



Seven questions to ask before building your  
**satellite SCADA network**



# Introduction

Traditional satellite communications has had a stigma of being expensive and requiring large, power-hungry terminals that are complex to integrate with your applications. For this reason, satellite services for Supervisory Control and Data Acquisition (SCADA) applications, low data rate (LDR) solutions and other remote unmanned machine to machine (M2M) monitoring management services have, until recently, only been thought as a last resort option used only where landline or cellular networks do not reach.

Today's modern satellite communication services now offer a range of new options specifically designed for SCADA and remote monitoring applications. Today's options bridge the gap, provide reliable, cost effective satellite services using small, low power consuming terminals that are easy to install. Global remote management applications such as those that monitor oil and gas pipelines, Smart Grids, track vehicles and vessels are leaning towards satellite communications over traditional cellular and terrestrial solutions as satellite not only increases reliability but also reduces the total cost of ownership.

This white paper describes why satellite communications is a cost effective and powerful solution. By exploring seven key questions, you will understand how satellite SCADA solutions meet your key requirements and how these services support modern SCADA applications.

For the remainder of this paper, SCADA will refer to any remote monitoring solution whether it is for SCADA, LDR or M2M, covering situations such as monitoring the flow of natural gas through a pipeline, monitoring the pressure of an oil well or sending weather data from a remote weather station.

## The evolution of satellite communications – reducing the cost of ownership

Within the SCADA and other industries, there are many misconceptions of what today's modern satellite communications actually are, such as:

- > Expensive to operate and maintain
- > Complex to install
- > Large and requiring significant space to install
- > Requiring significant amounts of power to operate
- > Unreliable in harsh weather

Today there are new satellite terminals designed specifically for SCADA applications. These solutions operate with extremely low power consumption, are easy to support, easy to maintain and can be installed without any specialized skills. The total cost of ownership is much lower than before and certainly lower than the misconceptions would have you think. New low cost airtime usage bundles are ideal for the majority of SCADA applications.

As an example, in Canada, pipeline monitoring of oil flow from the oil sands of Alberta is necessary to maintain delivery of oil to distribution centers. This traditional satellite solution normally requires antennas of at least 1.2m diameter; sometimes with anti-icing technology in the colder areas; an enclosure for modem/network devices; and, trained satellite technicians to install/design the solution. Many times the installation costs exceed the equipment costs.

The new Hughes 9502 M2M is a prime example of a terminal specifically designed for SCADA. Its small, simple two-piece design uses only an outdoor antenna and an indoor modem connected by an RF cable. With a simple pole mount design, setting up the terminal is as simple as pointing it in the approximate direction of the satellite – the terminal's browser based user interface will let you know when it has acquired the strongest satellite signal. Its stand-by operating power is less than 1W. The terminal also features a "Watchdog Timer" which automatically reestablishes a satellite connection in the event it is lost. It can also be remotely managed using SMS commands.

The evolution of modern satellite services is bridging the gap, providing more attractive alternatives than cellular or terrestrial solutions.

