



Application Brief: Perceptive Controls

*Systems integrator designs
cloud-based, cellular SCADA
system for rural water and
wastewater treatment systems*

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APPLICATION BRIEF: PERCEPTIVE CONTROLS

Systems integrator designs cloud-based, cellular SCADA system for rural water and wastewater treatment systems

BACKGROUND

Like plants and people, cities need water to grow. The average American's daily use of water reaches upwards of 100 gallons.

Major cities like New York, Chicago, and Los Angeles need billions of gallons of water per day. And when people turn on their faucets, they expect the system that delivers their water to just plain work.

But in reality, a lot more goes into delivering clean, potable water than most people realize. Transporting water and wastewater throughout municipalities is a complex task that requires significant investments in advanced SCADA technology.

But not all water districts have the budget to acquire the necessary technology.

THE CHALLENGE

Modern water and wastewater treatment regulations require water districts to maintain systems for monitoring, data acquisition, alarming, and reporting on the quality of water delivered to residents.

While large cities can afford the technology investments required to transport billions of gallons of water per day, smaller water districts, often located in remote and rural areas, can struggle to find the budget required to implement a modern SCADA system.

Instead, processes remain manually driven and as a result are prone to errors that can lead to a system failure.

The rugged and remote location of many rural water districts can also pose a challenge in implementing a SCADA system. Most modern municipal water systems use some form of wireless technology, often 900 MHz radios, to establish a SCADA network between remote

sites. These radios are ideal for SCADA networks because they operate in an unlicensed spectrum and do not require a service provider network to relay data from site to site.

However, in rugged terrain it can be difficult to obtain the direct line-of-sight connection 900 MHz radios require.

Cellular connections are often the next best option to establish a SCADA network between remote sites. But the data charges associated with cellular connectivity can be cost-prohibitive, due to the scan-based poll/response communication architecture of traditional SCADA systems.

Recognizing the needs of smaller water and wastewater treatment plant operators to add affordable SCADA systems to their operations, systems integrator Perceptive Controls developed a cellular, cloud-based SCADA system called Perceptive Polaris to overcome these challenges.

THE SOLUTION

Using Perceptive Polaris software with an Opto 22 SNAP PAC control system, Perceptive Controls was able to deliver a low-cost SCADA system that avoids expensive servers and hardware while still delivering the monitoring, control, alarming, and reporting capabilities water and wastewater plant operators require.

One of the key challenges engineers at Perceptive Controls faced during development of the solution was how to reduce the amount of data sent between lift station sites on the SCADA network.

"We knew that using cellular modems meant one of the most important requirements of this project would be the ability to transmit the smallest data packets possible, with as much data in each packet as possible," says Kevin Finkler, software engineer for Perceptive Controls. "We had to stay under the data caps of the cellular provider we planned to use."



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“Our original design was to use a script running on an Opto 22 PAC-R2 controller,” adds Finkler. “The script would collect data from municipal equipment and perform an HTTP POST to transmit the data to a cloud-based server we host for our clients. The server is where our Perceptive Polaris software application resides.”

But during evaluation and testing of the first version of the system, posting large amounts of data from the controller to the cloud server proved to be slow and processor intensive.

In addition, the cloud server didn’t have a reliable method for ensuring configuration changes, such as HMI setpoints, were sent back to the controller.

“This posed a problem,” says Chris Parish, senior application engineer at Perceptive Controls.

“The controller would often check for configuration changes, only to have the server respond back saying that no changes were needed. It wouldn’t work to have the controller check less frequently, because we wanted the

Through the RESTful API, developers can gain secure, programmatic access to data from new or legacy physical assets wired to the PAC.

controller to be able to respond in a timely manner,” Parish notes.

“We decided to consider alternate options for transferring data. So we investigated the RESTful API capabilities built into Opto 22 SNAP PAC controllers.”

Unlike other PACs and PLCs on the market, Opto 22 SNAP PAC controllers come with a built-in, secure HTTP/S server with an open, documented API, effectively creating a RESTful architecture.

RESTful architecture and its technologies, like HTTP/S and JSON (JavaScript Object Notation), are intrinsic to the Internet of Things and paramount to web, data, and mobile-based application development.

