Case Study: Building Secure Wastewater Management in the Cloud

Waterford Township makes the leap into MQTT-based utility management

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Formally organized in 1834, Waterford Township is located geographically in the center of Oakland County, Michigan, USA, and is home to over 72,000 residents. It is known regionally for its 34 lakes, from which it earns its name.

However, within municipal public utilities, Waterford is known for its leadership and persistent innovation in water/wastewater management. With 360 miles of water main and 355 miles of sanitary sewer, water management in Waterford is no small task. The Department of Public Works (DPW) operates and maintains 19 production wells, 3 storage tanks, 11 treatment plants, and 63 sewer lift stations.

To run all this, they invested years ago in integrating core applications, including geographic information systems (GIS), asset management systems (AMS), enterprise content management (ECM), and supervisory control and data acquisition (SCADA), all of them sharing data to enable seamless operations.

That system has delivered a lot of value over the years, but nothing lasts forever.

TIME TO UPGRADE

In 2017, Russell Williams, director of public works, and Frank Fisher, engineering superintendent, at Waterford DPW started on a routine maintenance project to upgrade their core SCADA infrastructure. At the time, they used a serial polling program to request updates from their many sites through a network of RTUs (remote telemetry units) that communicated over licensed radio frequency (RF) transmitters.

A year later, they had begun replacing these RTUs and radios with Opto 22 SNAP PAC S2 controllers and DIGI 4G LTE industrial cellular modems communicating through a private Verizon network.

However, that same year, they attended a conference announcing the release of Opto 22's *groov* EPIC edge programmable industrial controller, and it changed the scope of their plans. As Russ tells it, "We were talking about it on the ride back and said, 'If this does what it's supposed to, then it changes the whole layout of everything.'"

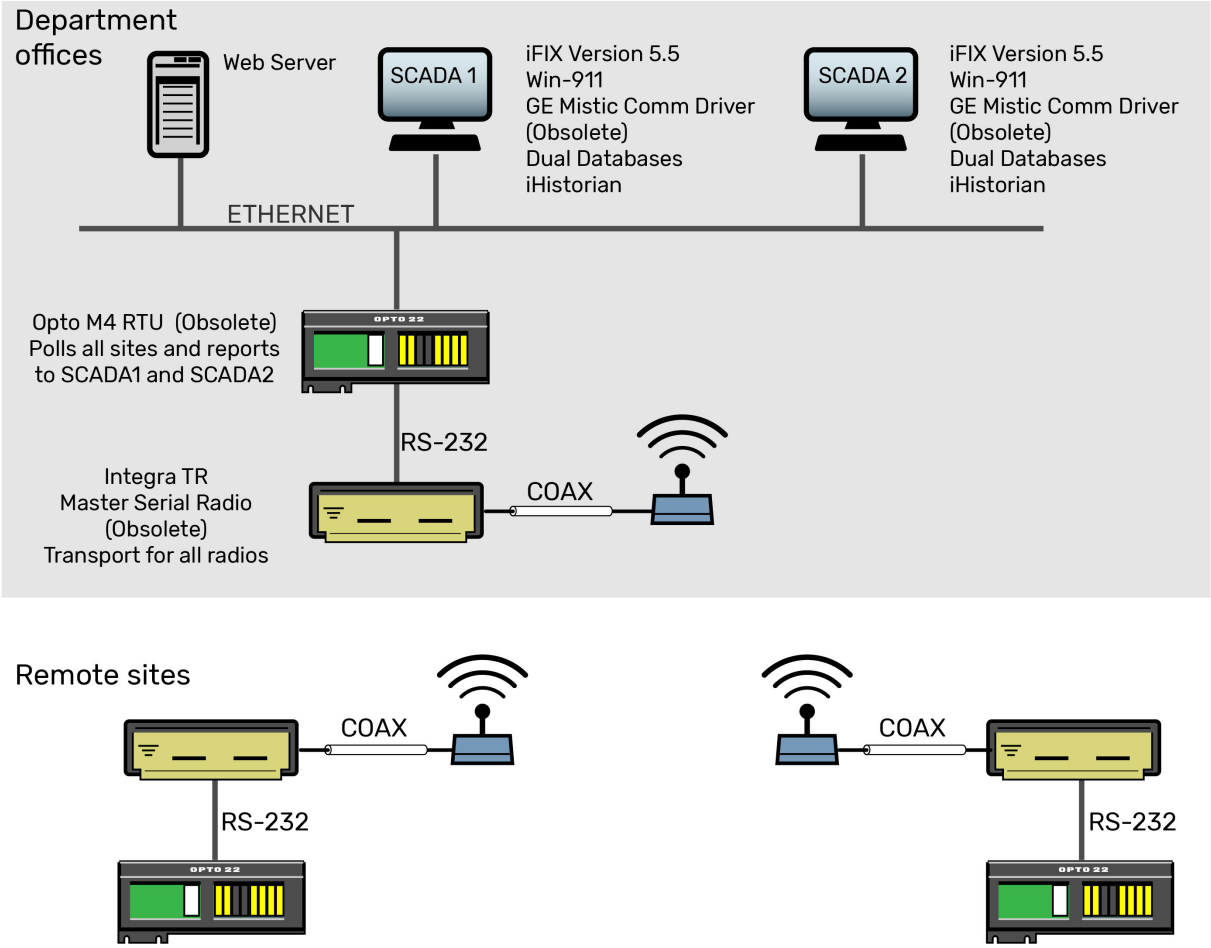
Removing Systemic Limitations

They were particularly excited by the idea that the EPIC's native support for MQTT Sparkplug publishing could help them eliminate some long-standing systemic limitations. With over 90 controllers on their network, the polling mechanism they used, combined with the limited bandwidth of their radio network, meant that data from each site would update only every 3-5 minutes.

