# Location, Location, Location: Choosing the Right Telemetry Method for Your Remote Water Monitoring Applications

Because of the remote locations and naturally harsh environments of many water resources, monitoring and communicating the resulting data is not always simple or straightforward. Telemetry is an automated process for performing measurements and collecting data back to receiving equipment for analysis. Remote or inaccessible locations require the use of different radio communication technologies integrated into the telemetry system to transmit the information. Therefore, a remote telemetry system is a necessary tool for many water resource monitoring professionals. This whitepaper will take an in depth look at using the most effective and efficient telemetry method to monitor and transmit water resource data based on the location of the application.

## The Origins of Telemetry

The automated communication process for performing measurements and collecting data, what is commonly referred to as telemetry today, can be traced back to the early parts of the 20th century when power utility companies needed a method to understand the operational conditions of their supply networks. During the mid-1960s, computer technology with the ability to process real-time functions emerged, enabling the dawn of supervisory control and data acquisition systems (SCADAs). These industrial utility systems were hardwired to monitor the status of the equipment, trigger alarms for changes, and in some cases, log data. Over the decades, the markets and technologies developed rapidly to include network analysis functions to allow for energy management of the utilities network, and part of these systems included radio communications to substations. Separately, the 1950's also exhibited the beginnings of aerospace telemetry when the Soviet Union launched Sputnik 1 and that, in part, has led to a huge global satellite communications network.

Regardless of the application, the data communications from early telemetry systems had limitations. The data was being delivered to the control center, but the systems usually did not offer the capability to interact directly with the remote transmitter and sensors. Today, we are more inclined to refer to concepts such as machine-to-machine (M2M) communication or the Internet of Things (IoT) when discussing how to embrace the promise of data communications products and services to help solve problems. However, some of the legacy communications systems still have an important role in helping hydrological and meteorological professionals resolve complex issues.

In the following pages we will discuss:

- Environmental Satellites (GOES, INSAT, etc.)
- Iridium Satellites
- Cellular Communications

**Satellite Data Transmission: Reliably Communicate Data from Even the Most Remote Areas**

## Geostationary Satellite systems

Today, there are a number of geostationary satellites operated by different government or intergovernmental organizations. Some of the services these satellite systems support include weather forecasting, climate data, severe storm tracking, meteorological research, and environmental monitoring. In addition to performing these tasks and providing photographic images, these satellite systems offer the option for government organizations to perform remote data transfer of hydro-metrological data from the Earth.

The Indian National Satellite System (INSAT), European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), and Geostationary Operational Environmental Satellite (GOES) are examples of these systems (Figure 1). The GOES satellite system, operated by NOAA in the United States, comprises of two primary satellites located 22,300 miles above the Earth's surface. Operating simultaneously these two satellites cover Alaska, Hawaii, the entire continental United States, and the Pacific and Atlantic Oceans.

All over the world, many public agencies play key roles in water resource monitoring, from managing the quality and availability of water for public consumption to predicting water-related events that will affect the public, such as flooding. These public organizations, such as the US Geological Survey and the US Army Corps of Engineers, rely on data from thousands of monitoring applications in remote sites ranging from southern swamplands to streams in the Rocky Mountains. Typically, one of the biggest challenges with remote locations is transmitting the acquired data from the water being monitored to a back office database in a reliable and timely manner (Figure 2). For remote applications that do not require real-time data communication, using equipment that transmits data via these geostationary satellite systems at predefined cyclic one hour intervals is ideal to meet the needs of the water resource managers.

While these integrated data logger transmission devices for satellite communication do use GPS to help guarantee communication stability and reliability even in the most remote environments, one of the limitations of this method for transferring data is the inability to perform two-way communication. Thus, if the Data Collection Platforms (DCP) system software needs to be updated, or a minor issue needs to be

