
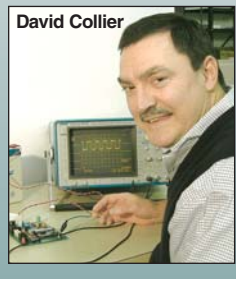


by **Michael Tavalare,** SCADA Engineer, **KeySpan Corp.,** and **David Collier,** Senior Systems Engineer, **ACS Telescada Corp.**

# New Digital Modems In RTUs Improve Reliability Of Gas Pressure Monitoring

The telecommunications industry eliminated analog cellular service in urban areas at year-end 2005 so that remote monitoring of natural gas pressure using analog communications technology would no longer work. Switching to digital cellular service was a problem because remote monitoring requires two-way data exchange, but digital service was originally designed for one-way communication (modems calling the Internet, not vice versa). This analog-vs.-digital problem is nationwide, affecting many gas and energy companies and other users such as police and fire departments.

To solve this problem, a communications equipment package was developed to allow quick, easy replacement of modems and related components in existing remote terminal units (RTUs). Also, new digital cellular service was introduced that allows two-way communications between modems and the SCADA system, with either end able to initiate data exchange. The new digital modems kept RTUs working and improved their performance with better cellular coverage and higher reliability. The replacement equipment also saved about $769,000 vs. buying and installing new remote units.

## Using SCADA Systems To Monitor And Control Gas Pressure

One function of SCADA systems in natural gas distribution applications is monitoring and controlling gas pressure at various points in the distribution network. RTUs in gas distribution SCADA systems have replaced old-fashioned paper chart recorders. Today's RTUs enable wireless remote monitoring as well as generating alarms at selected pressure thresholds (whenever the gas pressure in the line drops or gets too high).

KeySpan Corporation is the fifth-largest distributor of natural gas in the United States and the largest in the Northeast, operating regulated gas utilities in New York, Massachusetts, and New Hampshire that serve 2.6 million customers. In KeySpan's system, most RTUs are sited permanently at pressure regulator stations and at low-pressure distribution points. About one-fourth of the RTUs are deployed only in the winter (these are called winter-gage RTUs), when lowered gas distribution pressure is a primary concern. Pressure monitoring by RTUs in SCADA systems has several benefits to gas/energy companies and their customers:

- Ensure adequate gas supply pressures and deliver gas properly to customers.
- Find out immediately when pressure drops and help understand why.
- Help engineer the most efficient gas distribution network.
- Satisfy state regulatory commission requirements to record gas pressure.

The bottom line is that RTUs in gas pressure monitoring deliver more data and reduce costs by minimizing field work and field personnel requirements.

**Figure 1:** Photo of KeySpan master control room.

## The Elimination Of Analog Cellular Service Disabled Existing RTUs

The telecommunications industry eliminated analog cellular service in urban areas at year-end 2005 because digital technology made analog obsolete. Digital uses less power and less bandwidth, and thus can handle more calls and data. CDPD modems (Cellular Digital Packet Data) use analog cellular service, while CDMA modems (Code Division Multiple Access) use digital technology.

Because of this change, RTUs that used CDPD modems to monitor gas pressure would no longer work as of Jan. 1, 2006. This analog-vs.-digital problem is nationwide, and many other gas/energy companies are affected, as well as other wireless customers such as police and fire departments using CDPD modems.

A second problem was that the biggest market for modems is one-way Internet connection—modems call the Internet, but not vice versa. However, remote monitoring requires two-way data exchange between the gas company's SCADA master and the RTUs in the field.

KeySpan's territory had about 330 RTUs using CDPD modems and analog cellular service: 180 in New England, 101 in Long Island, and 49 in New York. The components in the existing RTUs, which were originally developed for KeySpan by ACS Telescada Corp., included:

- Gas connection/pressure transducer.
- CDPD modem/analog cellular.
- Microprocessor controller (board and chip).
- Battery.
- Solar power panel.
- Antenna.
- Power and data cables.

**Figure 2:** Photo of RTU and internal components

The cost-effective solution uses new

modems and two-way digital cellular service. In solving the problem, ACS Telescada developed a communications equipment package that allowed quick, easy replacement of RTU modems and related equipment in the field. The replacement equipment saved about $769,000, compared with buying and installing new RTUs.

Development of the package focused on selecting a new modem that would use digital cellular service while allowing two-way communications, with either end able to initiate data exchange, so that the SCADA master can poll the RTUs and the RTUs can call the master any time. Here's where the second part of the solution came in. A new digital cellular service called MIP/DMU, introduced by Verizon Wireless, was designed to let users stay connected when surfing the Internet in a moving vehicle and passing from cell to cell.

