Augment Veteran Networks

Most users of 4-20 mA, RS-232 and RS-485 serial or other legacy networks don't have the luxury of simply replacing them. Here's how to give older networks some of today's more sophisticated capabilities.

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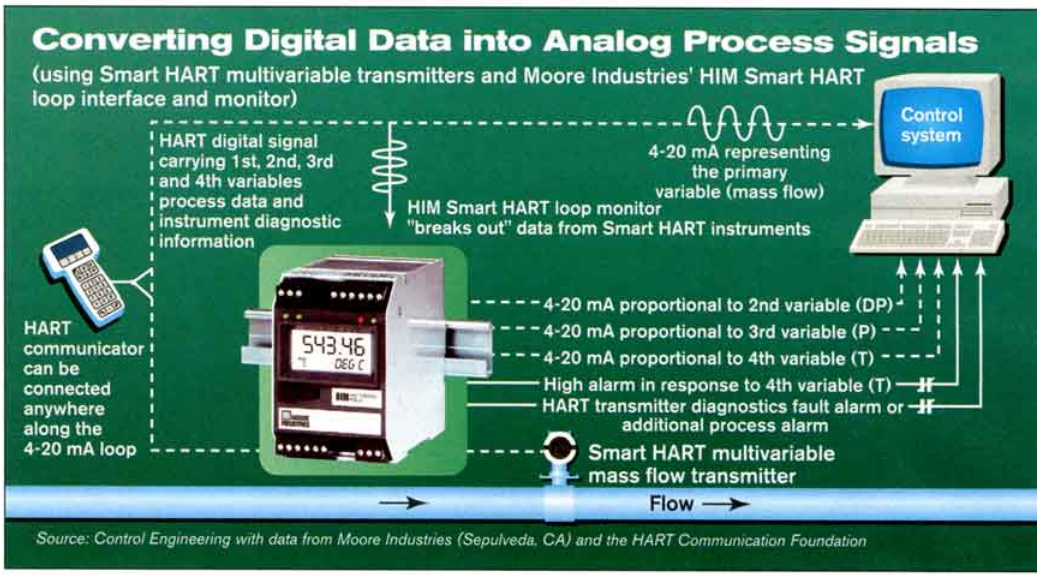
CONTROL ENGINEERING

Wouldn't it be great to deep six that tired, old network, and install a brand new, fancy-pants fieldbus with all the trimmings? Well, find a crayon and write a letter to Santa Claus, because that's probably the only way many engineers will get approval to replace their existing industrial networks.

This is true, of course, because completely replacing a control or automation network is prohibitively expensive and time-consuming in all but the most ancient, broken-down or obsolete cases. And, if crucial operations aren't directly threatened, most engineering managers are understandably reluctant to mess with finely tuned networks that can tolerate little or no downtime.

Meanwhile, higher-level managers are increasingly anxious to pull more diagnostic data from their manufacturing processes and link networks to asset management and resource planning systems that can deliver a competitive edge. Likewise, IT staffs are under pressure to tie networks to Ethernet and web-based systems expected to improve proactive and predictive maintenance and other quality assurance efforts.

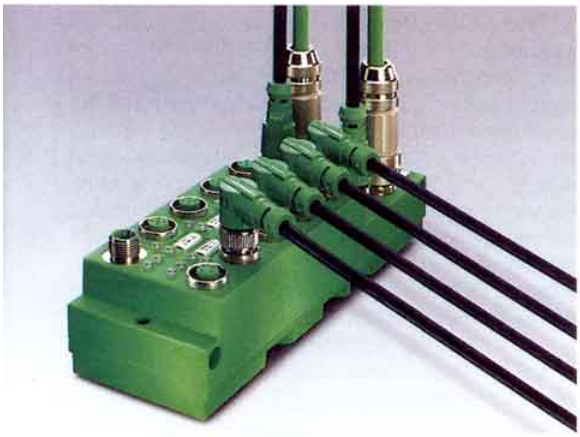


Moore Industries' HIM Smart HART Loop Interface and Monitor converts HART digital data to 4-20 mA signals that can be used by DCSs or PLC-based control systems.