Sometimes a lift station would run briefly in between polling cycles, creating gaps in their reporting and inhibiting operators' ability to accurately detect issues until alarms eventually made their way through. For each I/O point they added to the system, this latency only grew worse.

It seemed clear to them that MQTT (formerly IBM's MQ Telemetry Transport, now available in open source) could significantly reduce bandwidth usage and

Previous Configuration



Waterford DPW's legacy infrastructure relied on a network of RTUs and RF transmitters communicating to SCADA workstations in the office.

ensure delivery of important system actions. That's because, as opposed to cyclic polling, MQTT follows a strict report-by-exception publishing rule.

Instead of waiting to be commanded by the central server (called, in MQTT parlance, the broker), field devices and other MQTT network clients send data on their own, if and only if there is a change in a monitored value.

"We have many lift stations that will spend most of their time sitting," Russ explains, "[So] why transfer data all the time?"

With no dependence on a central polling program, they saw the possibility to eliminate a systemic bottleneck and potential point of failure.

In fact, MQTT's Sparkplug payload format takes resilience one step further by enabling edge devices like *groov* EPIC to store updates locally, in the event of a network interruption, and forward them to the broker as historical tags when the connection is restored.

"It just looks too simple. You've got to question it," recalls Russ.

But, willing to test the premise, Russ and Frank purchased three EPICs to play with over the summer, and soon they had the evidence in hand.

"We disconnected a controller and within a millisecond the system reported the failure. It really is that easy: change a variable and it shows up in the broker, then on your mobile phone," says Frank.

"It is that simple!" confirms Russ.

FROM PROOF OF CONCEPT TO IN PRODUCTION

To help them execute their vision, Waterford DPW engaged Perceptive Controls, a Michigan-based system integrator and long-time partner of Opto 22, specializing in industrial and process control applications for the water/wastewater, food and beverage, and oil and gas industries. But building an MQTT system for the first time came with a learning curve, according to Kevin Finkler, software engineer at Perceptive.

"This was the first time I had done something that wasn't strict client-server," says Kevin. "The topic system and how you can subscribe to a particular topic is pretty different…. When you first jump into MQTT, you understand that clients connect to brokers, but how do you actually send data? … You can browse through the broker and see it there, but understanding how it's functioning is hard."

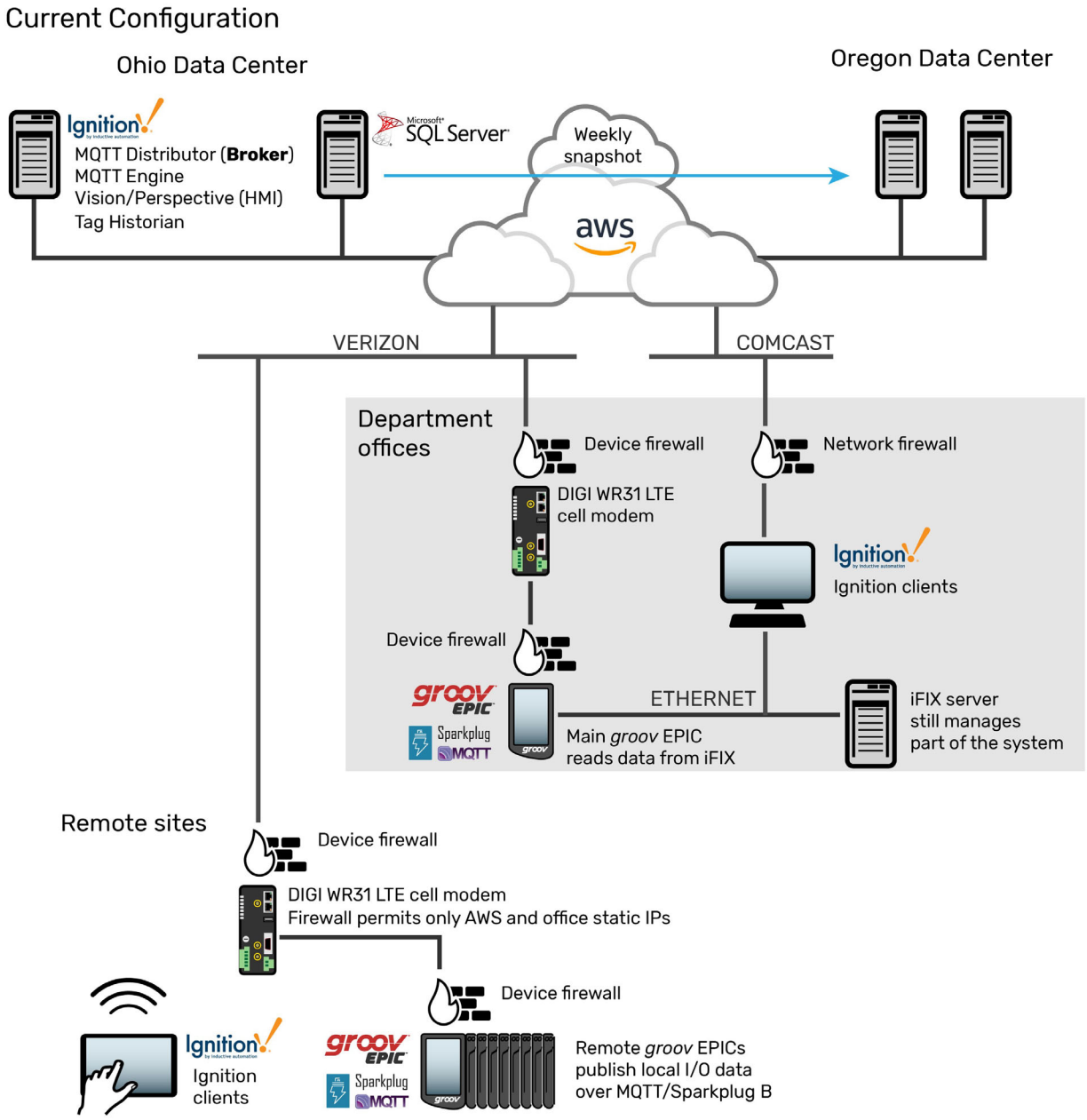
MQTT's publish-subscribe communication model is a definite departure from that of traditional industrial protocols in a few key ways:

