications located on the Internet. The use of IP also allows leveraging standard tools and components such as IP routers and dialer software. IP is supported on all wide-area connectivity media and integrates seamlessly with telecommunications services.

An additional reason that IP is the clear choice for creating a remote monitoring system is organizational infrastructure and knowledge-base. Most organizations have an Information Systems (IS) staff in place that can help in setting up and managing the connections for the monitored sites. While this increases the burden on the IS staff, it leverages the infrastructure in place thereby providing savings over creating complex, expensive, proprietary solutions for remote monitoring.

3.0 The LonTalk/IP Server Device

The general architecture of a VDN is shown in Figure 1. The key component to this architecture is the LonTalk/IP Server device. This device provides both the physical and logical connection between the IP network and the LonTalk network at each site. The basic functional components of this device are described below.

- **LonTalk Network Interface** - provides the physical transceiver interface and protocol execution for the device network (LonWorks) at the remote site.

Figure 1. Basic Architecture of Internet-based Monitoring System
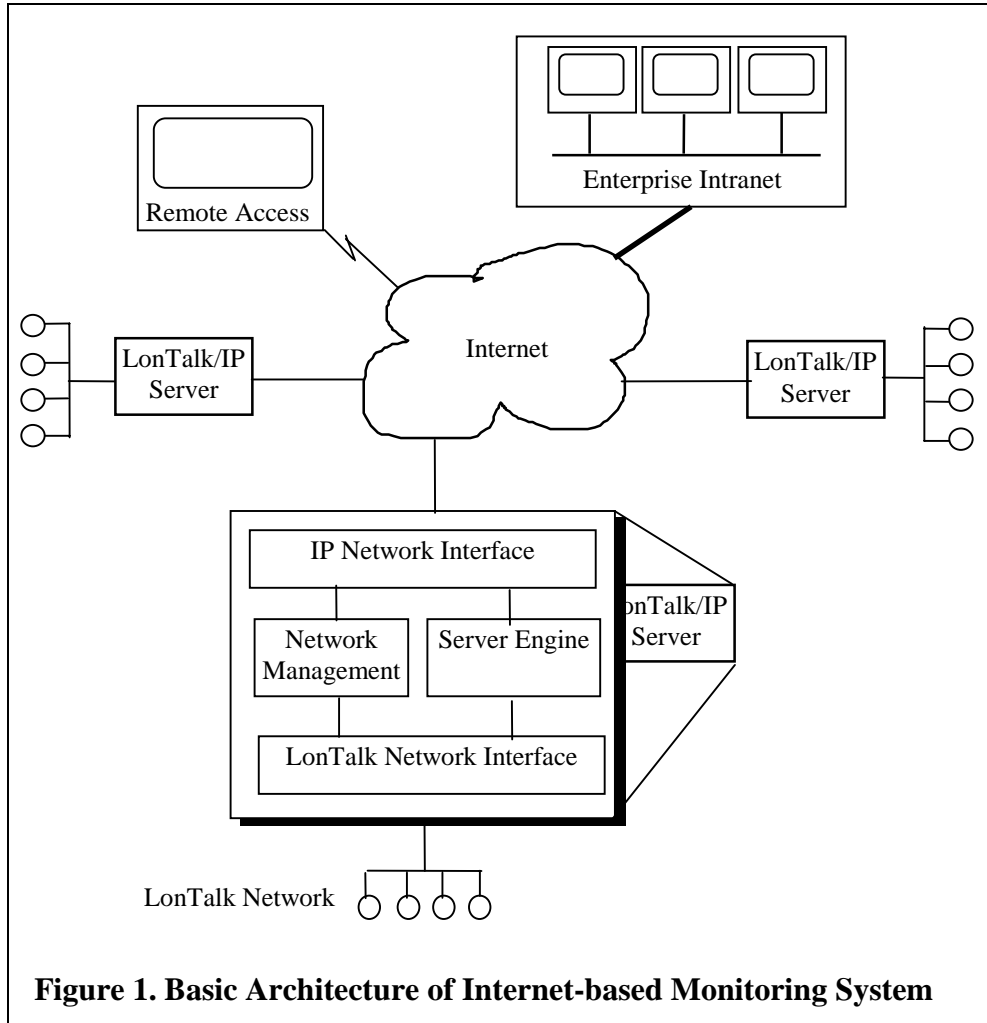
- **IP Network Interface** - provides physical connection and low-level protocol services for the IP network. This could be either Ethernet with TCP/IP stack or serial port + modem using PPP.

- **LonTalk to IP Server Engine** - this component provides the actual translation or routing of LonTalk to the IP network. It includes necessary logic to talk to all other LonTalk/IP router devices and clients in the system.

- **Network Management Services** - this includes management of the routing device including IP and LonTalk connections.