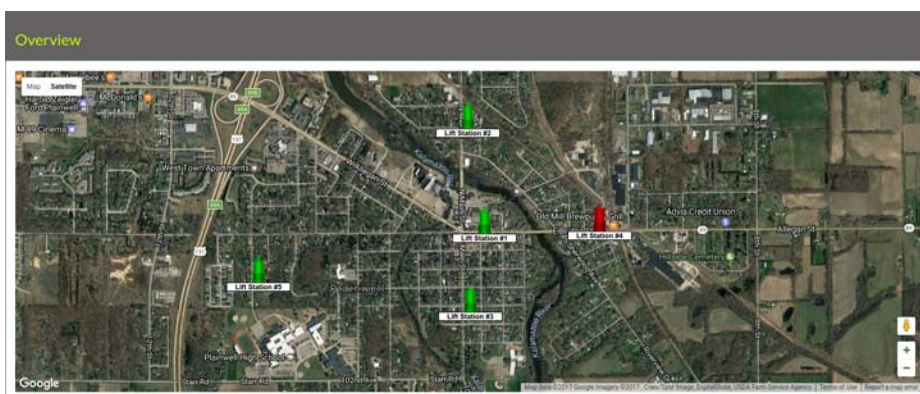
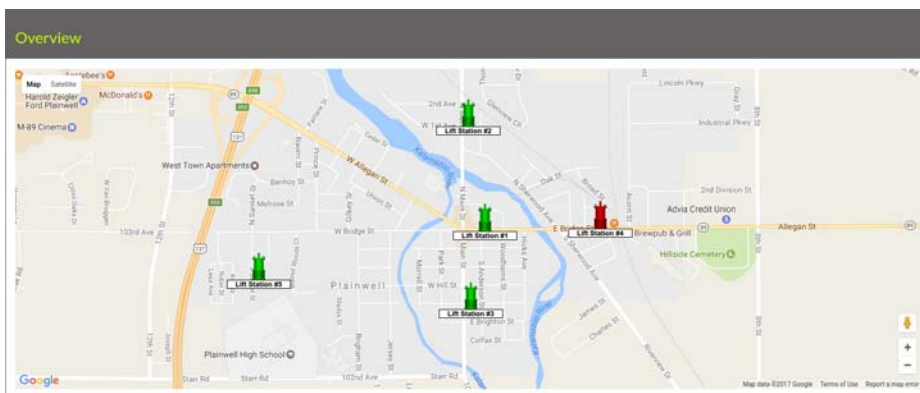
With their RESTful API and secure server, the SNAP PACs offer valuable alternatives for application development.

Through the RESTful API, developers can gain secure, programmatic access to data from new or legacy physical assets wired to the PAC.

Developers can use any programming language that supports JSON to access control variables and input/output (I/O) data.

“After switching to the new RESTful API method, we now have a cloud-based software application running on a dedicated server that uses the SNAP PAC’s RESTful API to request data directly from the controller.

“Requests are made over a private cellular network to



Lift stations can be monitored in real time, with map overlays to give operators real-time situational awareness.

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avoid cyber security-related concerns and avoid opening ports in firewalls,” says Finkler.

“We store data in float tables on the PAC (about 44 indexes per table) and the software can grab up to 100 tables of data per request without slowing down communication performance.”

The cloud application then uses the RESTful API to write back how many tables were retrieved, so the controller can delete the old data and move everything up in the table, with new data again at the top. This ensures that all data was received into the cloud application.

“It’s more efficient to make the cloud application process large amounts of data, instead of making the controller do the work in addition to its normal operations,” notes Finkler.

“This method saved an average of 5.8 KB per data set transmitted, which ended up saving us about 250 MB per day, adding up to significant savings in cellular data charges.”

Using the new RESTful API, Perceptive engineers can also send configuration changes on demand. Since configuration changes rarely occur after the initial setup, 99% of the previous configuration traffic has been eliminated, and data is transmitted only when necessary. The cloud application also monitors for alarms and sends out notifications to operators if necessary.

Using the Perceptive Polaris solution, water and wastewater customers can monitor their lift stations and SCADA network in real time, with advanced map overlays that provide operators with real-time situational awareness of the SCADA system.

