Case Study: Ending Communication Failures Across 180 Remote Sites

How a Michigan county water and wastewater utility replaced slow radio polling with edge-based Sparkplug B MQTT communications

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CASE STUDY: ENDING COMMUNICATION FAILURES ACROSS 180 REMOTE SITES

How GCDC-WWS replaced slow radio polling with edge-based Sparkplug B MQTT communications

The Genesee County Drain Commissioner, Jeff Wright, Division of Water & Waste Services (GCDC-WWS) operates 180 remote sites across 600 square miles in the state of Michigan.

When you start a remote pump, you expect to know right away whether it actually turned on. In the Genesee County Drain Commissioner Division of Water & Waste Services' (GCDC-WWS) legacy radio polling system, that confirmation could take four to five minutes.

Across 180 remote water sites in mid-Michigan's Genesee County, communication slowdowns and concentrator failures repeatedly cut off or delayed visibility to critical equipment. With delays measured in minutes and frequent communication dropouts, operators could not reliably fine-tune pumping stations. Short pump cycles often went completely unrecorded, and communication alarms became so common that distinguishing real failures from network noise grew increasingly difficult.

THE LIMITS OF RADIO POLLING

The GCDC-WWS operates drinking water distribution and wastewater collection systems across more than 600 square miles. Dozens of water and wastewater remote pump stations are spread throughout the county, each relying on consistent communication back to the central SCADA system.

GENESEE COUNTY WWS DRAIN COMMISSIONER

For years, remote site communication depended on a multi-hop licensed radio network. Field sites transmitted over 200 MHz radios to local concentrator stations, which then forwarded data over 900 MHz links back to the central office. While the radios were solid line-of-sight systems, the architecture created built-in latency and multiple points where a single concentrator failure could disconnect numerous downstream sites at once.

Communication followed a traditional polling model. The master station requested data from concentrator sites, which in turn polled individual field locations before sending responses back up the same chain.

"You'd send a command and just wait," says Terry Biederman, P.E., Assistant Director of Water for the GCDC-WWS. "This was an unacceptable situation. Communication failures were also so numerous that staff didn't know if they should respond and unnecessary overtime cost was increasing as a result."

Even when functioning normally, the sequential polling process limited real-time control and visibility.

RETHINKING REMOTE SITES

Communication delays were only part of the challenge. The existing approach depended on traditional PLC-based systems that needed dedicated controller hardware, separate communication equipment, costly programming software, and a SCADA platform with costly, per-seat licensing agreements.

Even small, unmanned, two-pump lift stations had to carry the weight of that full stack, creating capital and lifecycle costs that did not scale well across hundreds of diverse and geographically dispersed sites.

"A small lift station SCADA system could easily run $15,000 to $20,000 using the traditional approach," Biederman explains. "For small sites, that just wasn't cost effective."

As the GCDC-WWS began upgrading aging remote sites and their SCADA systems, the team faced a choice: they could replace older hardware with newer versions of the same architecture, or they could shift and take advantage of newer technologies that addressed their problems directly.

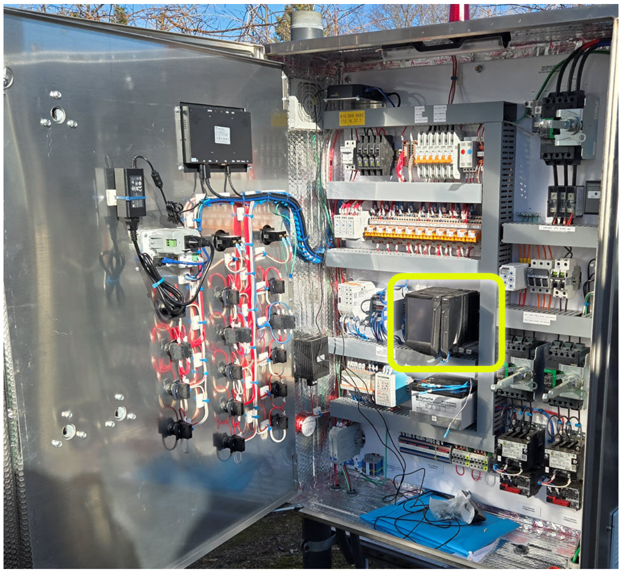
FROM POLLING TO PUBLISHING

The GCDC-WWS began evaluating a different model built around Sparkplug® B MQTT publish/subscribe communication versus the legacy polling model.

"We knew from our experience, and from other utility examples, that MQTT was the way to go," Biederman says.

Instead of waiting to be polled, Sparkplug B MQTT publish/subscribe architecture allows remote sites to publish data as changes occur. Because data is transmitted

Legacy systems in remote water and wastewater stations operated reliably with established controls, but using legacy communication methods made system-wide visibility difficult.



