SCADA Alternatives for Remote Monitoring

Abstract

SCADA can be utilized for remote data acquisition but because it is primarily a real-time control system, the user must make significant compromises to use it for this purpose. These compromises include cost, data integrity, flexibility, convenience and control of the task.

Introduction

A substantial portion of a water utility's operations are in the remote distribution or collection system: pipes, pumps, valves, tanks, meters, etc. Utility management personnel need to know how things are working operationally throughout their system to properly manage it.

In addition to customer usage billing, system efficiency and maintenance concerns, utilities are driven by perpetual expanding government regulations and customer demand for improved quality, safety and security. All of these factors exert pressure on utilities to better understand and document the operation of their network.

Most water & wastewater utilities employ a SCADA (Supervisory Control and Data Acquisition) system or DCS (Distributed Control System) to operate and monitor their water processing plants. Extending the SCADA network into the field seems logical and almost obvious if new investment in remote monitoring is required.

SCADA however is often not the best choice for remote monitoring when compared to systems that are intended specifically for this purpose. SCADA RTUs are designed primarily to operate in a controlled environment powered by external power while continuously communicating over a network to its host server. This is expensive and impractical in applications such as monitoring underground sewers and water valve vaults.

This paper discusses alternatives to SCADA for monitoring applications throughout the water infrastructure that can:

- **Save substantial installation and operating costs**
- **Improve reliability**
- **Provide the user substantial information management flexibility**

The SCADA Rational

A SCADA system requires a huge upfront investment in centralized computer equipment, software, consultants, training and personnel time resources to initially implement. Once the utility has made this investment, expansion of the system per point is relatively inexpensive, providing additional justification for the initial investment.

Furthermore, the SCADA system manager and operators are reluctant to add alternative information collection systems, particularly if they do not seamlessly integrate with the existing SCADA system they have operating at the plants.

SCADA is the safe investment for management reviewing the options; personnel are trained in its use, the utility has committed substantially to its implementation, and it is not something new. The SCADA argument is compelling and, for many remote sites, it is the best solution particularly sites that need to be controlled from a central location or where real-time mission critical data is required on the big screen in the operations center.

The DAS Alternative

A DAS (Data Acquisition System) intended to monitor the remote assets of a water utility offers key features not typically found in SCADA systems. In particular:

Robust Packaging – RTUs subject to harsh outdoor environments or installed underground where they may become occasionally submerged.

Battery Operation – RTUs designed to consume very little energy so that they can be powered by battery.

Data Reduction – Sample sensors frequently then compress data to meaningful information so that the amount of data transmitted to the host is minimal and useful.

Data Recorder – Record data in local memory until transmitted to the host. Additionally store this data for weeks or months to provide a backup should the communications network become unavailable or the host server go off-line.

Communicate Infrequently – Communicate with the host as needed; generally on a schedule and/or in response to a site alarm. This substantially reduces power consumption.

System Comparison

Consider first that DAS and SCADA are architecturally different types of systems. SCADA is a real-time polling system requiring a continuous channel of communications between the host computer and each remote RTU (remote terminal unit). In data acquisition mode, the SCADA RTU responds to requests for real-time measurements from the host computer. If monitoring a field parameter (e.g. flow or pressure) once every five seconds is important, the host computer sends a request for this parameter every five seconds.

SCADA systems operate in this fashion because when performing their primary function, which is control, they make decisions at the host server based on real-time data collected from all relevant monitored sensors. However, when a SCADA system is used for data acquisition only, particularly for remote monitoring applications, this approach is not optimum or even practical because of system complexity, cost and data reliability exposure.

A DAS however, is optimized for remote monitoring. A DAS RTU may be independently configured to sample each sensor or instrument at the optimum rate for that parameter. For a flowmeter this might be once every second; for sanitary sewer overflow (SSO) level maybe once every 15 seconds, for ground water level, maybe once per hour, etc.