There are several classes of available types of LonTalk/IP Server Engines. Which type is required depends on the overall system design. In it's simplest form, this engine provides direct, transparent routing of the LonTalk protocol to the other LonTalk/IP Servers in the system. Enterprise applications which access these types of LonTalk/IP Servers must understand LonWorks. This sort of device operates like a traditional network router.

Alternatively, the LonTalk/IP Servers can provide protocol translation services and operate more like a "gateway". A gateway must be configured to define a mapping between data on the LonTalk network and data on the IP network interface. These types of servers can then provide the remote data in more standardized formats for use by a broader class of programs.

4.0 Technical Issues

4.1 Integrating with the Enterprise
In many LonWorks applications the enterprise already has an existing LAN/WAN solution. Integrating LonWorks sub-nets with the existing LAN/WAN infrastructure is fairly straightforward. Typically, the LonTalk/IP Server device is an IP device on the LAN. It must be integrated with the LAN in the same way as any networked workstation would be. This includes allocating an IP address and addressing such issues as firewall visibility, physical network media, and bandwidth allocation. If the enterprise supports a WAN connection to link other offices or locations, those locations will be able to access the device networks directly via the VDN.

4.2 Supporting Remote Sites
For remote monitoring applications there is often no existing LAN infrastructure in place. For these applications it is still possible to create the VDN. One technique is to use local access points to the Internet via commercial Internet Service Providers (ISPs) along with LAN to LAN or Remote Access Server (RAS) technologies (see Figure 2). The remote site becomes a "mini" LAN (possibly with a single device - the LonTalk/IP Server) which gets connected into the business LAN/WAN via the Internet. Some LonTalk/IP Server devices may support a direct dialup PPP connection to the ISP.
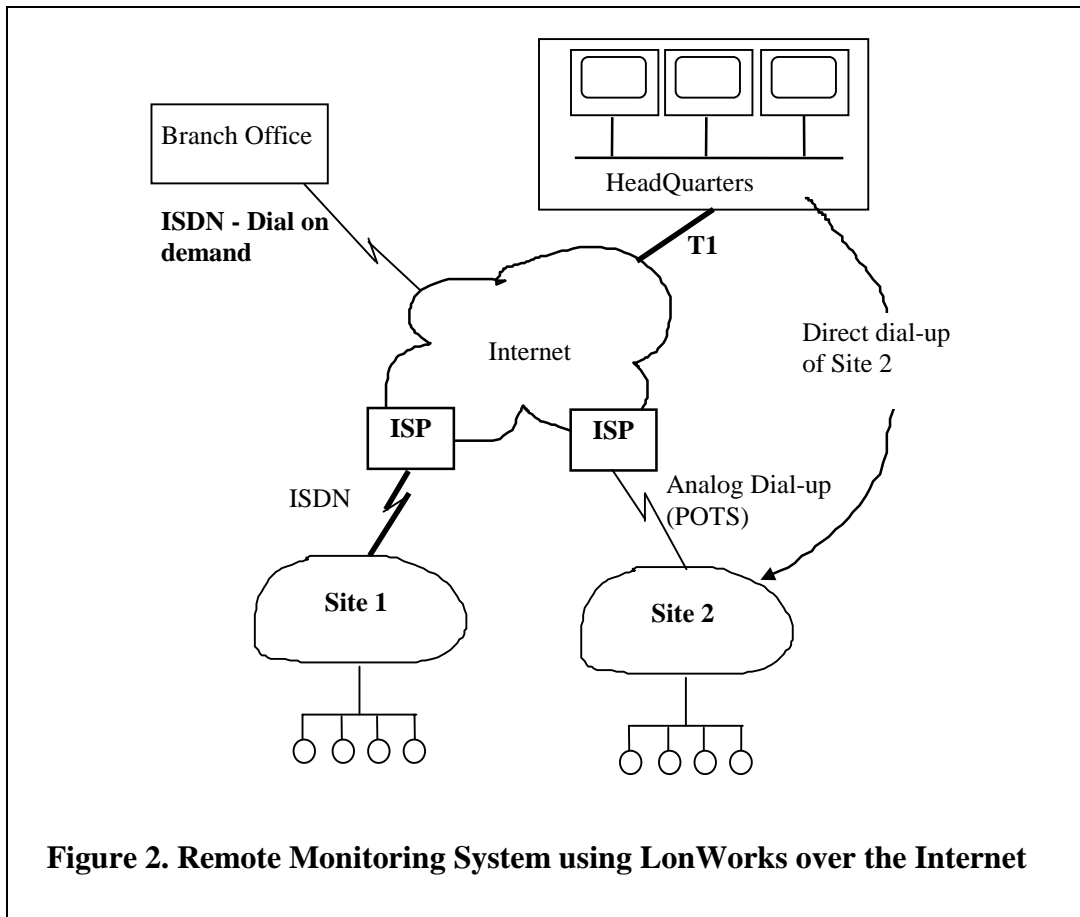
Figure 2. Remote Monitoring System using LonWorks over the Internet

To utilize the ISP-based architecture, the LonTalk/IP Server should support dial-out
capabilities as well as dial-on-demand. Using this architecture, enterprise applications can
always dial-up directly to a site. Once the connection is established, the application will
operate as if the LonTalk/IP Server is connected directly to the enterprise LAN.