Older networks omnipresent

A recent study by ARC Advisory Group (Dedham, MA) of the worldwide installed base of process instrumentation found there were 40-45 million devices, including 48% based on 4-20 mA; 26% based on Highway Addressable Remote Transducer (HART); 13% were pneumatic; 12% were proprietary; and 1% used various types of fieldbus.

"Some users don't have PLCs, while many others have Modbus or legacy-based systems, and so 4-20 mA is still one of the most popular outputs. This means new devices targeted at serving the largest possible audience still need a 4-20 mA option," says Tom Alford, capability manager for condition monitoring at Rockwell Automation Inc. (Milford, OH). "People have made large investments in networks that have grown over many years, and, while they might want to go with a new fieldbus-based network, they are being forced to comply with agressive payback schedules and limited resources,



To help simplify existing network and I/O wiring, Phoenix Contact's (Harrisburg, PA) IP67 I/O modules are mounted directly on machines and can be implemented in several fieldbus protocols, including DeviceNet, CANopen, Interbus-S and Profibus-DP.

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KEY WORDS

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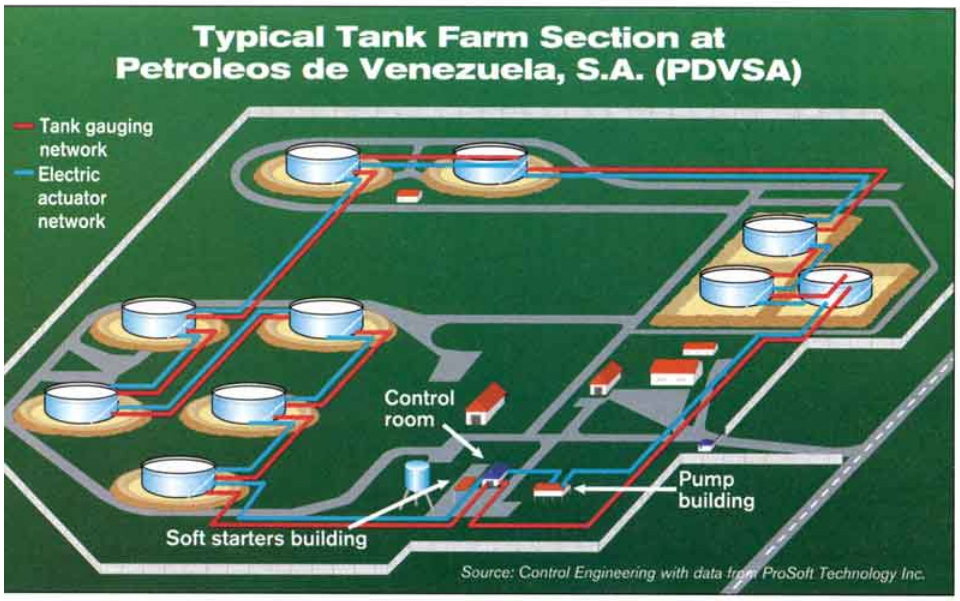


Tank farms operated by Petroleos de Venezuela, S.A. (PDVSA) recently installed ProSoft Technology's (Bakersfield, CA) 3100-MCM single-slot Modbus interface module on its Allen-Bradley 1771 PLC processors to assist stress-reducing soft starters for Limitorque's (Lynchburg, VA) valves, as well as improve communication between its tank gauging system, Limitorque's electric actuator, two-wire control system and motor protection relays.

making it difficult to take on a project of this size during current economic conditions. So, they often decide to just stay with their old network for another few years."

Unfortunately, the problem with older networks is that the little data they provide is usually too simple and abstract for today's needs. For example, a 4-20 mA signal can show whether a device is on or off or indicate an overall level of vibration. However, this limited analog signal doesn't have enough bandwidth and isn't dynamic enough to indicate a cause for the vibration or point to a reason why it's happening.

Start with smart devices

Fortunately, there are several ways to spruce up even traditional networks. One of the most popular is to enhance an older network's I/O devices, for example, by installing smart transmitters than can gather and more easily broadcast data upstream. In fact, users of some legacy HART networks are learning they can secure sophisticated data via existing 4-20 mA wiring and smart devices.

