



Connecting LonWorks and TCP/IP Enterprise Networks - Real Application Successes

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Abstract

Businesses are continuing to invest in Information Technology (IT) infrastructure such as corporate LANs and WANs and to make increasing use of the Internet. Because these businesses wish to leverage this investment, LonWorks control network vendors are increasingly being required to tie their monitoring or control system into existing LANs or to provide WAN or Internet access. Solutions for creating a seamless connection between LonWorks and enterprise TCP/IP networks exist now and are being deployed in a growing number of systems.

This paper details some recent projects where LonWorks has been integrated into the enterprise LAN or WAN to provide additional flexibility and value for the customer. The applications described span projects in Gaming, Building Automation, and Factory Automation and use several different types of IP/LonWorks connectivity solutions. For each project we discuss the application requirements that led to a TCP/IP solution as well as the expected and unexpected benefits of the resulting system.

Linking LonWorks to TCP/IP allows customers to leverage their IT infrastructure. The ubiquity and flexibility of the LAN and WAN allow customers to locate monitoring stations anywhere in the enterprise and allow remote access and diagnostics. Standard connectivity solutions like the ones described provide plug-and-play solutions and save thousands of dollars over custom, application-specific gateway solutions.

The Goal - Seamless Enterprise Connectivity

One of the attractions of LonWorks technology is the integration of historically disparate systems such as lighting and HVAC into a coherent system architecture. LonWorks does a good job of achieving this integration at the device level. But customers want more. They want a complete integration between the device network and the enterprise LAN/WAN infrastructure. The functionality that customers are requiring for this integration include:

- access to the device network from any PC on the LAN
- linking of separate device networks across the wide-area enterprise (e.g., HVAC networks in buildings across a school campus)
- remote access from the Internet (e.g., to support remote diagnostics and monitoring).
- gateways to existing legacy applications and data
- reliable, embedded connectivity solutions that avoid the cost and bottleneck of a PC

Standardization of business networks is all but complete. IP and the "Internet platform" have now become the de-facto standard for creating local and wide-area enterprise solutions¹. Device network customers are increasingly requiring that any LonWorks solution be tied into their existing or future enterprise network. The driving factors for this requirement include:

- reduced wiring by leveraging existing LAN/WAN infrastructure
- flexibility in access to LonWorks data from any PC on the LAN
- remote Internet access
- taking advantage of Virtual Private Networks (VPN) and other Internet technologies for building secure wide-area networks
- leverage existing mass-market LAN/WAN network equipment

Coactive Aesthetics is providing solutions for this seamless connectivity today. The remainder of this paper describes some of the real solutions we have provided for our customers.

One Size Does Not Fit All

It is important to understand that there is not a single solution to LonWorks/IP connectivity. Different application requirements demand different types of technical solutions. The main types of connectivity solutions used in connecting LonWorks with enterprise networks are:

Tunneling Routers

A tunneling router, such as Coactive's Router-LL, provides a transparent "pipe" for channeling LonWorks over an IP network. It is the most general purpose solution for LonWorks/IP connectivity. These devices work like any standard LonWorks router going from one physical media to another. They can be configured to operate as repeaters, bridge, learning router, or configured router. The IP channel (e.g., Ethernet) is viewed as simply an

¹ We use the term "IP" (Internet Protocols), also known as TCP/IP family of protocols, for the standard enterprise network as a whole. IP is the foundation protocols that modern enterprise LAN and WANs are built upon. IP is supported on a large variety of physical media used within enterprise networking including 10MBit and 100MBit Ethernet, PSTN Dial-up (PPP), leased-lines, fiber-optic, Frame Relay, ISDN, wireless, ATM. It is widely supported by all telecommunications and networking equipment.

alternate LonWorks media.

Typical uses of the tunneling router are for linking floors in a building or buildings across a campus to create a coherent "virtual" LonWorks network. Tunneling routers work with any LonWorks application and are easily integrated into either new or existing LonWorks applications.

LAN Network Interface

Devices such as Coactive's Router-LE operate like a remote LonWorks network interface. Instead of a serial connection such as an SLTA, or a PC bus connection such as a PCLTA, the Router-LE allows applications to connect to LonWorks over an Ethernet LAN. The device operates like a standard LonWorks interface so all LonWorks applications can work without modification.