- Field device connections originate from the device, not the broker.
- Each field device connects only to the broker, regardless of where its data needs to go.

A comparison of one of Waterford DPW's lift station control panels showing the old RTU layout and the new layout with the *groov* EPIC controller and DIGI modem.

- When using Sparkplug payloads, each device publishes (sends) a list of its available data items, called topics, upon establishing a connection to the broker.
- Other MQTT clients may also connect to the broker, see the available topics, and then subscribe to (request) updates on those topics when published by field devices.
- When a field device publishes an update, the broker forwards that update to all subscribing clients.

Understandably, the first challenge that Waterford faced was integrating this new communication model into their existing SCADA system, but this ultimately proved to be a nonstarter. At the time, Waterford had two workstations running an older version of GE Proficy iFIX, and the system simply lacked the ability to work with the MQTT protocol.



Waterford DPW's modernized infrastructure publishes data from *groov* EPIC controllers to a cloud-hosted Ignition SCADA and MQTT broker over a 4G LTE cellular network.

After experimenting with a few popular SCADA packages, they decided on Ignition by Inductive Automation® because it offered very tight MQTT integration, including the ability to serve as an MQTT broker. Even though MQTT gave Kevin a headache at first, establishing communication was straightforward once he had the right tools.

"It kind of happens automagically," Kevin says. "You basically define a few parameters [in Ignition] to set up the broker. And each of the EPIC devices was pretty simple. You just point it at the broker and it starts sending tags."

No "send data" commands to worry about after all.

"I love that both of these sides have embraced MQTT," adds Frank Fisher. "It makes the connection seamless."

BUILDING DEFENSE IN DEPTH

Earlier, as Frank searched for the components to build Waterford's new SCADA infrastructure, he experimented with hosting an MQTT broker on Amazon Web Services (AWS). With the new cellular network already under construction, it seemed like an opportunity to leverage cloud computing for greater fault tolerance and scalability.

Having successfully tested the concept, when Waterford decided on Ignition as their broker and SCADA, they decided to deploy the new system directly on AWS. With that done, Kevin and Frank began building out the mechanisms to secure the new infrastructure.

First, Frank configured the firewall on AWS to accept traffic only from his *groov* EPIC controllers and specific Ignition clients in Waterford's and Perceptive's offices. Firewalls on the cell modems and EPICs were also configured to accept only trusted IPs.

Then Frank installed a client SSL certificate on each EPIC, so Ignition could authenticate and encrypt the connection, protecting against man-in-the-middle attacks that could expose data or permit unauthorized control.

Every authorized user is required to create strong passwords to access any *groov* EPIC controller or Ignition client in the system, but over and above this, every user login is tracked and reported throughout the system as well.

Frank and Kevin even integrated physical site security into Ignition. Each lift station is secured with an outer door—under lock and key—and a physical switch on the door is connected to the local EPIC. Ignition monitors the switch

Waterford's new Ignition overview screen clearly shows any problems in the system.

state to detect when someone enters, and if a user login is not registered within a specific time with access privileges for that specific room, then Ignition generates a global alarm.

RETURN ON INVESTMENT

After completing upgrades on all 63 of its sewage lift stations and 6 of its clean water sites, the new *groov* EPIC-Ignition MQTT infrastructure has reduced field updates from multi-minute cycles to sub-second event-driven publications. With that kind of speed, Waterford never misses a system action or alarm notification anymore.

