Intelligent Pipelines

Expanding pipeline communication with the use of IP technology

Each day, hundreds of millions of gallons of petroleum products are shipped all over the world by pipeline companies. Oil and natural gas consumption is expected to grow, primarily due to higher projected energy demand in the commercial and transportation sectors. Natural gas, viewed as an environmentally friendly fuel, will see significant increase in consumption by the electric utilities. "Petroleum product consumption in North America is projected to increase by 10.3 million barrels per day from 1999 to 2020, at an average annual growth rate of 1.8 percent."[1]

The growth in the movement of petroleum products has resulted in a vast underground and aboveground pipeline network. "Two thirds of all domestic deliveries flow through 160,000 miles of oil pipelines in the United States."[2] This huge infrastructure will continue to expand to meet the projected demand. In President George W. Bush's National Energy Policy Speech, in May 2001, he said, "The U.S. will need newer, cleaner and safer pipes to move larger quantities of natural gas - up to 38,000 new miles of pipe and 263,000 miles of distribution lines."[3]

Pipelines have become an important part of the national infrastructure and therefore must be a protected asset. The question is - how do you protect an asset that is so widely dispersed? The answer that would be suggested by environmentalists, government and safety advocates would be as tightly as possible. But in a world where companies are driven by profit, there is a limit on how much can be spent. There has to be a solution that satisfies all concerns. This article will outline how IP technology enables companies to remotely monitor their equipment. In essence, making their equipment "intelligent pipelines".

SAFETY CONCERNS

Over the years, remote pipeline monitoring has become a big issue. From the perspective of the industry, it is important to enhance efficiency, reduce costs, provide mobility, and collect data in real-time. From a larger perspective, the importance of petroleum products to the U.S. economy as well as the deployment of more natural gas lines near population centers raises questions about the security of these pipelines.

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[1] Source: Energy Information Administration, *Annual Energy Review 2000*, August 2001

[2] Source: American Petroleum Institute, A Report from Petroleum's Oil Pipeline Industry

[3] President George W. Bush's National Energy Policy Speech, May 17, 2001 in St. Paul, Minnesota

Safety concerns in the pipeline industry focus on the possibilities for damage from terrorism as well as from natural occurrences and erosion of pipeline equipment. Damage to a pipeline can be extensive even with a small incidence. For example, last year a stray bullet hit an Alaska pipeline. An estimated total of 285,600 gallons spilt, of which 108,600 gallons were recovered.

According to the Office Of Pipeline Safety, it was reported that, between 1986 and 2001, there were 3,035 accidents with hazardous liquid pipeline operators, 285 injuries & fatalities, and over $764,198,000 in property damage. Pipeline operators are keen to find new ways to reduce spills, because it affects the environment and is very expensive to clean. "Spilling one 42-gallon barrel of oil from a pipeline typically costs the pipeline company $50,000 in lost revenue and clean-up expenses."[4] Over the years spills have been declining, however there are still thousands and thousands of gallons that spill throughout the year.

To-date, a physical presence is one of the few ways available to have active deterrence of any terrorist incidence or to minimize damage from a natural occurrence. The safest way to protect the asset from terrorism or vandalism is with armed guards. To have them stationed along the length of the pipeline, as well as a guard stationed at each pumping station would be the optimal solution, but this suggestion is cost prohibitive to any pipeline company.

Pipeline companies already have to deal with the increase in administrative responsibilities resulting from the additional and aging pipelines. More technicians are required to monitor the large and growing network and to inspect this equipment, which is so essential for the economic well being of the country. "Interstate pipelines deliver over 12.9 billion barrels of petroleum each year."[5]

In most cases, such as the Alaskan pipeline spill, it would have been difficult to avoid the situation, but it is possible to reduce the impact through quick action. This brings up the concept of "real time" monitoring. Having real-time access to data provides the ability to report on unusual signals or messages that would imply a problem with one of the pipelines.

While it may be cost-prohibitive to have guards stationed along the pipelines, remote monitoring will allow you to respond to alarms in real-time and make quick management decisions to re-route the oil, avoiding serious damage to local farmers, the environment and surrounding suburb life.

Today, only a small percentage of field equipment can be easily monitored or remotely configured under current conditions. Every time there is a new pipeline connection, new network or maintenance concern, it requires IT personnel, technicians and/or engineers to venture out to remote areas to install, configure or inspect the equipment. Network managers are under pressure to maintain and improve the current performance of the network, regardless of size. This has serious cost implications for energy companies.