An outdoor control panel retrofitted with an Opto 22 *groov* EPIC system

by exception instead of constant polling, bandwidth drops significantly, making cellular data plans practical at sites that previously relied on radio.

And since Sparkplug B MQTT uses a purely outbound, client-initiated connection model, there are no unsolicited inbound communications, making networking and firewall management much simpler, and reducing the attack surface.

> **"Ignition Edge is built in, so we get Sparkplug B MQTT publishing out of the box [with *groov* EPIC]. It also lets us connect downstream to legacy PLCs over OPC UA and bring that data into the same architecture."**
>
> **- Terry Biederman, P.E., Assistant Director of Water for the GCDC-WWS**

SCADA TRANSITION

Modernizing communications also meant modernizing the SCADA layer.

For years, the GCDC-WWS relied on iFIX®, a SCADA and HMI platform developed by GE Digital®, for visualization and historical data archiving. The system had served the county reliably, but it was built around traditional client/server polling architectures.

As the team evaluated Sparkplug B MQTT, they also began looking for a SCADA platform that supported publish/subscribe communication and reduced reliance on tightly coupled polling structures. That search led them to Ignition®, a modern SCADA and industrial development platform developed by Inductive Automation®.

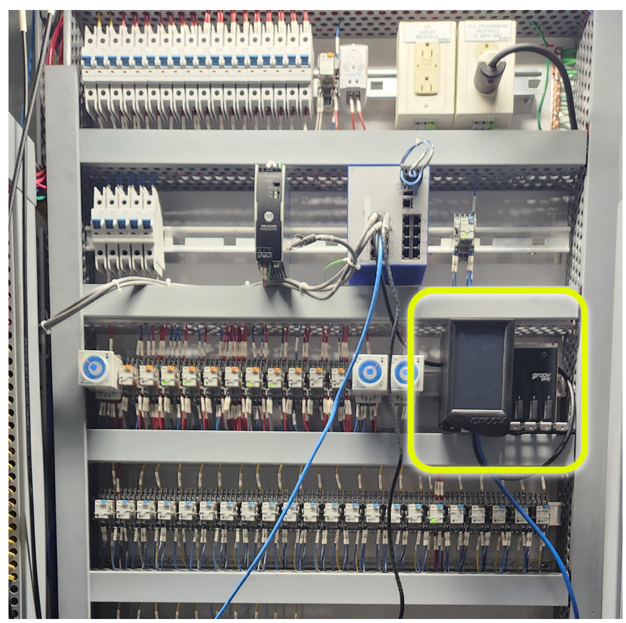
"There's a lot of legacy built into older SCADA systems," Biederman says. "We wanted a platform architected for how we're communicating now, not how we were communicating 20 years ago."

BRINGING SPARKPLUG B MQTT TO THE EDGE

The other part of the problem was figuring out how to extend this new Sparkplug B MQTT communication model to all the remote sites.

"We had aging PLC infrastructure and a communications network that needed an update," Biederman says. "Instead of replacing expensive PLCs at remote sites, we looked for a more cost-effective way to move forward."

The GCDC-WWS selected Opto 22 *groov* EPIC (**E**dge **P**rogrammable **I**ndustrial **C**ontroller) processors for larger water and sewer pumping stations, where control and I/O could run locally while publishing data via Sparkplug B MQTT. Smaller sewer pumping stations and sites like



The Opto 22 *groov* EPIC system worked with existing PLC hardware.

meter-pits (underground enclosures protecting water meters) were outfitted with Opto 22 *groov* RIO edge I/O devices to modernize communications first, with plans to expand I/O as sites are upgraded.

"Ignition Edge® is built in, so we get Sparkplug B MQTT publishing out of the box," Biederman explains. "It also lets us connect downstream to legacy PLCs over OPC UA® and bring that data into the same architecture."

Cost was equally important. A traditional small lift station could approach $15,000 to $20,000 under the previous model. A *groov* RIO with a cellular modem could be deployed for under $2,000, making SCADA visibility realistic at sites that previously had none.

PHASED DEPLOYMENT ACROSS THE SYSTEM

The first site came online in early 2023. Rather than attempt a full system replacement, GCDC-WWS began with targeted deployments at problem locations and communication weak points.

"We started with five problem sites," Biederman says. "Now (2026) we're at 45 out of about 180."

"We can theoretically replace all of our radio sites with cellular and still pay almost what we were paying for a fraction of them before."