Operators can view and respond to alarms through the website, and authorized users are alerted to alarms via email and/or text messaging. Operators who receive an alarm can acknowledge it by replying to the text message. Historical data is stored on cloud servers hosted by Perceptive Controls and backed up regularly.

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- Kevin Finkler, Perceptive Controls

LOOKING AHEAD

Engineers at Perceptive Controls are currently developing a mobile app that will communicate with the Perceptive Polaris server and allow users to respond to alarms and change setpoints as needed.

Says Finkler, “In the future, the entire SCADA system will be able to be managed from almost any authorized mobile device.”

ABOUT PERCEPTIVE CONTROLS

Specializing in automation and controls, system security, and municipal services, Michigan-based Perceptive Controls prides itself on the ability to listen to customers and deliver what they expect.



With over 12 years of proven municipal and infrastructure management and 20 years in utility operations, Perceptive understands your needs and how systems work in the real world.

The company’s mission is to provide customers with an easy and comprehensive way to monitor their site’s equipment as well as view and respond to alarms.

For more information, visit perceptivecontrols.com and perceptivepolaris.com, or contact **Perceptive Sales:**

Phone: **269-685-3040**

Email: sales@perceptivecontrols.com

ABOUT OPTO 22

Opto 22 was started in 1974 by a co-inventor of the solid-state relay (SSR), who discovered a way to make SSRs more reliable.

Opto 22 has consistently built products on open standards rather than on proprietary technologies. The company developed the red-white-yellow-black color-coding system for input/output (I/O) modules and the open Optomux® protocol, and pioneered Ethernet-based I/O.

In early 2013 Opto 22 introduced *groov*, an easy-to-use IoT tool for developing and viewing mobile operator interfaces—mobile apps to securely monitor and control virtually any automation system or equipment.

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In addition to SSRs and *groov*, Opto 22 is best known for its [high-quality I/O](#) and SNAP PAC [programmable automation controllers](#), which include a RESTful API.

All Opto 22 products are manufactured and supported in the U.S.A.



Because the company builds and tests its own products, most solid-state SSRs and I/O modules are guaranteed for life.

The company is especially trusted for its continuing policy of providing free product support, free training, and free pre-sales engineering assistance.

For **more** information, visit opto22.com and groov.com or contact **Opto 22 Pre-Sales Engineering**:

Phone: **800-321-6786** (toll-free in the U.S. and Canada) or **951-695-3000**

Email: systemseng@opto22.com

HOW CAN OPTO 22 HELP YOU?

For over 40 years, Opto 22 has brought commercial, off-the-shelf technologies to industrial systems all over the world. We pioneered the use of PCs in controls back in the 1980s, Ethernet networking at the I/O level in the 1990s, and machine-to-machine connectivity in the 2000s.

Today, our engineering focus is on building the hardware and software tools you need to realize the benefits of the Industrial Internet of Things (IIoT)—simply, reliably, and securely.

At the lowest level, our SNAP Ethernet I/O system offers an easy and cost-effective way to bridge the real world with the digital world, through a comprehensive collection of input and output modules designed to connect with virtually any electrical, electronic, mechanical, or environmental device. This I/O system converts these raw signals to useful digital data and shares it over the standard networks and protocols understood by IT.

Where edge computing, decision making, autonomous control, data collection, and logic solving need to occur, consider programmable automation controllers such as our SNAP PACs. Complete with a built-in HTTP/HTTPS server and RESTful API, easy-to-use flowchart-based programming, significant processing power, and a large library of protocol and communications capabilities, PACs can help you get your IIoT project up and running, quickly and affordably.

When it comes time to visualize, notify, and mobilize your information, our *groov* platform offers a simple, effective way to build operator interfaces that can be viewed on any screen, from your smartphone to big-screen HDTV. *groov* logs events and notifies you when events occur in your plant, in your remote assets, or within your building. The *groov* Box includes Node-RED for easy, open-source IIoT programming.

All Opto 22 products are backed by decades of expertise in applications like process control, discrete manufacturing, remote telemetry, data acquisition, and supervisory control. All our products are available worldwide and supported by Opto 22 engineers at no charge.

{RESTful API}



Opto 22 SNAP PAC controllers have a built-in HTTP/HTTPS server and a RESTful API.

Opto 22's *groov* Box appliance includes Node-RED.



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