There is pressure to find new solutions that will provide "remote eyes" on the network without hindering the existing equipment or infrastructure. With the lack of network connectivity it is difficult and costly to improve response time to security alarms, remotely monitor perimeter & exterior sensors, cameras, access control and lights.

[4] Source: American Petroleum Institute, A Report from Petroleum's Oil Pipeline Industry
[5] Source: Association of Oil Pipelines

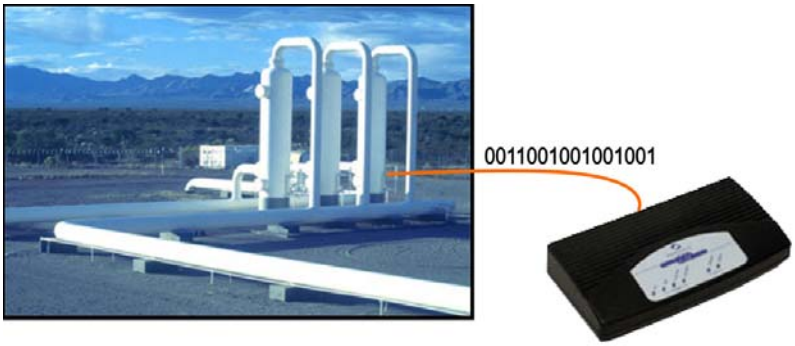
TECHNOLOGY

Within the last decade remote monitoring technology has become a primary focus for the oil and gas pipeline industry, particularly in the operations of pipeline systems.

With high-speed networking, sensor data can continually retrieve with only milliseconds of latency. The cost of bandwidth is dropping so fast that not only is it economical to increase the frequency of data capture, but it is also possible to increase the density of sensors.

The primary reason why data bandwidth has become so cheap is the advent of standardization. In the past, there were many incompatible protocols that were optimized for specific applications. But largely due to a government initiative, one protocol dominated. That protocol, Internet Protocol (IP) networks, found its origins in a defense project, but is now so prevalent that most people have long forgotten that it was originally designed to allow Military officials in Washington to have a reliable link to the missile silos in the Midwest. With standardization comes commoditization. And with every commodity comes pricing pressure. Data bandwidth today is significantly cheaper than it was a decade ago.

The ubiquitous Internet that we are all aware of that allows us to do web surfing and emails is an example of an IP network. However, when it comes to transmitting sensitive information, it is highly recommended that either the data be encrypted over secure IPSec tunnels over the public Internet or moved to a private Internet generally known as a Virtual Private Network (VPN). Access to a VPN can be through a two primary methods, wired or wireless.



Wired data networks began with low speed dial up networks. Frame relay introduced the always-on, reliable link that has become widely available today. The cost however reflected the highly reliable, industrial nature of the media. The new comer to the scene is DSL or Cable Modems. This uses the existing phone line or Cable and overlays a high frequency signal that can carry large amounts of data. Initially, this underdog technology grew up with a fairly bad reputation of being difficult to install and notoriously unreliable, but with ever advancing technology and support organizations, you will be pleasantly surprised with the advances that have been made. But the real driver is cost. In most cases, you will find that even though they carry over 10 times the data of a Frame Relay line, they can cost less than half the price.

Wireless networks were limited to short range solutions, but satellite has introduced lower cost options that are highly competitive. Personal Communications Service (PCS)/Global System for Mobile Communications (GSM) is also gaining a foothold in the market. Using

Cellular Digital Packet Data (CDPD) and/or iDEN wireless coverage provide an "always-on" connection, unlike dial-up, which must re-establish a connection each time data is transmitted.

INTEGRATING THE EXISTING EQUIPMENT INTO THE NEW NETWORK

More pipelines, representing a greater importance to our energy infrastructure, mean a greater responsibility for monitoring. Monitoring remote pipelines and off-site equipment has been a constant struggle and an expensive challenge for the energy sector. Many oil and gas pipeline network equipment operate effectively but lack network connectivity because they have standard RS-232 and RS-485 serial connections, which do not link to company's LAN/WANs. It is costly to upgrade or replace existing serial equipment and the incremental functionality does not justify the large price tag.

IP technology will allow you to keep your existing serial equipment and connect it to a device that will IP enable the equipment. It will provide bi-directional communications between the equipment and server, thus, providing remote network management capabilities, increasing IT management efficiency, and reducing overall maintenance costs.