Typical uses of the LAN Network Interface are allowing the monitoring console or back office PC to be located remotely from the LonWorks network - anywhere there is a LAN connection.

Gateways

Gateways translate from one protocol to another. For example a device which provided connectivity between LonWorks and Modbus would be considered a gateway. Such devices are necessary since seldom are all aspects of a system built from scratch or installed at the same time. It is often required that data from a newer LonWorks-based system be provided into a legacy application that only supports Modbus, for example.

While gateways add a certain complexity to a system design, they are a critical component to enable creating real systems where legacy components are required.

Real-world Applications

Below are descriptions of several applications where LonWorks has been successfully linked into the customers IP enterprise network using Coactive connectivity products. These applications span the full range of device types discussed above and encompass a variety of industries.

Casino Gaming System

A large manufacturer of casino gaming equipment uses LonWorks to monitor slot machine performance and provide intelligent maintenance functions. Each machine has several LonWorks nodes which are linked into a common network to transfer data to the backoffice computer systems. System sizes for a typical installation range from a few to hundreds of machines on a network. A LonWorks application running on the backoffice system is responsible for monitoring the nodes and transferring player and status data to other backoffice applications and databases.

Technical Requirements

The system was initially designed around serial interfaces to LonWorks. The backoffice computer system is Unix-based. As system size grew the serial interfaces became a bottleneck due to slow speed and the poor serial capabilities of Unix. The customer required an Ethernet-based solution to bring LonWorks data from the gaming machines back into the Unix-based backoffice application. This solution needed to support all LonWorks features including network management and explicit messages.

Solution Chosen

The solution chosen was Coactive's Router-LE. This device provides a direct connection between LonWorks and an Ethernet LAN. A driver-level interface was provided for integrating the customer's Unix-based application. The driver interface allows use of either standard serial LonWorks interfaces, the Router-LE, or both. This provided maximal flexibility in system architecture and migration. The Router-LE supported all LonWorks commands as required.

Results and Benefits Achieved

Using the Router-LE solution, the customer was able to reduce the number of network interfaces required by over 50%. Performance and reliability were improved and a more flexible wiring approach was achieved due to the use of Ethernet. The modularity of the solution allows the customer to easily expand the system as required.

Industrial Process Manufacturing

A large industrial manufacturer is refitting its process automation system to use LonWorks. The system controls and monitors a very large metal smelting process. The process is divided into "bays" with each bay having a LonWorks network of up to 100 analog signal monitoring nodes. A complete system comprises up to 16 bays. One or more UNIX workstations are used to monitor, control, and log system data.

Technical Requirements

The customer wanted to utilize existing Ethernet LAN and to achieve improved performance over serial solutions for monitoring their large LonWorks system. They required an interface to LonWorks from their UNIX workstations over the Ethernet LAN. They had experimented with a standard Ethernet "terminal server" combined with a LonTalk serial interface.

Solution Chosen

Coactive's Router-LE was selected for this application. The Router-LE linked the customer's Unix application over an Ethernet LAN to each "bay". The Router-LE driver interface provided allows use of either standard serial LonWorks interfaces, the Router-LE, or both. This provided maximal flexibility in system architecture and migration. The Router-LE supported all LonWorks commands as required.

Results and Benefits Achieved

Performance and reliability were improved considerably over the previous terminal server solution. The modularity of the solution allows the customer to easily expand the system as required. The Router-LE provides a single device replacing the separate terminal server and LonWorks serial interface devices required previously, thus reducing part-count and further increasing reliability.

Multi-Site Hospital Campus

A multi-site hospital utilizes a backup generator system which provides a LonWorks interface for monitoring and control of the power system. There are two separate generator locations at each of two of the campus locations. The customer requires the ability to monitor and control the power system from either campus location and wishes to leverage the existing Fiber-optic TCP/IP LAN that exists across the facility.

Technical Requirements

Each generator location must be tied transparently into the Fiber-optic LAN to workstations at both sites. Since the generator systems were already installed, it was important that the solution require no special programming or complex installation. It was required that the system be expandable to future generator and other LonWorks-based systems within the hospital campus.

