WHITE PAPER

# Using Cellular RTU Technology for Remote Monitoring and Control in Pipeline and Well Applications

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MOXA®

## Introduction

*Cellular technology minimizes site visits and allows the use of high bandwidth applications such as video surveillance.*

Aligning resource availability with the demands of local and global populaces has become increasingly difficult, particularly since water, fuel, and materials have become scarce in many regions of the world, and the responsibilities of those tasked with providing and managing these resources have become more challenging.

Today's resource managers must ensure availability of resources while mitigating leakage and/or contamination during delivery. This task is complicated by the fact that the distribution infrastructure, which includes pipelines, pumps, and wells, is often located in isolated areas where wired communication is not available.

Traditionally, radio communication was used as part of the solution, and even though this communication medium has proved cost-effective, a significant disadvantage was the limit imposed on the data transmission speed between remote sites and the central management system.

Cellular technology does not pose the same restrictions, and if combined with control capabilities can provide a single hardware platform that is easier to deploy, minimizes site visits for configuration and maintenance, and allows the use of high bandwidth applications such as video surveillance.

## Challenges and Solutions

In this paper we discuss the technical challenges inherent in remote data acquisition, with special emphasis on applications that involve the monitoring and control of data from pipelines, pumps, and well-heads. We first consider what is involved in deploying a cellular-based system within a remote monitoring application, as well as the critical features and functionality required to make this a viable solution. The following topics are covered:

- Why Cellular?
- Dynamic Versus Static IPs in Remote Data Acquisition
- Active "Push" Versus Traditional Polling
- Data Consistency

We also introduce Moxa's ioLogik W5300 series and show how this product meets the needs of resource managers by integrating both the control and communication platforms into one device. This innovative product not only gives users greater control over the resources that they manage, but also enables greater flexibility in deployment, and helps keep maintenance costs under control.

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Moxa manufactures one of the world's leading brands of device networking solutions. Products include industrial embedded computers, industrial Ethernet switches, serial device servers, multiport serial boards, embedded device servers, and remote I/O solutions. Our products are key components of many networking applications, including industrial automation, manufacturing, POS, and medical treatment facilities.

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## Why Cellular?

When operators use radio communications for pipeline management, they typically use Remote Terminal Units (RTUs) to log data in local storage devices, and then send maintenance personnel to collect the data site by site. Since data is not transmitted in real-time, implementing high bandwidth applications such as video surveillance (along with managing the cost and effort of deploying additional resources to collect and parse the data from the remote sites) can introduce additional resource management difficulties. As a result, system architects are turning to cellular communications when a more flexible communication medium is required.

The beauty of cellular technology is that it is IP-based, and since the vast majority of field monitoring devices are now IP-enabled, it is possible to get all of the data from field devices over a cellular network. But using IP-based communication media alone is not enough to create an ideal remote monitoring system, since bandwidth and latency limits are also important for these field operations.

Since cellular networks are IP-based, they have essentially no distance limitations compared to traditional radio and microwave communication interfaces, and consequently the number of communication relay nodes required is reduced. Since the system uses the communication infrastructure already put in place by the cellular provider, the operator incurs essentially no additional infrastructure costs. In addition, the cellular network's bandwidth is significantly wider than RF and less vulnerable to outside interference, so fewer data acquisition relay points are required.

Cellular technology has recently seen dramatic advances in performance, and the transition from "2.5G" GPRS technology to "3.5G" HSDPA technology has unlocked substantial improvements in bandwidth and network latency. The cellular uplink bandwidth can reach 3.6 Mbps, and the downlink bandwidth can reach as high as 7.2 Mbps. Cellular latency has also been improved dramatically, and now can reach as low as 100 ms. The bottom line is that cellular performance now exceeds most of the other long-range communications technologies available today.

## Dynamic Versus Static IPs in Remote Data Acquisition

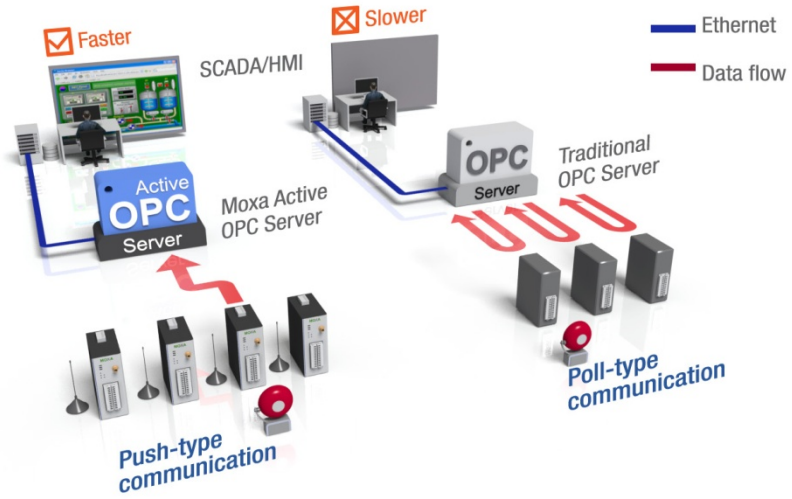
For most cellular solutions, both the cellular modems at the remote sites and the SCADA server at the central site should be assigned static public IPs in order to establish bi-directional communications and to allow the central site to query the data loggers at any time. However, since cellular network carriers charge higher monthly fees for static public IPs than dynamic private IPs, maintaining static IPs can be extremely expensive and cause managers to shut down some remote sites.