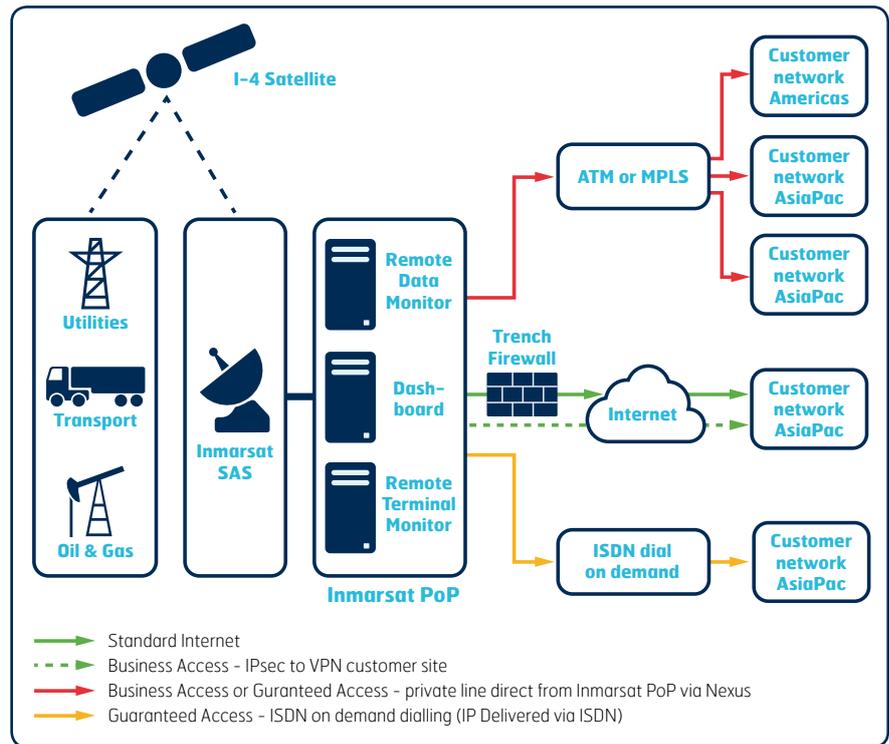
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## SCADA networks – remote management at its best

SCADA systems are networks collecting data from equipment sensors that transmit and receive data with a distant control center. Each sensor monitors operating parameters, such as temperature, pressure or video (for security). Terminals collate and transmit data from all sensors. Sensors also receive data from control stations to optimize their control parameters. The size and scale of a SCADA network varies depending on the scope of the particular operation – some have only a few sensors while others are large and globally connected.

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SCADA networks support various remote monitoring applications, with various security options.

## Seven questions to ask before building a SCADA network

Building a SCADA network can be complex, with many requirements and variables to consider, all of which will affect your total cost of ownership and network performance. Many of the variables are very specific to your situation. However, there are seven fundamental requirements that drive the key questions you should ask yourself in order to design the SCADA network that is best for you:

### 1: How much data, in kbytes or Mbytes per month, will each remote terminal transmit and receive?

You need to base your SCADA network on the amount of data that you expect to transmit on a monthly basis. How many kbytes or Mbytes will each of your terminals transmit and receive on a monthly basis? As mentioned earlier, terminals collate data from sensors in the network and push it to a control station. Conversely, these terminals also receive data from the control station to optimize their control parameters. Knowing what information you are sharing back and forth can help determine how much data each terminal sends and receives per poll, or transmission.

In the majority of cases, SCADA systems poll remote terminals at consistent time intervals so you can easily calculate monthly terminal. If you poll your remote terminal every 15 minutes, there are 96 polls per day. At 10 kbytes per transmission, that would be 960 kbytes per day, or 28.8 Mbytes per month. Be careful though, if terminals poll based on events (such as alarm driven polling) you will need to conduct more statistical analysis to determine the average data use per terminal.

Optimized based on cost, power consumption and size, modern SCADA satellite services are now available that cover the full spectrum of monthly data use requirements.



## 2: How frequently will I poll information from my remote terminal?

SCADA applications generally poll for information at regular intervals such as once a day, once an hour, every five minutes or even every 30 seconds. The more frequently you poll, the more data you send across your network and the more power you will need to fuel the remote terminals.

Situations where conditions change every few seconds, or possibly even faster, need near real-time updates – as we see in the oil and gas sector. Typically, the data packets sent for SCADA are very small, so speed of transfer is not an issue. But the volume of data moving across your SCADA network will quickly add up at month end. Therefore, for frequent polling monthly, flat-rate price plans are typically more economical versus pay-per-MB plans.

Modern satellite SCADA terminals generally stay in a low power state (idle mode) when they are not transmitting data. Every time a terminal changes state from idle to transmit, it uses additional power. So, increased frequency of communication can have a significant impact on your final power budget.

## 3: What is the power source for each terminal?

One of the most important requirements to consider is availability of onsite power. Some SCADA solutions rely on mains power or generators while others can comfortably run on batteries and solar power. As a rule, the more power you require the more expensive and complex your remote power solution.