In Kevin's opinion, "Ultra-low latency is probably the biggest benefit. The latency between the controller and the Ignition gateway is less than 200 ms. That's across the cellular network with all of [the EPICs] communicating to a server in the cloud."

And in fact, for most sites, it's closer to 50 ms.

Because of MQTT's report-by-exception behavior, in combination with analog I/O deadbanding in each *groov* EPIC, the new infrastructure has also reduced bandwidth consumption. This reduction allows Waterford to publish even more data than before. They have access to communications and controller diagnostics, like update latency, connection timestamps, message size, firmware version, and more, which simply wasn't possible in the old system.

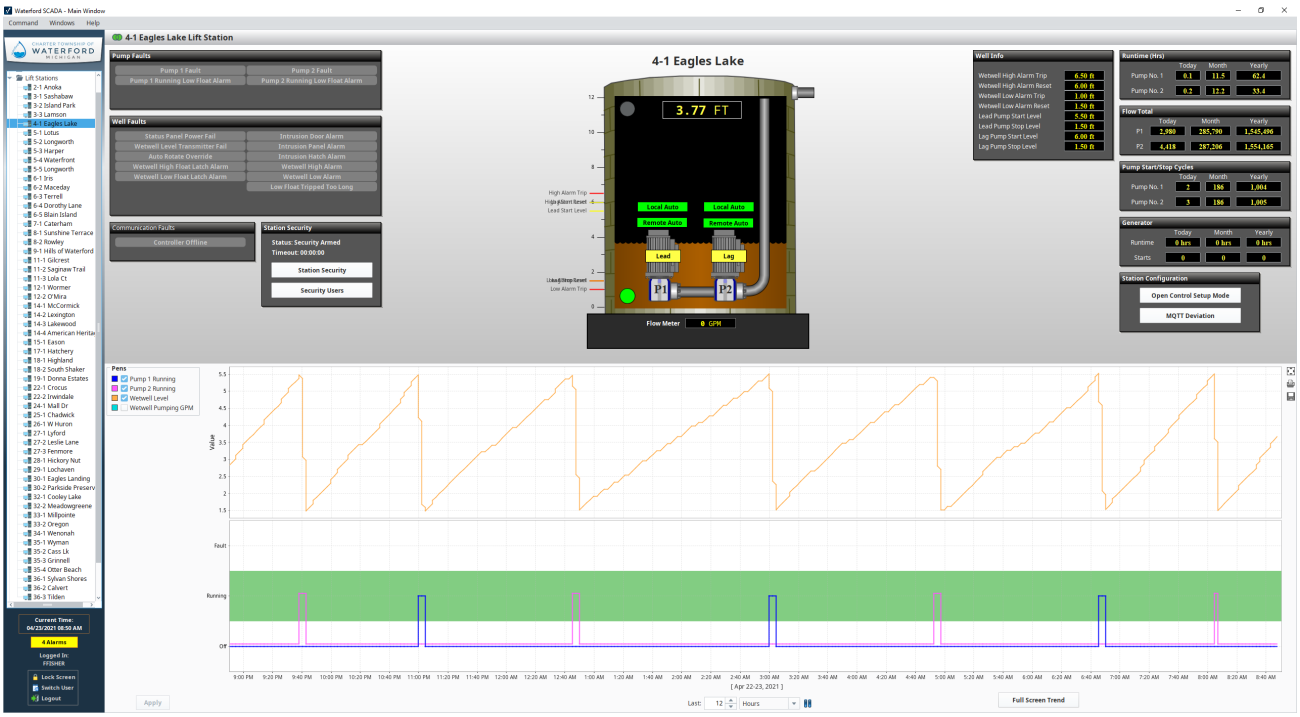
Benefits for Operators

Ignition takes advantage of all this data with a more user-friendly look and feel, highlighting critical elements like wetwell level, run time, and pump flow totals in each lift station, so operators can quickly spot problem indicators.