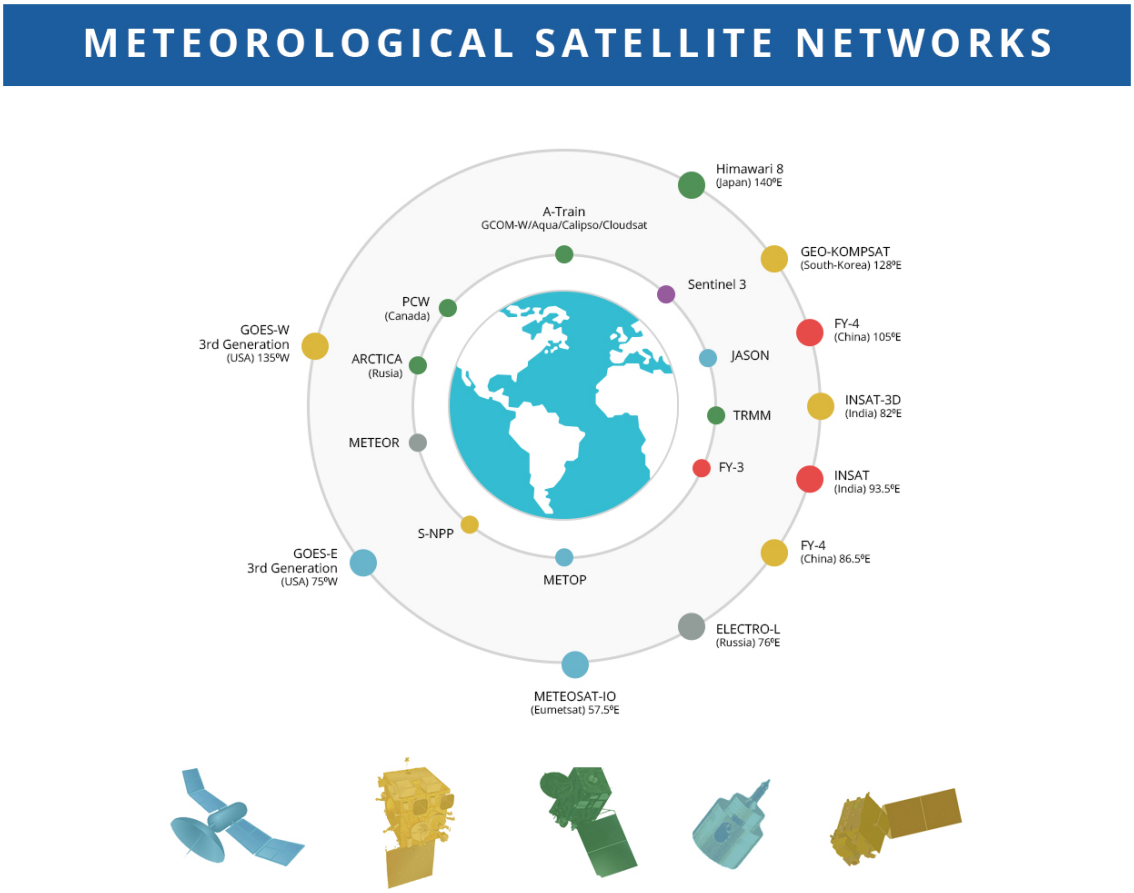



***Figure 1.*** *Geo Stationary Satellites*

addressed, the only way to communicate with or manipulate the DCP/data logger equipment is to physically send someone onsite. This can take a lot of time and money depending on the remoteness of the site. In addition, the bandwidth of the network can be low and there is increasing pressure on the spectrum availability compared to what is available using other transmission technologies. The impact of this low bandwidth is that end users typically have a 10 second defined time slot every hour to send a limited amount of data. That said, for hydrometric and metrological applications that are not real time-critical, this radio transmission technology, coupled with the backbone infrastructure provided by an organization such as NOAA in the US, EUMETSAT in Europe, and the Indian Meteorological Department is a robust and reliable solution, even in hurricane conditions. In fact, there are more than 25,000 environmental monitoring stations successfully operating on the GOES network in North and South America.

## Iridium Satellite system - Short Burst Data

Iridium telemetry satellite technology uses a network of 66 active low-orbiting satellites managed by Iridium Communications to provide global communication services reliably with low latency. The fee-based service is well situated for underserved or remote locations as long as there is a clear view of the sky. A distinct advantage of Iridium satellites is that this technology can provide two-way communication between a remote station and a back office or server with redundant mesh satellite communication architecture to ensure quality of service. In addition, the small footprint of the modules along with their low power consumption, make this a viable option when the application has a lower volume of data but has a requirement for higher data availability. Typically, the delivery of a message occurs in less than 20 seconds with message delivery confirmation.