As SCADA is usually a very remote application – a pipeline may travel through very remote territory to bring oil or natural gas to a distribution point – you cannot rely on access to reliable mains power. Yet, access to a power supply is essential, not only to operate the communication terminal but all remote sensors and control systems as well. You may need to consider asking your provider if solar power, batteries or other power options are available.

Based on Shannon Heartly's Information Theorem<sup>1</sup>, there is minimum amount power required to send information. The more information you wish to send the more power you require. Once you have answered questions 1 (how much data) and 2 (how frequently do I send/receive data) you can then determine how much power you need. Choose your satellite provider carefully as many do not offer low power satellite solutions.

You will also want to ensure that your system optimizes its power consumption so you are not wasting money or energy, particularly in a remote setting. The Hughes 9502 terminal operating on Inmarsat's BGAN M2M service is an example of a terminal that has smart power management. The satellite service and terminal coordinate their operation to optimize power consumption. When the 9502 is idle it uses less than 1W of power and, at the same time, Inmarsat's satellite network places 'idle terminals' over a low power satellite regional beam to keep power consumption to a minimum. After 90 seconds of inactivity over the BGAN M2M service, the terminal and BGAN service revert quickly to idle mode<sup>2</sup>. The combination of terminal management and satellite management keeps power consumption to a minimum.

## 4: In what kind of environment will each terminal operate?

SCADA solutions generally operate in very harsh environments. You need to understand the environment in which your SCADA network will operate in order to choose the best-fit terminal and service. Weather not only affects the remote terminal, it affects the availability of the communication service. Heavy rain, snow and even dust can degrade communication services. Choose your service based on its reliability in the typical weather you expect for your SCADA sites.

Do your homework. Learn what frequency band a satellite operator uses and ask for their availability statistics. Some frequency's fair better in harsh weather, particularly heavy rain, and some networks are more robust.

Also, ask how your terminal will stand-up in extremely hot or cold temperatures, dry dusty conditions or very wet tropical conditions. New SCADA satellite terminals are engineered for harsh weather; Inmarsat's offerings are robust and designed for strict environmental standards. You may also consider custom or included enclosures as added protection.

## 5: How secure must my data be?

Defining your SCADA security requirements can be an extremely difficult task. However, everyone implementing SCADA solutions acknowledges its importance. Once compromised, trying to fix your security vulnerabilities after the fact is an expensive task. Simply put, you must implement security to your SCADA network upfront to avoid malicious attacks.

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Cyber attacks on SCADA networks are a very real and serious threat. The most well known was on the Maroochy Shire Council's sewage control system in Queensland, Australia, in January 2000. Their control system was experiencing intermittent faults the operators thought to be an equipment failure. However, it was a network attack on the control system that resulted in the flooding of 800,000 liters of raw sewage in parks, rivers and the grounds of a Hyatt Regency hotel. The cost for repairing the damage in the Maroochy Shire attack was in the millions.

<sup>1</sup> Shannon-Hartley Information Theorem provides a method to determine the maximum rate at which information can be transmitted over a communications channel of a specified bandwidth and power in the presence of noise.

<sup>2</sup> idle mode means 'always on'.

Look for a SCADA network that provides the level of security you need. As an example, Inmarsat provides a secure global private IP network solution for its SCADA customers. Over 8,000 satellite SCADA terminals reside on the Inmarsat network in North America and all use secure private network solutions. Using a single global private IP address, remote terminals are configured centrally and moved between locations without needing to be re-configured.

Your security protocol should call for your system to bypass the public internet; depending on your budget and security concerns there are many options available. Consider options such as leased lines, MPLS circuits<sup>3</sup>, encrypted virtual private networks<sup>4</sup> or VSAT backhaul. Inmarsat also offers private networks encrypted with password and SIM card protection to ensure only authorized users have access to your data and remote terminals. Obviously, the more complex the option the more expensive. This is where your own cost-benefit analysis of the cost of security versus your peace of mind factors.