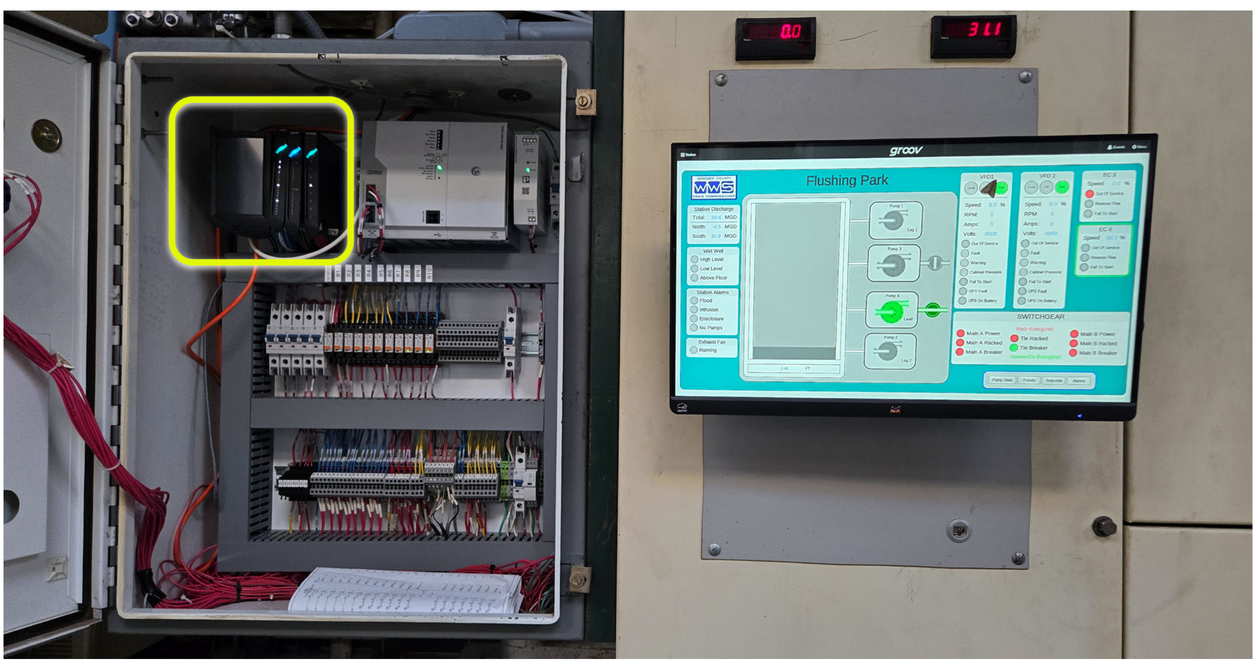
- Sean Weeder, CTO of GCDC-WWS

The simplicity of their new standard architecture allows them to manage it all on their own, without outside systems integrators.

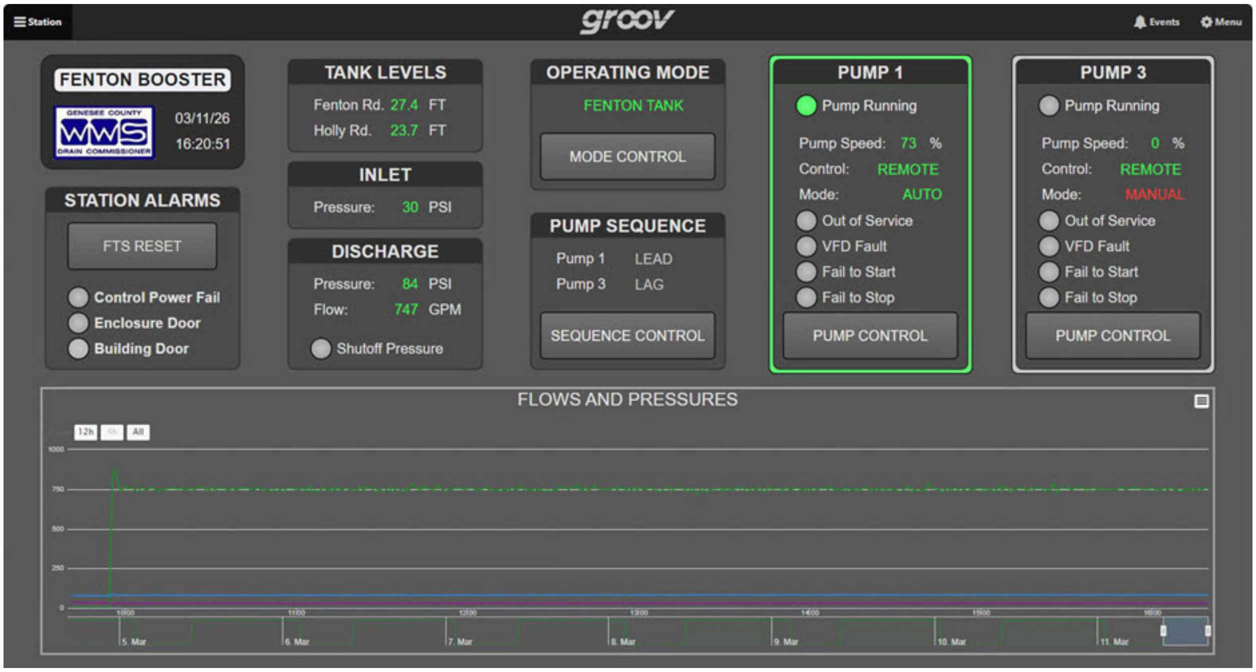
"We do this all internally," Biederman says. "All programming and configuration are performed in-house."