Iridium value-added resellers (VARs) integrate a specific subscriber unit and service into the DCP and data logger products offered to their customer base, providing the capability for a completely wireless end-to-end data solution. The water resources managers would typically have software from the VAR installed in their back office or server where the email messages from the Iridium gateway are decoded and made available to local databases or third-party applications. Common applications for Iridium include vehicle tracking and asset management; however, the growth of its use in environmental monitoring applications is reflective of the stakeholder's expectations of an economical modern monitoring network.

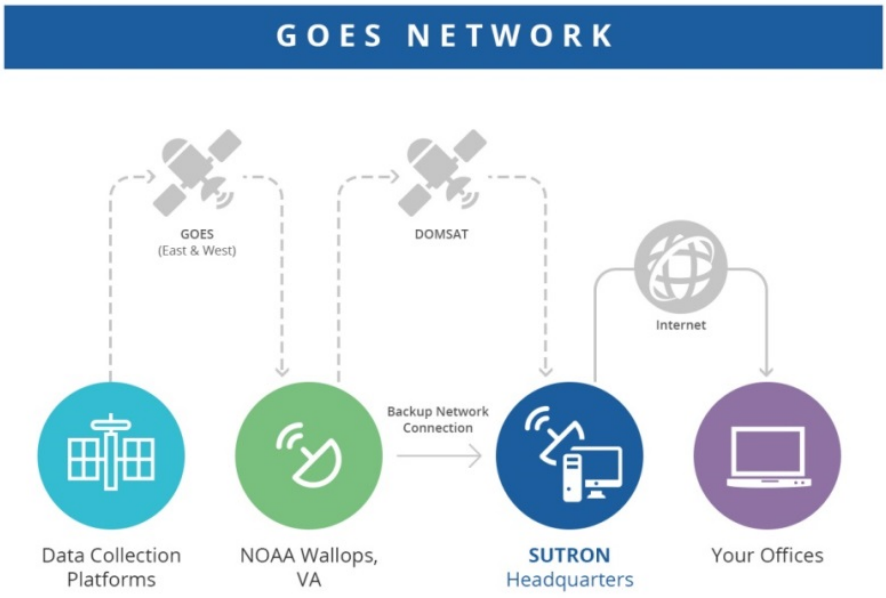



***Figure 2**. A diagram of an active data transmission from a remote measurement station using the GOES network*

## Cellular Communications - Reliable Data Communication for Non-Secluded or Local Applications

For applications not located in secluded areas, there are several telemetry options available for performing reliable data communication. A number of decades ago, the use of fax and modem dial up was common. The ability to access remote equipment and its data was possible given the proximity of the land line telephone network. With the growth of digital cellular technologies, such as Global System for Mobile (GSM) and code division multiple access (CDMA), came the use of data collection using methods such as short message service (SMS) and high speed data transmission services. Today, the use of handsets and smartphones is prolific, and the M2M industry has seen explosive growth.

When deploying a new network of remote monitoring stations and building the infrastructure, some items the implementation team needs to consider are service availability, latency, initial costs, sustainability, recurring costs, and two-way communications capabilities. Depending on the needs and budget of the organization, modern cellular technology can be an attractive option for many, especially since the monthly fee for these services has decreased significantly in recent years.

Environmental sensor and data logger manufactures have kept pace with recent trends to offer integrated hardware and software application solutions where the user only needs a data plan, SIM card, or appropriate account with a cellular provider to get data from the field to the desktop. Different regions globally use either GSM or CDMA digital cellular and in some countries both technologies are available. Generally speaking from a technology standpoint, the support for Internet protocol (IP) services are similar. The cellular network providers offer data plan products that target the increasing demand of M2M communications and it is common to have a third-party company offer managed services and connectivity solutions that can be more competitive than the principle cellular service provider. Other services offered include enhanced security services by leveraging VPN technology, custom APN access, and Static IP addresses. Typically, users consider the network coverage, recurring fees, and application requirements when selecting the best option.