The DAS RTU, which is fundamentally a data recorder, then performs data reduction on these data samples to produce information having meaningful value to the user. This might be the total flow at 15-minute intervals, the amplitude and time stamp of water hammer events, or the severity, time of day and duration of a SSO event.
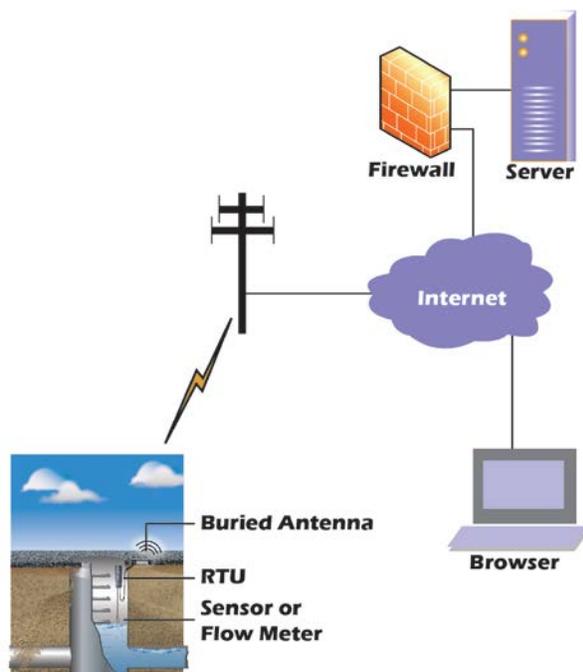
Typical remote data acquisition system.

Push Not Pull

SCADA systems poll remote sensors, typically at the highest rate necessary to facilitate control loop dynamics or to capture upset events that occasionally occur in the process. This might be a sample rate of every few seconds. Although necessary for the plant floor environment, where events occur quickly and sensor power and networking access is convenient, real-time information is not often necessary or even appropriate for remotely deployed sensors and instruments.

In most remote monitoring applications where control is not required, uploading information to the host computer at a rate useful to the user is desirable; this might be every 15 minutes, once per day or on exception. For example, uploading data from a remote rain gauge is only necessary when it is actually raining, or a CSO overflow event when it is overflowing. The pressure history of a remote water main might be useful information daily unless the pressure goes out of range, in which case real-time alarms may be desired.

Consider, for example, monitoring the level and flow of wastewater under the streets of a city. Plumbing power into a sewer to service a SCADA RTU is an expensive ordeal. Deployment of antennas for a real-time radio communications system is a further challenge.

Alternatively, a battery-powered remote DAS RTU utilizing cellular m2m communications can be deployed underground in the sewer with the sensors. In Push mode, the RTU makes the decision when to initiate the data call. This permits shutting down the radio modem between calls, allowing DAS RTUs to be battery powered.

Pushing data also allows the RTU to transmit data optimally for the application, for example, when it is raining or when the sensors are dynamically changing. This generally reduces data traffic at the host by one or two orders of magnitude, reducing computer resources and communication cost.
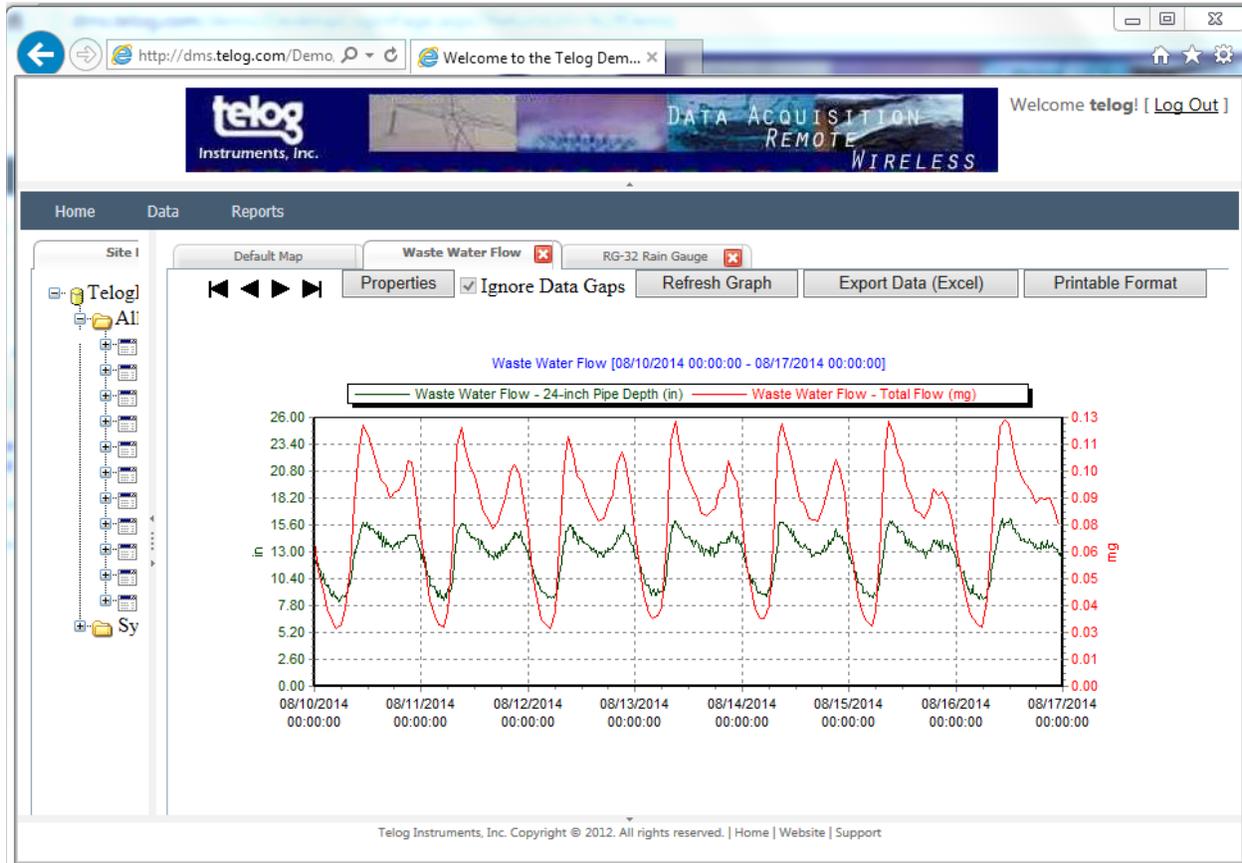
Real-time DAS data presentation via web browser.