Moxa's ioLogik W5300 series and patented Active OPC software allow users to subscribe to a dynamic private IP data plan for their RTUs. The ioLogik W5300 can automatically establish communications with the Active OPC Server using a fixed IP, and the Active OPC Server will receive and register the ioLogik W5300's IP address and receive or record tag updates accordingly. ioLogik W5300 RTUs are very easy and cost effective to deploy and manage in a dynamic private IP environment.

In addition to using Active OPC Server as middleware to access the

ioLogik W5300 via a dynamic or a private IP over the cellular network, you may also use the more traditional DDNS. The ioLogik W5300 Micro RTU controller series now supports DDNS conversion from a dynamic or private IP to a DNS hostname (also called URL), so that the central software will be able to connect to the remote ioLogik W5300 without needing to apply for a fixed IP or VPN service from a network provider.

## Active "Push" Versus Traditional Polling




Once the user decides to use cellular communications, one of the most critical and obvious issues is "how much will it cost?" In a traditional automation-centric environment, operators would use devices such as PLCs to retrieve data, and in this case bandwidth is not an issue since the PLCs are typically working within a wired infrastructure. However, for remote applications bandwidth is a big concern, and the tradeoff in real-time data acquisition provided by a polling architecture is offset by the higher costs incurred by using a cellular environment.

"Active push" (which can be described as event-based data acquisition, and is also referred to as "report by exception") can reduce the high cost associated with deploying a cellular system. With active push, the only time data is acquired from sensors or alarms is when an "event" occurs at the site. When the event occurs, the data is "pushed" to the control system, and the operator can then manage the resulting event reports.

Another issue is communication time-outs; both Ethernet-based and serial-based field devices often use remote polling to acquire data. A device whose communication timeout value is set to accommodate LAN communication speeds will face communication timeout issues when deployed on a cellular network. Repeated communication timeouts will crash the system and can incur additional fees for each reconnection attempt. An active push architecture that creates data reports is the solution to this problem since replacing constant data polling with active reports allows the system to overcome communications timeouts.

With active reporting, the central monitoring server does not need to constantly interrogate field devices for data. Instead, the central server just waits for incoming data. Active reporting not only reduces bandwidth usage, it also makes real-time alarms possible. Most importantly, with active reporting it is possible to dynamically

adjust communications margins to accommodate the network's timeout tolerance, and prevent timeouts from occurring at all.

## Data Consistency

Being able to establish real-time data acquisition in a remote environment that has an unreliable communication infrastructure is important since operators need real-time information to make decisions that affect resource allocation and delivery. Traditionally, operators would use data loggers to store event information (for PLCs, the data stored is the entire data-set received from polling over a particular time period), with the information retrieved manually during site visits. As you might imagine, this is a highly inefficient way of managing remote site information, particularly since it can lead to overlaps in data, and create multiple layers of data that the operator needs to sort through.

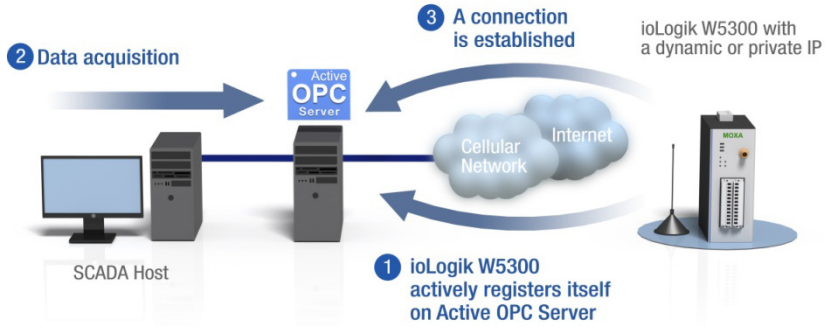
Since cellular communication can provide real-time access to any data that is created, combining this communication infrastructure with event-based data acquisition can help the operator achieve a higher consistency with the data received from remote locations.

## Moxa ioLogik W5300 Series

Moxa's ioLogik W5300 RTU controller was designed to provide a more flexible technology and give users an easy to use and cost effective solution in one platform.

**The ioLogik W5300 provides the remote operator** with a 3-in-1 data acquisition platform that uses GSM/GPRS cellular technology. With its patented Active OPC "push" or event-driven architecture, the W5300 has all of the features described in the previous sections of this paper.