There are a few key features that will provide flexibility, convenience, and real-time information using TCP/IP technology.

TCP (Transmission Control Protocol) is a feature that establishes a connection to provide a reliable communication stream to send data over packet-switched networks. TCP guarantees delivery of data and also guarantees that packets will be delivered in the same order in which they were sent. With the TCP/IP, it establishes a connection between two hosts to communicate back and forth.

The Telnet program runs on your computer and opens a "Telnet Session" that connects your PC to a server on the network, enabling you to control the server and communicate with other servers on the network.

Simple Network Management Protocol (SNMP) is used to manage devices supporting the protocol from any number of hosts or PCs running SNMP software. With SNMP, you can gather statistics or configure the IP device. You can gather statistics with get-request and get-next-request messages, and configure with set-request messages. Each of these SNMP messages has a community string that is a clear-text password sent in every packet between a management station and the Precidia device (which contains an SNMP agent). The SNMP community string is used to authenticate messages sent between the manager and agent. Only when the manager sends a message with the correct community string will the agent respond.

Dial-up IP devices access an IP network using a series of protocols called Point-to-Point Protocol (PPP). One stage of the connection is the authentication protocol that sends a "username/password" to verify that the device is allowed to access the network.

REMOTE DEVICES

With the growth of the Internet and company intranets it is the ideal time to leverage existing infrastructures and create connections with remote locations. There are numerous products on the market that connect serial devices to IP. These can connect to Ethernet, Point-to-Point Protocol (PPP) or wireless networks.

Precidia Technologies Ethernet products, Ether232, Ether422, and Ether485, seamlessly migrates stand-alone serial equipment onto more sophisticated IP networks. These network-enabling devices seamlessly migrate serial devices to a company's LAN/WAN. They facilitate the upgrade of legacy equipment and consolidate stand-alone equipment.

Precidia's IP232 is an ideal solution for remote management of any RS232 serial device, without being connected to a LAN or WAN. While other solutions have an Ethernet interface for connection to a LAN or WAN, the IP232 has an embedded v.34 modem and offers a dial connection access to IP networks. Once the connection is established, the IP232 receives raw serial data from its RS232 connection, converts it to IP packets, and sends the packets to the Internet or private IP/VPN via a PPP dial connection. This allows you to leverage the low cost and global reach of the Internet to seamlessly connect serial devices such as pumps, valves and data acquisition devices, to IP networks.

Precidia's Cell232*Plus*, to be released in the late summer of 2002, is designed to connect serial devices through a wireless network without having an existing a LAN/WAN infrastructure. The Cell232*Plus* is created to plug into a wireless digital handset or radio transceiver, using the wireless modem.

Whether you have an existing LAN/WAN or no network infrastructure you can still connect to your remote serial equipment from any location. Each device has a built-in web server, supporting dynamic and static web pages, allowing remote access to the device from virtually anywhere in the world. A technician or engineer who would normally have to drive to a site, can now have instant access using a laptop that is connected to the Internet. This is not only efficient on resources, it also provides added security to monitor and respond to accidents or vandalism.

REMOTE MONITORING DEVICES PROVIDE THREE KEY BENEFITS FOR PIPELINES:

COST SAVINGS

The devices seamlessly install into the pipeline's existing infrastructure or wireless network, and require no upgrade or replacement of older operational equipment. They enable older equipment to communicate from remote sites to the LAN/WAN or wireless network, eliminating the need to purchase additional equipment and wiring.

REMOTE ADMINISTRATION

With remote access devices, the IT and/or engineering departments are able to remotely configure the devices to access the equipment without having to leave the office – saving hours in support. The devices also have the capability to perform automatic routing of traffic to a backup system during a disaster or accident.

REMOTE DIAGNOSTICS
The IP-enabling products facilitate remote diagnostics, with vast cost savings by reducing the need to dispatch personnel on service calls and 24-hour onsite monitoring of the pipelines in remote locations. They can simultaneously route data to multiple destinations. The devices also allows for data and diagnostics to be handled simultaneously, in real-time.