4.3 Security
Using IP as the connectivity platform not only enables use of the Internet for remote
connectivity, but it also provides standard solutions for security. Internet-based commerce
applications have rapidly created solutions for all aspects of secure network
communications. These solutions can be leveraged to create completely secure connections
between the enterprise and the remote monitoring sites at a variety of cost/performance
levels.

4.4 Reliability
The Internet as a communications transport mechanism is extremely reliable. The multi-
path routing and redundancy make it a robust network. For an ISP-based architecture, for
example, providing alternate dialup numbers and IP addresses can provide automated
failure handling.

4.5 Latency

The latency of most Internet connections will vary, sometimes widely, over time. This can be a problem for some systems which depend on timely acknowledgement of messages. While this can be easily taken into account in design of the network, some systems may benefit from a gateway approach to the LonTalk/IP Server device. The gateway approach decouples the timing of the LonTalk side from that of the IP side, thereby reducing dependency on the IP latency performance.

4.6 Bandwidth

Depending on the type of Internet connection being used, the available bandwidth for an Internet-based monitoring system will vary widely. This variability provides a benefit for designers and integrators in creating a cost/performance tradeoff. The advantage of the Internet-based solution is that there are much higher levels of bandwidth available, if needed, than for traditional dial-up approaches.

4.7 Network Management

Network management is an important aspect of a networked remote monitoring system. Typically the network management of each site itself is handled locally at installation time and during maintenance. Some limited network management functions for the LonWorks network at a site may be provided via the LonTalk/IP Server device. These might include checking if a device is online and healthy.

The management of the IP side is equally important. Standard management protocols exist in the IP world and should be supported by the LonTalk/IP Server device. Supporting standard management protocols allows the IP device to be smoothly integrated and managed by the enterprise IS staff.

5.0 Applications

There are many types of remote monitoring applications which can specifically benefit from connecting LonWorks over Internet/Intranet. Technical solutions for two such applications are described below.

5.1 Campus-wide access to an HVAC System

Problem: A small college campus has LonWorks-based HVAC systems installed in several of their buildings. They want to provide simple monitoring of temperatures and statuses, and control of set-points at several locations throughout the campus. The campus has a TCP/IP network installed throughout.
Solution: LonTalk/IP Servers (routers) are installed at each of the LonTalk sub-nets they wish to monitor. The routers are connected to the campus TCP/IP network creating a campus-wide VDN. At each workstation that needs to have access to the VDN a LonTalk

Network Interface is installed providing access to the entire VDN. A custom or standard software application can be used to provide graphical display and control of the HVAC system.

5.2   Monitoring of Remote Telco Equipment

Problem: A telephone company has remote switching equipment stations throughout their service area. The stations include a LonWorks based monitoring system for status, alarming, and preventative maintenance functions. They currently dial up to each station one at a time to check status.

Solution: An ISP account is setup so that there is a local number available for each site. A dialup LonTalk/IP Server with dial-out capabilities is installed at each site and configured to call the ISP. The monitoring nodes are setup to instruct the Server to dial at predefined times or whenever there is an alarm condition. The monitoring workstation is connected to the Internet and can communicate with whichever sites are currently connected, or can dial a site directly if it is not connected. The TCP/IP architecture provides a scalable solution what can be mixed-and-matched with directly connected VDN sub-nets.

5.3 Water Treatment Plant Monitoring System

Problem: A water-treatment facility has several distributed sites from which data needs to be gathered on a regular basis. Local control and alarming functions are also required. The sites are located long-distance from the central office.

Solution: An ISP account is setup so that each site has local Internet access. A dial-up LonTalk/IP Server device connects to the LonWorks data collection network at the site. The LonTalk/IP Server device includes data logging services as well as alarming functions. Alarms result in automatic dial-up and sending of an email message. The email message can also trigger pager functions on the central office web server.

Each site connects to the Internet via the ISP at predefined intervals to upload logged data. Data can be uploaded via FTP to the corporate web server or emailed to staff in standard formats. A web browser can also be used by central office personnel to inspect the current status at a site. Current and historical data is displayed graphically in real-time in a web browser.

6.0 Summary

The Internet is a powerful tool for delivering advanced remote monitoring applications. Coupled with LonWorks via a LonTalk/IP Server device, powerful, scalable systems can be delivered that provide tremendous cost/performance advantages over traditional solutions.

Basing the monitoring architecture on IP allows designers and integrators to leverage the infrastructure, equipment, and knowledge of the IS staff of the organization. The types of solutions described in this paper outline the next generation of networked monitoring systems, but are available today.