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Satellite Communications
Find Use for Expanded Monitoring Applications

BY GREG BERLOCHER

Many monitoring applications are a good fit for satellite communications, as they often involve remote locations which are hard to serve via other telecommunication alternatives. The amount of data to be transmitted, how much latency can be tolerated, and the availability of electricity from the power grid are just a few of the challenges satellite engineers must deal with.

Although the monitoring market is a good one, it is not homogeneous. Monitoring covers a broad range of applications which often are lumped under a single, generic moniker. In reality, the monitoring market is stratified with different solutions, each with quite different communication needs.

Distributed control systems (DCS) typically are seen in refineries, factories, electrical substations and other automated industrial environments which require extremely quick logic decisions. DCS systems use programmable logic controllers (PLC) which can detect a change of state, such as an overload in an electrical transmission line, and can respond within a few milliseconds. These systems are hardwired, relying on either copper of fiber-optic cables to link PLCs and host computers. Supervisory control and data acquisition (SCADA) systems involve a host computer system which interacts with remote terminal units (RTU). The RTU serves as an aggregator for different types of analog and digital input and output devices and converts the data into a transmission protocol. SCADA systems use some form of telecommunications to connect the SCADA host to the RTU, allowing the host computer to gather status data from and issue controls to devices hundreds or thousands of miles away. Generally, response times in SCADA networks range from a fraction of a second to several seconds. In some cases, gathering data is the main goal, with few control commands being sent from the host. These types of networks are often referred to as data acquisition networks instead of SCADA.

Machine-to-machine (M2M) networks embody many of the same functional requirements as SCADA networks, but there generally are fewer points of data per remote asset, have limited control functions, and often have much greater latitude when it comes to response time. While SCADA systems are deployed to monitor and control strategic assets such as an electrical grid or pipeline, M2M type services are used to monitor and manage non-strategic assets, including mobile ones. Automated meter reading (AMR) systems have been the dream of electric, water and gas companies for decades, but technology costs have precluded their large scale adoption. The advent of low cost RF devices, combined with the ubiquity of the Internet, is beginning to change the tide in favor of future AMR deployments.

Satellite communication can play an important role with all of these types of networks. While DCS systems have been singled out for the demanding response time requirements, it is not uncommon for a DCS system to cohabitate with a SCADA system. Electrical substations are a prime example, with a DCS system monitoring and resetting circuit breakers locally, while the SCADA system is used to monitor and control other electric devices at the substation. Hughes has a long track record of success supporting SCADA networks in the oil and gas pipeline and electric utility industries which has led to several new initiatives. Doug Medina, Hughes senior director of marketing, says the company is engaged in pursuing two smart grid initiatives—substation communications and monitoring and advanced meter infrastructure (AMI). "The electric utilities in the United States have a number of critical assets at substations which need to be monitored in real-time. Substations are often located in areas where there isn't a lot of terrestrial communications coverage. Satellite is also finding a home in helping the electric utilities reach their goal of near 100 percent network uptime. The utilities have found that satellite is well suited for their needs and the demand to monitor these critical assets is increasing," he says. Medina also notes Hughes' advanced meter reading initiative. "Utilities are ramping up the deployment of advanced meters in the residential market. The meters often have RF devices embedded in them, and VSAT is an ideal communication path to backhaul the consumer's home usage data from the different meter collection points."

Spacenet is another satellite service provider with a long history of supporting SCADA applications. The company's Armadillo terminal sprts a ruggedized satellite modem which did not need air conditioning, allowing it to be mounted next to outdoor equipment. The Armadillo has several DC power options, allowing it to be powered from a battery system. Spacenet has just launched the second generation of Prysm Pro, an off off-the-shelf IP network appliance that can be customized to support enhanced applications. Prysm Pro provides integrated support for a wide range of standard applications, including multiple network connections to assure high network availability, monitor control and video surveillance. Amir Yafe, executive director of product management and technical marketing at Spacenet, says Prysm Pro allows customers to develop custom applications and pointed to the unique needs of operators of SCADA networks as a prime example. "Pipelines and electric utilities typically have unique communication requirements, including extremely high network availability and support for unique serial protocols. The Prysm Pro allows clients to develop custom applications which run on modular hardware that interconnects with the VSAT. The Prysm Pro is integrated into Spacenet's network management system allowing the customer to control much more than their VSAT network," he says.

iDirect is looking more aggressively into SCADA networks, says Michel Zimet, the companies director, vertical

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marketing, energy and utilities. "Utilities, pipelines and water districts want to replace narrowband networks and bring [Voice over IP] and access to corporate applications into remote locations where they have their equipment. The deterministic TDMA scheme iDirect utilizes allows predictable response times for SCADA applications, and our advanced group quality of service (GQoS) feature ensures that SCADA traffic always has priority over voice and office automation applications."