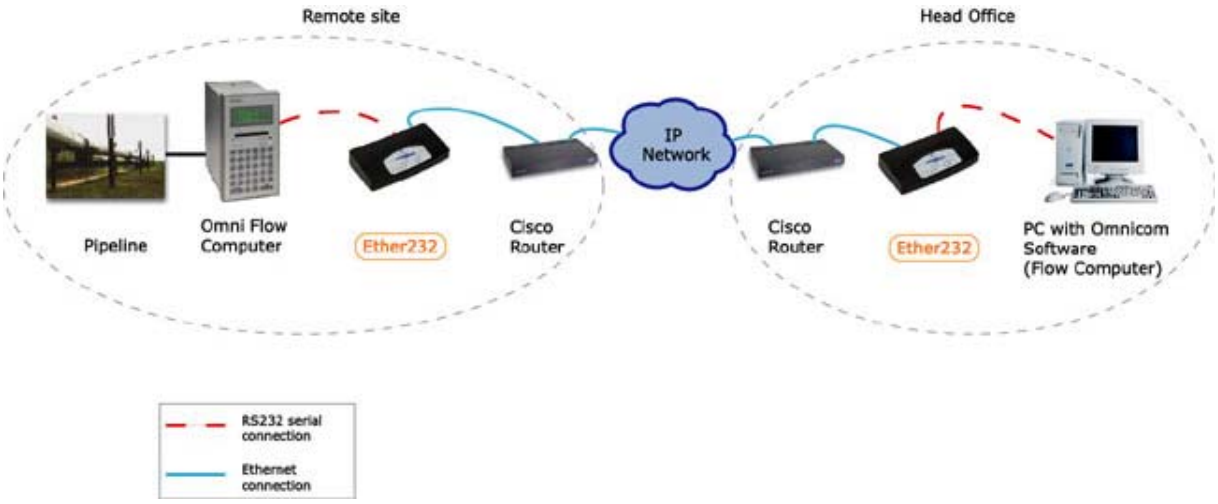
PIPELINE APPLICATION

Many pipeline companies are realizing the benefits of IP enabling equipment. For example, one pipeline company, a leader in the petroleum products industry, was looking for a solution to connect serial equipment to their network for remote monitoring capabilities. They had the option to install a phone line to communicate with their Omni Flow Computers, however that would incur installation fees and monthly expenses of having a dedicated phone line. It was important to find a solution that could leverage their existing LAN/WAN infrastructure and save them time and IT resources.

The company was looking to remotely connect and monitor data from their Omni Flow Computers, which controls valves, measures pipeline flow, and counts barrels, with a cost effective solution. Precidia Technologies serial to IP connectivity product, the Ether232, was the product of choice because it connects stand-alone equipment to IP networks via Ethernet.

Using Precidia's device, the company was able to reduce the personnel costs associated with troubleshooting field equipment problems, configuring, and programming remotely, as the device monitors in real time from a standard PC using the Precidia device. Precidia's Ether232 save the company days of work each month."

This cost effective solution has extended the service life of the company's expensive pipeline equipment, and simplified the management and maintenance of the network. The data from the sensors can now be connected to the network cost-effectively for troubleshooting, configuring, programming, and real-time data collection.



CONCLUSION

Pipelines are part of the nation's strategic infrastructure. The extent to which they are disseminated across the country makes them difficult to monitor, but advances in telecommunications has led to dramatic price reductions in communication costs and opens the door to tremendous gains from real-time monitoring. But to exploit these lower network costs, pipeline companies need to move away from non-standardized protocols to the more ubiquitous TCP/IP standard. TCP/IP technology has been around for years, unfortunately, pipeline companies have been slow to leverage it into their equipment until just the last few years. With the continuing evolution of the IP networks and the continuing price decreases expected from this technology, it's an ideal time to consider migrating.

IP enabling access devices are a cost-effective management solution centering on the ability to automate time-consuming on-site tasks by remotely configuring via a Telnet interface or serial port, and simplifying equipment diagnostics and maintenance. They also extend the life of your serial equipment without changing your current network infrastructure.

It is difficult to remotely monitor pipelines, but it's important to be aware of new technology that will assist you in real-time monitoring and data logging. It will also free-up valuable technical resources and in turn allow you to spend more time on preventing network problems before they occur.

With the capability to remotely monitor equipment you will be able to detect any issues or remove poorly performing equipment, because you will have real-time access to data 24 hours / 7 days a week. Real-time data logging is exciting because it will present a new opportunity to enable quick decision-making and dynamic facility management. In the past, technicians and engineers spent a lot of valuable time on-site performing troubleshooting, configuration, and general support. Now through the use of IP enabling access devices, you can spend time on other valuable tasks and save money at the same time.

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