Solution Chosen

Coactive's Router-LL tunneling router product was chosen for this application. These devices provide a transparent link between LonWorks subnets across any TCP/IP network. A 10baseT Ethernet link was provided by the Hospital IS department to attach the Router-LLs into the campus Fiber backbone. One Router-LL was installed at each generator location, and one at each workstation location. Existing monitoring applications operated without modification and installation was straightforward.

Results and Benefits Achieved

Using the Router-LL solution the customer was able to monitor and control their generator systems flexibly from either campus location. By linking the power generator information into the LAN they are positioned to further integrate other facility management functions. The resulting system is completely expandable to additional workstations and/or generator sites. This solution can also be used to incorporate additional LonWorks subsystems such as HVAC and lighting as they become available.

Pharmaceutical Manufacturing Facility

A leading world-wide manufacturer of pharmaceuticals uses LonWorks-based HVAC equipment in their facility. They also have a facility-wide Ethernet LAN available. Originally their facility monitoring workstations were attached directly to the LonWorks HVAC network. To gain some flexibility and avoid adding additional wiring, this customer wanted to link their HVAC system to the facility monitoring PC across their LAN. The

HVAC system spanned several floors and areas of the building as well as multiple buildings.

Technical Requirements

Both the LonWorks HVAC network and the facility monitoring application were already installed and operational. It was important that the connectivity solution be able to integrate smoothly with the existing system without recommissioning or reprogramming. The facility monitoring application is hosted on a PC running OS/2. Future expandability to include other facility functions was also a strong requirement.

Solution Chosen

A Router-LL solution was used to meet this customer's needs. Each HVAC LonWorks area network was attached to a Router-LL which connected directly to the facility Ethernet LAN. An additional Router-LL at the central monitoring PC completed the connection, without modifying the existing application or drivers.

Results and Benefits Achieved

Integration of this solution was smooth and simple. The customer has full expandability to add either additional workstations or LonWorks subnets. Because the Router-LL operates as a standard IP device, the facilities IS manager is comfortable managing this device along with other PCs and workstations within the corporate network environment.

High-Rise Building Management System

The Chifley building, the largest high-rise (30+ stories) in downtown Sydney Australia, uses LonWorks for several HVAC and security functions. The customer required high-performance monitoring of many of the 4000+ I/O points in the system. The building houses some of the largest retailers in the downtown area. Planned future phases of the project include expanding the utilization LonWorks to an additional 6000+ I/O points.

Technical Requirements

High-speed, low-latency alarm monitoring and logging from a central point was required for many of the I/O points. The solution also needed to integrate smoothly with the chosen SCADA/MMI package.

Solution Chosen

The CiTect SCADA package was selected due to its performance and many advanced features.

Coactive worked with the CiTect team to develop the Gateway-LM solution. This is a LonWorks/Ethernet gateway that provides a Modbus data interface over Ethernet/TCP/IP. The Modbus interface allowed simple integration with the CiTect SCADA package as well as high-performance data transfer over Ethernet. The Gateway-LM supports SNVT types for simple integration with the LonWorks HVAC and other nodes.

Results and Benefits Achieved

The system has been operational for over a year and a half. Sub-second response was achieved for monitoring the 4000+ I/O points using the Gateway-LM approach. The customer is planning on extending this system to over 6000+ more I/O points in the building.

Conclusion and Future Directions

As explored above, LonWorks is being linked into all sorts of IP enterprise networks today. The connectivity products being delivered are growing and evolving to provide increasing levels of integration with the Enterprise. System designers and Integrators should become familiar with these possibilities so that customer needs can be met now and into the future.

Some of the key technical areas that will continue to drive and expand the use of these connectivity solutions and bring even more value to the end customer include:

- standardization for interoperability of LonTalk/IP connectivity devices
- distributed object interfaces for application integration
- wider range of IP interfaces available (ISDN, dial-up, 100MBit Ethernet)
- Java and Web-based interfaces to LonWorks (such as WebIO)
- use of standard application interfaces such as Java Automation API and OPC