Zimet points to several emerging trends in monitoring and SCADA applications. "RTUs have been moving away from low-speed serial connections for a while now. Just about all new RTUs have Ethernet interfaces. … We also see new federal regulations, such as NERC Critical Infrastructure Protection (NERC CIP), having an impact on network planning. These requirements stipulate that utilities have a viable backup network in place. We have all seen what happens to wireless networks during a major event. A satellite network is the only viable alternative to back up a terrestrial network. SCADA clients also like the fact that a satellite solution can be a closed network, without any connection at all to the Internet. Add link encryption to that and you begin to understand why utilities have become increasingly aware of the benefits of satellite. The NERC CIP requirements are forcing them to take a much closer look at satellite than they did before."

Although the Hughes 9201 was first developed to support voice and Internet connectivity, Inmarsat's BGAN service appeared to be a natural fit for many monitoring applications, with reasonably priced hardware, global coverage and affordable airtime for good quantities of data. Previous testing revealed that the original terminals would not auto-power cycle and were prone to ultimately dropping their network connections without autonomous ability to re-establish them. Human intervention was required to reestablish a network connection. This limitation severely hampered the adoption of Inmarsat's Broadband Global Area Network (BGAN) service in the monitoring community and the anticipated stampede of users never materialized. Recognizing the problem, Hughes developed SCADA-friendly firmware to solve these issues and is relaunching the 9201 as an M2M BGAN terminal. The new hardware sports features that should solve the problem of dropped network connections. The terminal has an Ethernet port, supports SMS functionality and is powered by low voltage DC, making it much more solar-friendly than traditional VSATs, which typically require 20 watt AC of continuous power.

A quick Web search reveals that basic BGAN service can be acquired for about $60 per month, which includes a fixed IP address which can be used globally. Data traffic is extra, costing an estimated $6 or less per megabyte. SCADA networks offer near real-time collection of data and allows control commands to be sent in an expeditious fashion, ranging from a fraction to several seconds, but minimizing latency comes with a price. While this sort of responsiveness is critical to electric utilities and pipelines, it would be incorrect to assume that everyone needs the same response time.

Asset Management

Asset management is another subsegment of the monitoring market. Periodic data sent back from an industrial asset provides a snapshot on the asset's status and overall health. For instance, an isolated tank holding liquids is periodically drained by a tank truck. If the tank is M2M enabled, it can send out a notification that it is approaching its holding capacity. Knowing the volume level in the tank allows the company that owns the tank to schedule a truck roll when needed rather than visiting the tank on an arbitrary schedule. This saves labor cost, fuel and reduces windshield time — a plus in a litigious society. The response time for a tank level application is radically different than the responsive required for a liquid pipeline, which can burst within seconds should there be a dramatic spike in pressure. As the strategic value of an industrial asset goes down, the value of real-time monitoring decreases

as well. M2M applications are a less expensive form of monitoring which provide less frequent snapshots of data. A complete scan of a company's assets may take hours, or even days.

A good example of a satellite terminal that is well-suited for the M2M segment is the SAT 202 from EMS Global Tracking (a division of EMS Technologies Inc). The SAT 202 enjoys an extremely small footprint, just 11 centimeters in diameter, and weighs 8 ounces. It will operate in temperatures ranging from -40° to 70° C. The SAT 202 accepts a voltage range of 9 to 36 V DC, making the unit easy to power with a battery system. Enhanced energy management options allow the unit to be put to sleep during quiescent periods making it extremely solar friendly. The SAT 202 has serial interface allowing it to connect to an external RTU or PLC. The unit also has its own inputs and outputs (I/O), allowing it to interface directly with a variety of sensors. Internal scripting capabilities allow developers to come up with a variety of new applications. You can choose to use the internal I/O and eliminate the cost of the RTU or use an external I/O controller (EMS' GEM product) to bolster the number of sensors you can monitor if the RTU has limited capacity. While the unit is small, compact, and solar-friendly, it is designed to send small bursts of data. Each message can contain a maximum of 8 bytes of data, or 84 bits. While writing extremely tight code might appear to be a lost art, M2M developers excel at this craft.

Look for the monitoring market to continue its growth in the future, with new and exciting services being introduced. Miniaturized sensors costing a fraction of earlier models are becoming pervasive, helping to fuel this growth. Look for satellite to play a major role in the monitoring market for years to come.

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