Similarly, PC-based and other embedded or distributed solutions can also help collect, analyze, and distribute analog and serial data from legacy devices and networks. For instance, National Instruments' (NI, Austin, TX) FieldPoint 2000 brings in analog signals and uses its LabView software's computations to enhance existing data and control functions. Don Holley, NI's automation marketing manager, says LabView RealTime's PID algorithms were recently used at a paper mill to perform disturbance rejections and pick PID gains, which improved water temperature regulation and prevented system oscillations.

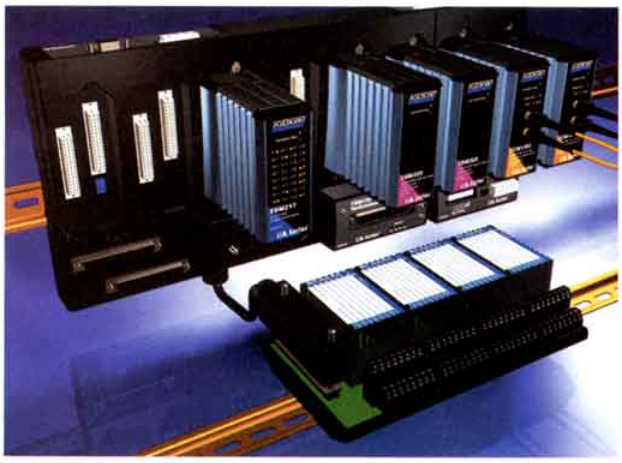
"Users first have to ask themselves what's driving them to change their legacy network?" says Mr. Holley. "Does it need too much maintenance? Are segments of it no longer supported or are parts no longer available? Does the application need optimization that the legacy system can't perform? Or is there just some information or features users want that the legacy system can't deliver?"

Mr. Holley says increasing use of fieldbus standards and other interoperability efforts, such as the OPC Foundation's (Scottsdale, AZ) OPC Data eXchange (DX) project, also help bridge legacy-based systems to newer networks. OPC DX is even expected to allow protocols, such as Profibus and DeviceNet, to talk to each other. [For an update on OPC DX, see this issue's News section.] To further ease networking efforts, OPC servers are included in many solutions, including SST-DNP-104-2, a two-channel PC/104 interface card from Woodhead Connectivity (Waterloo, Ontario, Canada).

HART's resurgence

Because inexpensive renovations generally mean doing as little as possible, HART is probably the most useful way to enhance a veteran network because it's likely to require the least new equipment. About 75% of current process instrumentation shipments consist of smart instruments and 75% of these are HART-enabled, according to Ron Helson, director of the HART Communication Foundation (Austin, TX). This means that many users can update their networks with smart field devices they're probably already using for tasks, such as set up, calibration and maintenance.

"Many people don't know that HART can be used for communications in real time, and many are astounded to learn it doesn't require device description language," says Mr. Helson. "You can simply go behind a panel in your control room; tie in a low-cost interface module to existing 4-20 mA wiring between the control system and field devices; and that module will allow you to communicate with HART field devices, and give you access to secondary process variables." These other variables actually ride on the same 4-20 mA wires as the primary variable, and are then broken out by the new interface module. Mr. Helson adds these secondary variables can include data on actual valve positions, which allow comparisons with target positions.



Invensys/Foxboro's I/A Series Fieldbus Modules enable I/A Series systems to use HART communications to continuously access a variety of field device diagnostics and other asset management data from workstations or PCs.

HART helps process variables break out from 4-20 mA

Interface modules access variables

The two latest versions of these interface modules are I/A Series Fieldbus Modules from Invensys/Foxboro (Foxboro, MA) and HIM Smart HART Loop Interface and Monitor from Moore Industries-International Inc. (North Hills, CA).

Moore's HIM Smart HART Loop Interface and Monitor allows up to three additional analog process measurements from smart HART multivariable mass flow, level, pressure and pH transmitters. For a multivariable mass flow transmitter, this can include pressure, differential pressure, process temperature, flow rate, flow total and sensor temperature.

Using HART digital data riding on the 4-20 mA current loop, HIM separates up to three 4-20 mA signals representing any combination of a smart multivariable transmitter's first, second, third or fourth measurement variables. The variables can then be used by analog control systems, such as a DCS or a PLC. Also, dual alarm trip outlets can be individually configured to warn of high/low process conditions.