As deployments increased, the Sparkplug B MQTT infrastructure evolved as well. Early implementations used a freeware Sparkplug B MQTT server. As the number of publishing devices grew, the county transitioned to dedicated Sparkplug B MQTT servers with redundancy.

"We had some growing pains," explains Sean Weeder, Chief Technology Officer (CTO). "When you go from 5 sites to 45 sites, you realize you need dedicated, industrial-grade Sparkplug B MQTT servers."



***groov* EPIC running local control and I/O, with *groov* View providing a live operator interface while data is shared via Sparkplug B MQTT.**



***groov* View HMI provides local pump monitoring.**

The system currently operates in a hybrid environment. Legacy sites continue reporting into the existing Proficy® historian used with iFIX, while newer sites integrate into both Proficy Historian and Ignition's Historian Modules. The county plans to migrate more historical data into Ignition as future upgrades roll out.

MEASURABLE IMPACT

"Sparkplug B MQTT communication failures have gone to zero," Biederman says of the upgraded sites.

Under the previous architecture, radio and concentrator issues generated hundreds of communication alarms each year. Many required overtime investigation. At converted sites, that pattern stopped. In the rare event that a telemetry failure does occur, symptoms are more readily visible, and troubleshooting is much easier.

Because Sparkplug B MQTT transmits data by exception instead of constant polling, the county has tripled the number of cellular-connected sites while keeping total data costs similar to before. At one station, a large sewer pumping facility, the legacy system consumed about 50 gigabytes of cellular data per month. After switching to Sparkplug B MQTT, usage dropped to under 1 gigabyte per month.

"And it's more data, and pretty much instantaneous," Weeder says. "In the old system, even when communications were working as intended, poll time was so long we would miss full pump runs."

Those events are now captured as they occur. Operators now see pump activity in real time.

"We can theoretically replace all of our radio sites with cellular and still pay almost what we were paying for a fraction of them before," Weeder explains. "Smaller two-pump lift stations that once operated without SCADA due to cellular data costs are now connected."

EXPANDING ON THE NEW ARCHITECTURE

With Sparkplug B MQTT and *groov* edge devices in place, the architecture is expanding.

groov RIO EMU (energy monitoring unit) modules are being piloted at one of their largest water pumping stations to monitor incoming utility voltage and power delivered to three high-service pump VFDs (Variable Frequency Drives). The effort is part of a broader initiative to measure power quality and usage across additional facilities as sites are upgraded.

"I've been using Opto 22 since 1998. Their warranty is one of the best in the industry. I/O module replacement for life. And their support has always been fantastic."

- Terry Biederman, P.E., Assistant Director of Water for the GCDC-WWS

The team is also exploring deeper integration using Node-RED, a free IoT software development tool built into all *groov* devices. By connecting to the county's automated meter infrastructure (AMI) database through its API, they plan to pull meter data directly into SCADA for daily water efficiency monitoring and system-level analysis.

"We've done some of it already," Weeder says. "It helps us leverage our AMI information investment and bring it into SCADA, so we can see everything in one place."

The long-term plan is steady expansion. The communication model is in place. The hardware platform is standardized. Each new site follows the same architecture.

And the GCDC-WWS team is thrilled with their choice in vendors.

"I've been using Opto 22 since 1998. Their warranty is one of the best in the industry. I/O module replacement for life," Biederman says. "And their support has always been fantastic."

ABOUT GCDC-WWS

Genesee County Drain Commissioner Division of Water and Waste Services operates water distribution, water treatment, sewer collection, and sewer treatment systems that serve 21 municipalities throughout Genesee County in the State of Michigan. It also operates and maintains a 65-mile transmission main with two pumping stations from Lake Huron to the water treatment plant as part of the Karegnondi Water Authority (KWA).

For more information, please visit:
https://www.gcdcwws.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.

Famous worldwide for its reliable industrial I/O, the company in 2018 introduced *groov* EPIC® (edge programmable industrial controller). EPIC has an open-source Linux® OS and provides connectivity to PLCs, software, and online services, plus data handling and visualization, in addition to real-time control.

groov RIO Ethernet-based edge I/O modules, introduced in 2020, include I/O and IIoT software in a compact industrial package that goes anywhere.

All Opto 22 products are manufactured and supported in the U.S.A. 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 online training, and free pre-sales engineering assistance.

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

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