> Look for operators focused on SCADA solutions and be aware that many cellular companies may fall short on being able to support your network.

## 6: How much network downtime can I tolerate?

All communications services, no matter what service you choose, suffer downtime (outages), be it weather or hardware related. For your SCADA network, downtime may mean lost production and revenue, particularly for those who choose to poll for data in real-time. To be realistic, determine how many hours of acceptable downtime you can afford in one year and convert this to a percentage. For example, 100 hours in one year equates to approximately 98.9%.

Most satellite providers design their services around achieving specified satellite network availability. Inmarsat's satellite SCADA networks achieve availability of 99.9%, or just under 9 hours of downtime a year. By comparison, commercial Ku-band VSAT networks generally operate at 99.5% availability, or 44 hours of downtime a year.

For most, these downtimes are acceptable and users can choose one over the other. However, many oilfield operators cannot and deploy both Inmarsat's L-band satellite and Commercial Ku-band VSAT service at the same time. The combined availability of the two satellite networks equates to 99.997%<sup>5</sup>, or 30 minutes of downtime per year – allowing them access to real-time data virtually all year.

Some SCADA solutions use cellular communications to transmit data. Be careful though, the majority of cellular providers will not guarantee service availability. However, there are options that combine the best of both worlds. For example, Inmarsat's IsatData Pro terminal, the IDP-780, incorporates both satellite and cellular services, benefiting from the relatively lower cost of cellular and the high availability of satellite.

Another aspect to consider is the level of support and SCADA expertise from your provider. Today, most satellite operators monitor their network 24/7, and provide 24/7 customer support. Look for operators focused on SCADA solutions and be aware that many cellular companies may fall short on being able to support your network.

## 7: Does the terminal use a Serial or IP protocols to communicate with the remote sensor?

IP communication is considered the industry standard for data communications, surpassing serial-based protocols. New remote sensors and remote terminal units use IP protocols though a large number of remote sensors still communicate using serial-based protocols such as RS-232 and RS-485.

A problem arises when your remote serial based sensor communicates over an IP link. This is common with SCADA networks, so you should look for an IP-to-serial converter, or terminal server, to translate the protocols. However, this does mean another device that draws power and takes up space.

Some satellite SCADA solutions accommodate combinations of IP and serial-based protocols. IsatData Pro and Ku-band VSAT SCADA from Inmarsat directly supports serial-based protocols. While the BGAN M2M Hughes 9502 terminal's native protocol is IP, Inmarsat provides a fully integrated enclosure with pre-configured terminal servers to support serial-protocols.

## Choosing your satellite SCADA network

Once you have answered these questions, you have identified your basic SCADA requirement and can narrow your search for the terminals, network and security options that are right for you. Consider today's range of satellite SCADA services that meet the requirements of even the most demanding SCADA networks, with a lower total cost of ownership than traditional satellite services. And, finally, choose your SCADA provider based on their experience, focus on SCADA services, and network availability.

3 Multiprotocol Label Switching (MPLS) is a mechanism in high-performance communication protocol that directs traffic from one point to another encapsulating data over a variety of transport protocols such as ATM, frame relay, DSL.

4 Note: Secure VPNs do traverse the internet via a secure tunnel making the traffic logically separated from the internet and secure from network intrusion and attack.

5 Combined Availability =  $1 - (1 - \text{BGAN}) * (1 - \text{VSAT}) = 1 - (1 - 0.999) * (1 - 0.97) = 99.997\%$

# Conclusion

Today's modern satellite SCADA services offer a range of options suitable for virtually any SCADA network, and should be considered even if cellular or terrestrial services are available. Providing cost effective services using small, low power consuming terminals that are easy to install, satellite based SCADA networks have increased reliability and lower total cost of ownership versus cellular or terrestrial. More and more, global remote management applications, including those that monitor oil and gas pipelines and Smart grids and track assets are relying on satellite communications. Based on the seven key questions explored in this white paper, satellite based solutions meet the requirements for even the most complex SCADA network.

## Find out more

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