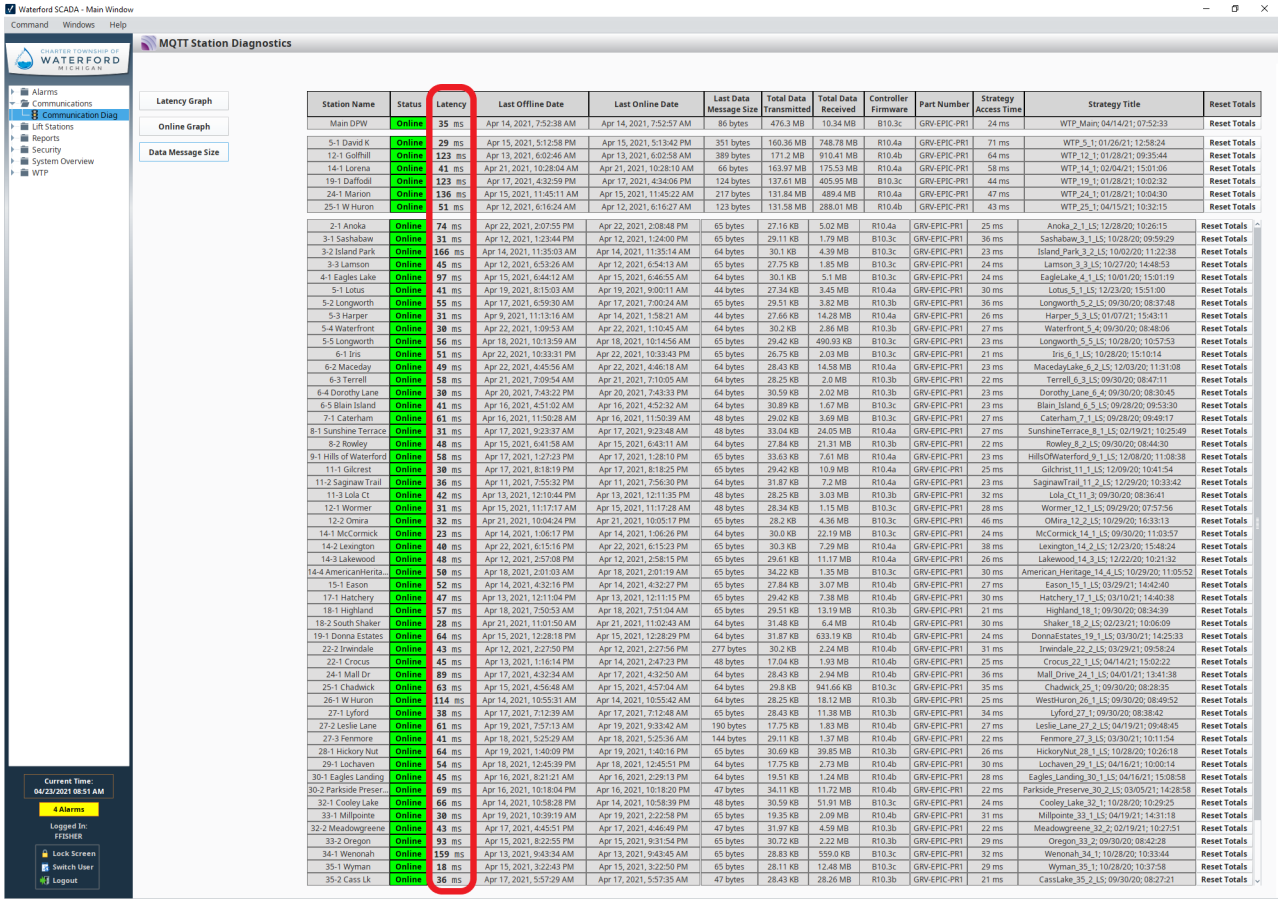
With cell-enabled tablets, operators can stay connected from anywhere through Ignition's mobile-ready HMI.

Increased Reliability

Waterford's cloud-based infrastructure also enables greater flexibility and reliability. Perceptive is able to perform controller updates over the air, which has reduced travel time and allowed them to continue project development unabated throughout the COVID-19 pandemic. If there is ever an issue at the Ohio, USA data center that hosts the new SCADA server, in 30 minutes, Frank can have the entire system up and running on a snapshot of the same server



One of Waterford's new lift station control screens. The station security panel is shown at center left.