Data Integrity

Data integrity refers to the assurance that the data transmitted from the remote site to the host is not corrupted or lost. A SCADA system can provide perfect data integrity only if and when the host computer is running and the communications channel is functional.

Reality demonstrates that computers crash and remote communication networks fail. Whenever this happens and for the period of time this happens, remote site data sourced by SCADA RTUs will be lost forever.

A DAS utilizing RTUs that are data recorders maintains its measured data at the remote site typically for many months, even when data is being transferred frequently to the host. If the communications channel goes down or the host computer crashes, remote data collection continues and is automatically recovered when the computer or network problems are fixed.

The typical SCADA system approach to improve data integrity for remote monitoring is redundancy. The thinking is that by adding redundant communications channels, computers and fault tolerant computer drives, system reliability is improved. This is true of course, but the user ends up purchasing two expensive data acquisition systems instead of one.

Ru-33 RTU with ultrasonic sensor

Installed Cost

For a host of reasons, SCADA systems for remote monitoring are quite costly when compared to a DAS approach. A remotely installed SCADA RTU may range in cost from $6,500 to $20,000. Much of this is due to the fact that SCADA RTUs are designed to be installed on the shop floor where the climate is predictable, power is available, communications is a simple plug-in and installation is easy.

Installing this same RTU in an underground vault is a bit more daunting: the climate is hostile, the vault might occasionally flood, closest utility power is up a pole hundreds of yards away and there is no Ethernet cable or phone line connection anywhere in sight.

A DAS RTU is designed for this environment. For example, one RTU is supplied with a 6-V lantern battery intended to operate the RTU for many months, including making regular though infrequent data calls to the host infrastructure. It is supplied in an enclosure that anticipates the worst possible site conditions, e.g. a sewer containing corrosive gas that floods from time to time.

The typical installed cost of the RTU, including cellular m2m modem and buried antenna, is less than $4000 and takes an experienced crew less than an hour per site to install.

DAS + SCADA

DAS is superior to SCADA for remote monitoring applications and, in some cases, the only practical option. It is often desirable that remote data be integrated into the user's SCADA/HMI platform to provide system operators and management a complete view of their systems.

Today, moving data from the host computer DAS application to the SCADA/HMI application is a simple IT task, particularly if both systems are employing industry standard data protocols, (e.g. relational databases). This methodology provides the user the best of all worlds: the cost, versatility and reliability of a remote DAS system – and all their plant and field data on a common platform.