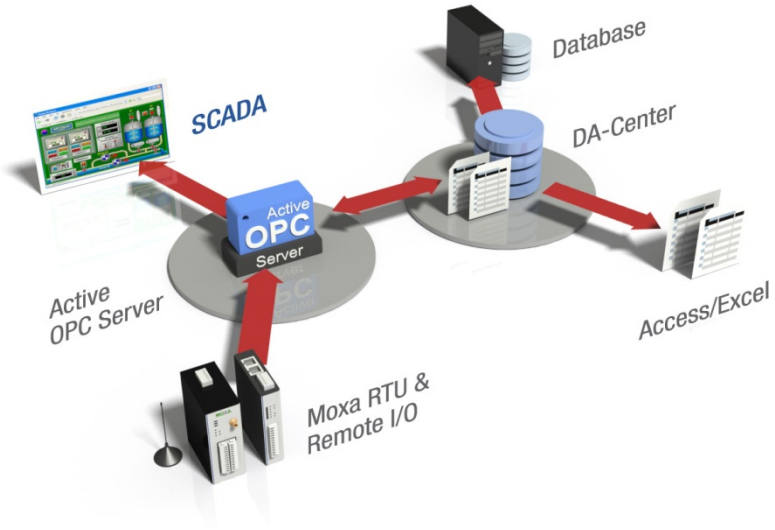
**Moxa's proprietary Active OPC Server** acts as middleware that re-routes data streams from a private IP address to the central host. Private and dynamic IPs are commonly found in cellular communications, but traditional LAN-based IP surveillance systems cannot use private IPs. Active OPC Server provides a work-around to this obstacle, and allows the use of any type of IP-enabled SIM card.




**SNMP with I/O status** provides an easy transition to IT-centric users, particularly since it can be used in conjunction with database systems such as ERP and CIM via SNMP.

**DA-Center for real-time data acquisition** allows users to collect data logs over the air from a central site, without the need to visit remote sites. For example, if the cellular connection is lost, the RTU should be able to re-transmit non-duplicated data logs after a cellular reconnection. With Moxa's DA-Center, this task is made simpler because the utility works hand-in-hand with Moxa's Active

OPC for seamless data collection. After each cellular connection, DA-Center will compare the historical data and the real-time data, and then complement the missing data by asking the ioLogik W5300 RTU to re-transmit non-duplicated data logs into the dataset. In addition, DA-Center can convert datasets into a tabular format for exporting the log files to a database or spreadsheet. The following figure shows the architecture of the DA-Center solution.




**Front-end intelligence and local logic** for distributed systems allows remote monitoring and control at sites distributed over a wide area. One problem with traditional remote monitoring and control systems is that all the intelligence for the system is located in the central control room. If the operator loses contact with the remote devices, there is no way for the host(s) in the control room to receive alerts. Front-end intelligence uses a different approach; by placing some of the intelligence near the sensors and alarms, the system can use local logic to keep the local system working even if the network fails. In addition, combining inputs and outputs in the same local module ensures greater reliability.

**The I/O Channel Expansion capability** provided by the W5300 series gives the operator the option of adding more I/O points to their remote monitoring operation when needed. Up to 68 additional I/O points can be added through the built-in Ethernet port using Moxa's E1200 series remote I/O products. (Note that the actual number of I/O points depends on the combination of models selected.)

## Conclusion

With the advent of cellular communications, remote monitoring systems are changing and improving. Simply put, remote monitoring systems can do more but cost less than before thanks to IP-based cellular technology. The operator's system complexity can be reduced by eliminating data acquisition layers, which reduces management and maintenance costs, and high bandwidth applications, such as video functionality, can be added. Even greater advances will be possible as 4G cellular technology is rolled out and more and more devices migrate to IP-based solutions.

Moxa's Cellular RTUs deliver cellular technology in a robust, industrial-strength package, and come with the software and support tools needed to quickly put the technology to use.

**ioLogik W5300 Series Selection Table**

| Models | | I/O Combinations | | | | | Programming |
|---|---|---|---|---|---|---|---|
| Standard Temperature (-10 to 55°C) | Wide Temperature (-30 to 70°C) | Digital Inputs | Digital Outputs | Analog Inputs | Relay Outputs | Configurable DIOs | |
| ioLogik W5312 | ioLogik W5312-T | 8 | 8 | – | – | 4 | Click&Go |
| ioLogik W5340 | ioLogik W5340-T | – | – | 4 | 2 | 8 | Click&Go |
| ioLogik W5340-HSDPA | ioLogik W5340-HSDPA-T (-20°C) | – | – | 4 | 2 | 8 | Click&Go |
| ioLogik W5348-HSDPA-C | ioLogik W5348-HSDPA-C-T (-20°C) | – | – | 4 | 2 | 8 | C/C++ |