Station Name	Status	Latency	Last Offline Date	Last Online Date	Last Data Message Size	Total Data Transmitted	Total Data Received	Controller Firmware	Part Number	Strategy Access Time	Strategy Title	Reset Totals
Main DPW	Online	35 ms	Apr 14, 2021, 7:52:38 AM	Apr 14, 2021, 7:52:57 AM	86 bytes	476.3 MB	10.34 MB	B10.3c	GRV-EPIC-PR1	24 ms	WTP_Main; 04/14/21; 07:52:33	Reset Totals
5-1 David K	Online	29 ms	Apr 15, 2021, 5:12:58 PM	Apr 15, 2021, 5:13:42 PM	351 bytes	160.36 MB	748.78 MB	R10.4a	GRV-EPIC-PR1	71 ms	WTP_5_1; 01/26/21; 12:58:24	Reset Totals
12-1 Golfhill	Online	123 ms	Apr 13, 2021, 6:02:46 AM	Apr 13, 2021, 6:02:58 AM	389 bytes	171.2 MB	910.41 MB	R10.4b	GRV-EPIC-PR1	64 ms	WTP_12_1; 01/28/21; 09:35:44	Reset Totals
14-1 Lorena	Online	41 ms	Apr 21, 2021, 10:28:04 AM	Apr 21, 2021, 10:28:10 AM	66 bytes	163.97 MB	175.53 MB	R10.4a	GRV-EPIC-PR1	58 ms	WTP_14_1; 02/04/21; 15:01:06	Reset Totals
19-1 Daffodil	Online	123 ms	Apr 17, 2021, 4:32:59 PM	Apr 17, 2021, 4:34:06 PM	124 bytes	137.61 MB	405.95 MB	B10.3c	GRV-EPIC-PR1	44 ms	WTP_19_1; 01/28/21; 10:02:32	Reset Totals
24-1 Marion	Online	136 ms	Apr 15, 2021, 11:45:11 AM	Apr 15, 2021, 11:45:22 AM	217 bytes	131.84 MB	489.4 MB	R10.4a	GRV-EPIC-PR1	47 ms	WTP_24_1; 01/28/21; 10:04:30	Reset Totals
25-1 W Huron	Online	51 ms	Apr 12, 2021, 6:16:24 AM	Apr 12, 2021, 6:16:27 AM	123 bytes	131.58 MB	288.01 MB	R10.4b	GRV-EPIC-PR1	43 ms	WTP_25_1; 04/15/21; 10:32:15	Reset Totals
2-1 Anoka	Online	74 ms	Apr 22, 2021, 2:07:55 PM	Apr 22, 2021, 2:08:48 PM	65 bytes	27.16 KB	5.02 MB	R10.4a	GRV-EPIC-PR1	25 ms	Anoka_2_1_LS; 12/28/20; 10:26:15	Reset Totals
3-1 Sashabaw	Online	31 ms	Apr 12, 2021, 1:23:44 PM	Apr 12, 2021, 1:24:00 PM	65 bytes	29.11 KB	1.79 MB	B10.3c	GRV-EPIC-PR1	36 ms	Sashabaw_3_1_LS; 10/28/20; 09:59:29	Reset Totals
3-2 Island Park	Online	166 ms	Apr 14, 2021, 11:35:03 AM	Apr 14, 2021, 11:35:14 AM	64 bytes	30.1 KB	4.39 MB	B10.3c	GRV-EPIC-PR1	23 ms	Island_Park_3_2_LS; 10/02/20; 11:22:38	Reset Totals
3-3 Lamson	Online	45 ms	Apr 12, 2021, 6:53:26 AM	Apr 12, 2021, 6:54:13 AM	65 bytes	27.75 KB	1.85 MB	B10.3c	GRV-EPIC-PR1	24 ms	Lamson_3_3_LS; 10/27/20; 14:48:53	Reset Totals
4-1 Eagles Lake	Online	97 ms	Apr 15, 2021, 6:44:12 AM	Apr 15, 2021, 6:46:55 AM	64 bytes	30.1 KB	5.1 MB	B10.3c	GRV-EPIC-PR1	24 ms	EagleLake_4_1_LS; 10/01/20; 15:01:19	Reset Totals
5-1 Lotus	Online	41 ms	Apr 19, 2021, 8:15:03 AM	Apr 19, 2021, 9:00:11 AM	44 bytes	27.34 KB	3.45 MB	R10.4a	GRV-EPIC-PR1	30 ms	Lotus_5_1_LS; 12/23/20; 15:51:00	Reset Totals
5-2 Longworth	Online	55 ms	Apr 17, 2021, 6:59:30 AM	Apr 17, 2021, 7:00:24 AM	65 bytes	29.51 KB	3.82 MB	R10.3b	GRV-EPIC-PR1	36 ms	Longworth_5_2_LS; 09/30/20; 08:37:48	Reset Totals
5-3 Harper	Online	31 ms	Apr 9, 2021, 11:13:16 AM	Apr 14, 2021, 1:58:21 AM	44 bytes	27.66 KB	14.28 MB	R10.4a	GRV-EPIC-PR1	26 ms	Harper_5_3_LS; 01/07/21; 15:43:11	Reset Totals
5-4 Waterfront	Online	30 ms	Apr 22, 2021, 1:09:53 AM	Apr 22, 2021, 1:10:45 AM	64 bytes	30.2 KB	2.86 MB	R10.3b	GRV-EPIC-PR1	27 ms	Waterfront_5_4; 09/30/20; 08:48:06	Reset Totals