In gas distribution applications, this digital cellular service allows two-way SCADA master-RTU communications, because the cellular network assigns a static IP address (the same Internet protocol) to a modem's electronic serial number. This static IP address is reassigned each time the RTU connects so that the data gets sent to the right place.

CDMA modem technology was selected as the communications standard. Factors in selecting the new modem included:

- Cost.
- Cellular service charges (Verizon's are about $8/month per megabyte).
- Same antenna frequency (800 MHz), allowing an adapter vs. replacing antenna.
- Same voltage as the RTU's battery and solar panel (6-Volt), avoiding power source replacement.

Development of the communications equipment package also involved revising the RTU firmware so that it would work with the new CDMA modems. The firmware was incorporated in a new microcontroller with a larger program memory. The larger on-chip memory allowed one chip to replace two and made retrofitting a little easier. The replacement modem/microcontroller package preserves or improves all the capabilities of KeySpan's existing RTUs:

- Time intervals and pressure thresholds are all programmable remotely by KeySpan's SCADA master (or can be programmed locally if desired).
- Checks pressure at any "wake-up" interval (for example, every three to 60 seconds).
- Conserves power by "sleeping" until waking up to check pressure.
- Logs pressure data at longer intervals (for example, every one to 60 minutes) and stores it, typically for at least a month.
- Automatically calls in one time each day and reports the previous 24 hours of time-stamped data (takes about 1.5 seconds to upload the information).
- Looks for variations in pressure that cross selected threshold levels (down or up).

When a threshold is crossed and that threshold has been programmed as "critical," the RTU calls in immediately and provides a time-stamped alarm. The alarm thresholds differ at various points in the gas distribution network.

The contents of the replacement package included CDMA modem, microcontroller/chip programmed to work with new modem, antenna adapter, and modem power and data cables.

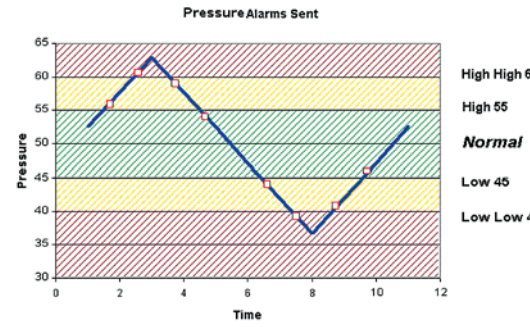


**Figure 3:** ▶ Selected gas pressure threshold levels where RTU sends alarm to SCADA master.

The replacement program keeps RTUs working and improves reliability. The communications equipment was acquired, and replacement packages were assembled and sent out during summer 2005.

The field replacement program began in July. To install the equipment, KeySpan used highly qualified electrical instrumentation technicians who needed only minimal hands-on training (one-two days) to become skilled in the set-up method. The learning curve was short and the whole program went very smoothly. On Jan. 1, 2006 the 330 RTUs equipped with the replacement packages continued working seamlessly.

**Figure 4:** Photo of KeySpan technician at an RTU.

CDMA modems also make the RTUs much more reliable than the CDPD modems used previously. The digital cellular coverage is at least 40% better and pressure information is communicated better on very cold days. The cold-day issue is important because natural gas distribution systems are subjected to their highest stress levels on the coldest days. When gas demand for heating increases, the system pressure can drop and customers at the end of the pipe could get less gas.

Moreover, the information gathered on the coldest day (typically in January) is used in a computer model of the gas distribution system. That model, in turn, serves as the basis for the summer season's construction plan and budget. So, it's critical to the gas company that cold-day data be as complete as possible. CDMA communications will be more reliable in this respect than CDPD, which sometimes required cold-day data to be retrieved manually from the RTUs.

KeySpan and other gas/energy companies can install ACS Telescada's new digital RTUs as needed in their distribution networks. RTUs designed for gas pressure monitoring are equipped with various pressure transducers, from 1 psig up to 10,000 psig.

The outlook for RTUs in gas distribution SCADA systems indicates the role of RTUs in gas/energy company SCADA systems could expand in the future. For example, instead of just monitoring pressure, smart RTUs can:

- Monitor and record ambient temperature.
- Detect atmospheric natural gas in regulator vaults and generate alarms at selected threshold levels.
- Remotely control gas pilot valves, either on a demand basis or automatically using a preprogrammed algorithm that is based on pressure as a function of ambient temperature and time of day.

Many new modem and telecommunications technologies are being introduced or are on the horizon. These hardware and software evolutions will offer quicker response, faster data transmission, and improved system reliability. ***P&GJ***

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