In addition, the use of the terrestrial radio communications in environmental monitoring applications is common, particularly in areas associated with agriculture, energy production and mining. Having the ability to collect localized data from a range of different sensor parameters over a relatively small geographic area or catchment is becoming increasing important for the modern larger scale farming operation. An excellent example of utilizing radio communication for localized information and also leveraging cellular technology is the Adcon Telemetry suite of solutions. The low-power radio units have a range of up to 12 miles provided they have a good line of sight to the central telemetry gateway or base station.

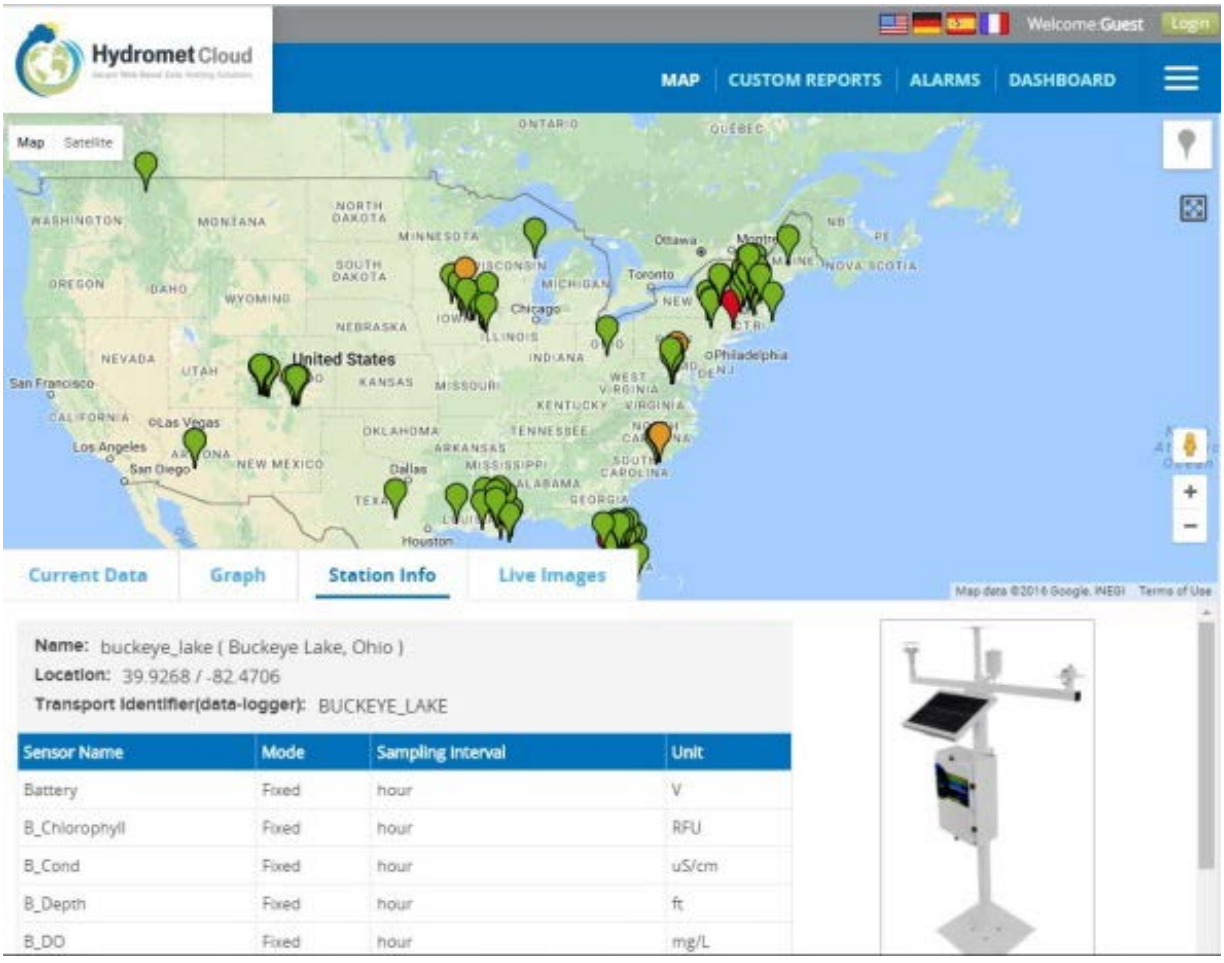
There are of course monitoring locations where landlines or cable still exists and can be fully utilized. The installation of a cable modem and Ethernet router is required in such cases. A big benefit of these modern fixed-line network installations is the live access to the sensor data along with the capability to fully control devices if required. More and more stations are starting to use cameras that can push their high-resolution images through these routers.