5-5 Longworth	Online	56 ms	Apr 18, 2021, 10:13:59 AM	Apr 18, 2021, 10:14:56 AM	65 bytes	29.42 KB	490.93 KB	B10.3c	GRV-EPIC-PR1	23 ms	Longworth_5_5_LS; 10/28/20; 10:57:53	Reset Totals
6-1 Iris	Online	51 ms	Apr 22, 2021, 10:33:31 PM	Apr 22, 2021, 10:33:43 PM	65 bytes	26.75 KB	2.03 MB	B10.3c	GRV-EPIC-PR1	21 ms	Iris_6_1_LS; 10/28/20; 15:10:14	Reset Totals
6-2 Macesby	Online	49 ms	Apr 22, 2021, 4:45:56 AM	Apr 22, 2021, 4:46:18 AM	64 bytes	28.43 KB	14.58 MB	R10.4a	GRV-EPIC-PR1	23 ms	MacesbyLake_6_2_LS; 12/03/20; 11:31:08	Reset Totals
6-3 Terrell	Online	58 ms	Apr 21, 2021, 7:09:54 AM	Apr 21, 2021, 7:10:05 AM	64 bytes	28.25 KB	2.0 MB	R10.3b	GRV-EPIC-PR1	22 ms	Terrell_6_3_LS; 09/30/20; 08:47:11	Reset Totals
6-4 Dorothy Lane	Online	30 ms	Apr 20, 2021, 7:43:22 PM	Apr 20, 2021, 7:43:33 PM	64 bytes	30.59 KB	2.02 MB	R10.3b	GRV-EPIC-PR1	23 ms	Dorothy_Lane_6_4; 09/30/20; 08:30:45	Reset Totals
6-5 Blain Island	Online	41 ms	Apr 16, 2021, 4:51:02 AM	Apr 16, 2021, 4:52:32 AM	64 bytes	30.89 KB	1.67 MB	B10.3c	GRV-EPIC-PR1	23 ms	Blain_Island_6_5_LS; 09/28/20; 09:53:30	Reset Totals
7-1 Caterham	Online	61 ms	Apr 16, 2021, 11:50:28 AM	Apr 16, 2021, 11:50:39 AM	48 bytes	29.02 KB	3.69 MB	B10.3c	GRV-EPIC-PR1	27 ms	Caterham_7_1_LS; 09/28/20; 09:49:17	Reset Totals
8-1 Sunshine Terrace	Online	31 ms	Apr 17, 2021, 9:23:37 AM	Apr 17, 2021, 9:23:48 AM	48 bytes	33.04 KB	24.05 MB	R10.4a	GRV-EPIC-PR1	27 ms	SunshineTerrace_8_1_LS; 02/19/21; 10:25:49	Reset Totals
8-2 Rowley	Online	48 ms	Apr 15, 2021, 6:41:58 AM	Apr 15, 2021, 6:43:11 AM	64 bytes	27.84 KB	21.31 MB	R10.3b	GRV-EPIC-PR1	22 ms	Rowley_8_2_LS; 09/30/20; 08:44:30	Reset Totals
9-1 Hills of Waterford	Online	58 ms	Apr 17, 2021, 1:27:23 PM	Apr 17, 2021, 1:28:10 PM	65 bytes	33.63 KB	7.61 MB	R10.4a	GRV-EPIC-PR1	23 ms	HillsOfWaterford_9_1_LS; 12/08/20; 11:08:38	Reset Totals
11-1 Gilcrest	Online	30 ms	Apr 17, 2021, 8:18:19 PM	Apr 17, 2021, 8:18:25 PM	65 bytes	29.42 KB	10.9 MB	R10.4a	GRV-EPIC-PR1	25 ms	Gilchrist_11_1_LS; 12/09/20; 10:41:54	Reset Totals
11-2 Saginaw Trail	Online	36 ms	Apr 11, 2021, 7:55:32 PM	Apr 11, 2021, 7:56:30 PM	64 bytes	31.87 KB	7.2 MB	R10.4a	GRV-EPIC-PR1	23 ms	SaginawTrail_11_2_LS; 12/29/20; 10:33:42	Reset Totals
11-3 Lola Ct	Online	42 ms	Apr 13, 2021, 12:10:44 PM	Apr 13, 2021, 12:11:35 PM	48 bytes	28.25 KB	3.03 MB	R10.3b	GRV-EPIC-PR1	32 ms	Lola_Ct_11_3; 09/30/20; 08:36:41	Reset Totals
12-1 Wormer	Online	31 ms	Apr 15, 2021, 11:17:17 AM	Apr 15, 2021, 11:17:28 AM	48 bytes	28.34 KB	1.15 MB	B10.3c	GRV-EPIC-PR1	28 ms	Wormer_12_1_LS; 09/29/20; 07:57:56	Reset Totals
12-2 Omira	Online	32 ms	Apr 21, 2021, 10:04:24 PM	Apr 21, 2021, 10:05:17 PM	65 bytes	28.2 KB	4.36 MB	B10.3c	GRV-EPIC-PR1	46 ms	OMira_12_2_LS; 10/29/20; 16:33:13	Reset Totals
14-1 McCormick	Online	23 ms	Apr 14, 2021, 1:06:17 PM	Apr 14, 2021, 1:06:26 PM	64 bytes	30.0 KB	22.19 MB	B10.3c	GRV-EPIC-PR1	24 ms	McCormick_14_1_LS; 09/30/20; 11:03:57	Reset Totals
14-2 Lexington	Online	40 ms	Apr 22, 2021, 6:15:16 PM	Apr 22, 2021, 6:15:23 PM	65 bytes	30.3 KB	7.29 MB	R10.4a	GRV-EPIC-PR1	38 ms	Lexington_14_2_LS; 12/23/20; 15:48:24	Reset Totals
14-3 Lakewood	Online	48 ms	Apr 12, 2021, 2:57:08 PM	Apr 12, 2021, 2:58:15 PM	65 bytes	29.61 KB	11.17 MB	R10.4a	GRV-EPIC-PR1	26 ms	Lakewood_14_3_LS; 12/22/20; 10:21:32	Reset Totals