These outlets can also be set to alert if a monitored device and/or the HART monitor is experiencing a fault condition. This includes using the HART protocol's status bits to indicate a smart transmitter cold start; field device malfunction; or that the primary variable analog output is fixed, saturated or out of limits.

Similarly, Foxboro's I/A Series Fieldbus Modules work with its I/A Series Control Processor 60 to provide real-time access to process data and status, as well as on-demand access to field device parameters and diagnostics. Each module channel provides a 4-20 mA analog signal and a HART digital signal, so users can mix conventional 4-20 mA field devices with HART smart field devices. In a long-term field upgrade program, such a configuration would allow users to integrate smart transmitters that might already be installed and gradually update conventional field devices to HART using funds budgeted for maintenance.

Mr. Helson adds that, "By fully integrating HART communication with the plant control system, as Foxboro has done, the system communicates with HART devices on a full-time basis to detect and alert users to impending problems before they can negatively impact the process."

The late Jim Gray, Invensys' director of I/A Series system marketing, added that, "Compared to FOUNDATION fieldbus and other similar approaches, HART field devices are less expensive to purchase, and are easy to install and commission. While communicating at a slower speed than the digital fieldbuses, HART devices offer many of the same benefits, including remote configuration and real-time asset management capabilities." [*Control Engineering* regrets Mr. Gray's recent death and offers its condolences to his family and many friends. For more on his recent passing, see this issue's News section.]

Interoperability, components

Other economical methods of accessing and improving veteran networks include combining existing components. For example, Wago Corp's (Germantown WI) RS-232 I/O module can be joined with its programmable field controller (PFC) to move data from up to 64 I/O modules and 90 module types via 4-20 mA wires, Profibus or Ethernet. Users can also support a legacy network by dropping an IEC-61131 function program into the PFC's Modbus master, which allows them to take data from an RS-232 module and Modbus network, and transfer it any other specified network, according to Charlie Cook, Wago's technical manager for advanced electroniucs.

"Augmenting veteran serial or 4-20 mA networks cannot only be accomplished by bridging them to newer technologies, but by accessing and utilizing them with lower cost and easier to use products within their current architecture," says Paul Ruland, Automationdirect's (Cumming, GA) PLC and I/O product manager. "The market now offers micro PLCs under $200 that include built-in RS-422 and RS-485 networking ports, along with nano PLCs under $100, both of which support industry *defacto* standard Modbus RTU master/slave capabilities and offer 4-20 mA analog I/O options for as little as $20 per channel.

Woodhead Connectivity's SST-DNP-104-2 two-channel PC/104 interface card for DeviceNet can connect a PC/104 computer to two DeviceNet networks.

Mr. Ruland adds that, "The advancement in microprocessors, RAM and ROM technologies, and efficient surface-mount manufacturing techniques has provided great benefit to smaller customers, and has allowed them to preserve their basic network designs longer under tighter cost restraints. Also, many of these lower cost networking and analog capabilities in nano and micro PLCs have new easy-to-use features like Modbus-specific master instructions, and built-in autotune PID setup loops that automatically transfer and setup the 4-20-mA analog I/O data with no module required."

Similarly, PLC-based networks can also add Ethernet-enabled modules, such as Lantronix's (Irvine, CA) UDS 100 device server. Paul Wacker, Lantronix's product marketing manager, says this not only helps users avoid costly network replacement, but also allows them to perform local serial port-type functions from anywhere on an industrial network.

In addition, to help higher-level fieldbus protocols access legacy systems, Rockwell is releasing its Entek XM Series condition monitoring solution in September 2002. Using existing network infrastructures for plant-floor connectivity, XM is a module that can bridge DeviceNet, ControlNet and Ethernet/IP protocols as well as 4-20 mA outputs. Because Modbus is one of the most prevalent legacy network it encounters, Rockwell is planning on developing a Modbus interface to XM. Rockwell's Mr. Alford says XM allows users, for example, to observe vibration changes in machinery. These data can be used to establish trends, and subsequently reduce unneeded preventive maintenance and downtime. □

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