Having a monitoring network that has two-way redundant communications and IP capabilities has long lasting strategic implications. All modern organizations have goals to drive efficiencies, improve customer services, and deliver insights into the data collected. Recent trends have seen increases in cloud-based solutions that are not only providing visualization of the recorded data from a sensor on the site, but also, the application is providing information hidden in the data. This metadata, or data about the data, can be a valuable input for determining the quality of the data, site maintenance requirements, or perhaps underlining trends. The ability to remotely send data back, reconfigure the equipment, correlate sensor

data, or perform other tasks on demand is becoming part of an expectation of what a modern and future hydro-meteorological monitoring network can do regardless of the global location.

## Strike the Right Balance to Receive Your Data When You Need It

Current common telemetry methods are typically based on a single communication method, and, as you can see from the options we've already discussed, each method has clear advantages and disadvantages for various applications. Sometimes, the telemetry method that best suits your application is an obvious choice, such as using a satellite-based method for a surface water monitoring application in a remote area of India or Brazil, but for some applications, there is not always a clear answer. In some cases, a hybrid telemetry approach is an excellent option, but, this is not something that is commonly available from most vendors. For example, if you have an application setup to monitor the flow of a stream in an area that has access to a cellular connection, but, under normal conditions, you only need to send data to your office for review once per hour, the most cost-effective telemetry option could be geostationary satellite communication. However, if at a certain flow rate or precipitation intensity the stream could pose a flooding hazard or cause issues with a local municipality's water supply, you may need to communicate the data more frequently or send it to a different data ingestion web server application. In this case, cellular communication might be the best option. Therefore, a hybrid system that has the ability to change its transmission method based on site conditions or has a dual-communication path backup option would be the ideal choice.



Meeting the service delivery objectives of any organization is always as priority. The ability to leverage two-way communications when needed offers clear advantages. The use of the Sutron Satlink 3 for data logging and satellite transmission for day-to-day operations with optional Iridium and cellular transmissions as a backup will increase the service efficiencies and decrease the total cost of ownership for monitoring networks spread over wide areas.

Another consideration for choosing the appropriate telemetry method is, how frequently are you willing or able to physically be onsite to check on the application? If your application is located in an area that is not easy to access, you may want your application to function autonomously for an extended period of time. Thus, using a low-power and less frequent data communication method to preserve battery life, such as Iridium satellite, is the best choice if you absolutely need that data but have no other cost-effective communication infrastructure in place.

One additional item to think about is how will you receive and review the incoming data? While most large organizations can invest in a large server/software system or develop a propriety one, this can be a challenge for smaller organizations. OTT Hydromet helps organizations collect and manage data through its advanced data collection Web service, SutronWIN, which delivers the acquired data via the Internet in a ready-to-use format (Figure 3). Users who are logged into the website can view, plot, download, and process the data as it's received as well as set-up alerts and alarms for their systems. Hydromet Cloud can also take data from multiple sources and put the data into a single format for users. This service is hosted by OTT Hydromet, and is especially useful for organizations who need a monitoring network but don't have the IT infrastructure to build a backend network to support an in-house model.

## Benefits of the Right Telemetry System

Throughout the environmental water cycle, including surface water, groundwater, coastal water, and everything in between, there are water quantity and quality measurements that need to be performed and communicated at some type of regular interval. To develop the most efficient system, it is important to consider all off your available communication options before selecting one. Choosing the right telemetry method for your water monitoring application can offer many benefits including extending the life of your onsite systems and offering cost savings for both data transmission and system maintenance.

For more information on choosing the right telemetry method for your remote water monitoring applications, please contact Sutron or OTT Hydromet.

Sutron Corporation
22400 Davis Dr. Sterling, VA 20164 · U.S.A.
Phone (703) 406-2800
sales@sutron.com · www.sutron.com

OTT Hydromet
5600 Lindbergh Drive
Loveland, CO 80538 · U.S.A.
Phone (970) 669-3050
sales@otthydromet.com · www.ott.com