14-4 AmericanHerita...	Online	50 ms	Apr 18, 2021, 2:01:03 AM	Apr 18, 2021, 2:01:19 AM	65 bytes	34.22 KB	1.35 MB	B10.3c	GRV-EPIC-PR1	30 ms	American_Heritage_14_4_LS; 10/29/20; 11:05:52	Reset Totals
15-1 Eason	Online	52 ms	Apr 14, 2021, 4:32:16 PM	Apr 14, 2021, 4:32:27 PM	65 bytes	27.84 KB	3.07 MB	R10.4b	GRV-EPIC-PR1	27 ms	Eason_15_1_LS; 03/29/21; 14:42:40	Reset Totals
17-1 Hatchery	Online	47 ms	Apr 13, 2021, 12:11:04 PM	Apr 13, 2021, 12:11:15 PM	65 bytes	29.42 KB	7.38 MB	R10.4b	GRV-EPIC-PR1	30 ms	Hatchery_17_1_LS; 03/10/21; 14:40:38	Reset Totals
18-1 Highland	Online	57 ms	Apr 18, 2021, 7:50:53 AM	Apr 18, 2021, 7:51:04 AM	65 bytes	29.51 KB	13.19 MB	R10.3b	GRV-EPIC-PR1	21 ms	Highland_18_1; 09/30/20; 08:34:39	Reset Totals
18-2 South Shaker	Online	28 ms	Apr 21, 2021, 11:01:50 AM	Apr 21, 2021, 11:02:43 AM	64 bytes	31.48 KB	6.4 MB	R10.4b	GRV-EPIC-PR1	30 ms	Shaker_18_2_LS; 02/23/21; 10:06:09	Reset Totals
19-1 Donna Estates	Online	64 ms	Apr 15, 2021, 12:28:18 PM	Apr 15, 2021, 12:28:29 PM	64 bytes	31.87 KB	633.19 KB	R10.4b	GRV-EPIC-PR1	24 ms	DonnaEstates_19_1_LS; 03/30/21; 14:25:33	Reset Totals
22-2 Irwindale	Online	43 ms	Apr 12, 2021, 2:27:50 PM	Apr 12, 2021, 2:27:56 PM	277 bytes	30.2 KB	2.24 MB	R10.4b	GRV-EPIC-PR1	31 ms	Irwindale_22_2_LS; 03/29/21; 09:58:24	Reset Totals
22-1 Crocus	Online	45 ms	Apr 13, 2021, 1:16:14 PM	Apr 14, 2021, 2:47:23 PM	48 bytes	17.04 KB	1.93 MB	R10.4b	GRV-EPIC-PR1	25 ms	Crocus_22_1_LS; 04/14/21; 15:02:22	Reset Totals
24-1 Mall Dr	Online	89 ms	Apr 17, 2021, 4:32:34 AM	Apr 17, 2021, 4:32:50 AM	64 bytes	28.43 KB	2.94 MB	R10.4b	GRV-EPIC-PR1	36 ms	Mall_Drive_24_1_LS; 04/01/21; 13:41:38	Reset Totals
25-1 Chadwick	Online	63 ms	Apr 15, 2021, 4:56:48 AM	Apr 15, 2021, 4:57:04 AM	64 bytes	29.8 KB	941.66 KB	B10.3c	GRV-EPIC-PR1	35 ms	Chadwick_25_1; 09/30/20; 08:28:35	Reset Totals
26-1 W Huron	Online	114 ms	Apr 14, 2021, 10:55:31 AM	Apr 14, 2021, 10:55:42 AM	64 bytes	28.25 KB	18.12 MB	R10.3b	GRV-EPIC-PR1	25 ms	WestHuron_26_1_LS; 09/30/20; 08:49:52	Reset Totals
27-1 Lyford	Online	38 ms	Apr 17, 2021, 7:12:39 AM	Apr 17, 2021, 7:12:48 AM	65 bytes	28.43 KB	11.38 MB	R10.3b	GRV-EPIC-PR1	34 ms	Lyford_27_1; 09/30/20; 08:38:42	Reset Totals
27-2 Leslie Lane	Online	61 ms	Apr 19, 2021, 7:57:13 AM	Apr 19, 2021, 9:33:42 AM	190 bytes	17.75 KB	1.83 MB	R10.4b	GRV-EPIC-PR1	27 ms	Leslie_Lane_27_2_LS; 04/19/21; 09:48:45	Reset Totals
27-3 Fenmore	Online	41 ms	Apr 18, 2021, 5:25:29 AM	Apr 18, 2021, 5:25:36 AM	144 bytes	29.11 KB	1.37 MB	R10.4b	GRV-EPIC-PR1	22 ms	Fenmore_27_3_LS; 03/30/21; 10:11:54	Reset Totals
28-1 Hickory Nut	Online	64 ms	Apr 19, 2021, 1:40:09 PM	Apr 19, 2021, 1:40:16 PM	65 bytes	30.69 KB	39.85 MB	R10.3b	GRV-EPIC-PR1	26 ms	HickoryNut_28_1_LS; 10/28/20; 10:26:18	Reset Totals
29-1 Lochaven	Online	54 ms	Apr 18, 2021, 12:45:39 PM	Apr 18, 2021, 12:45:51 PM	64 bytes	17.75 KB	2.73 MB	R10.4b	GRV-EPIC-PR1	30 ms	Lochaven_29_1_LS; 04/16/21; 10:00:14	Reset Totals
30-1 Eagles Landing	Online	45 ms	Apr 16, 2021, 8:21:21 AM	Apr 16, 2021, 2:29:13 PM	64 bytes	19.51 KB	1.24 MB	R10.4b	GRV-EPIC-PR1	28 ms	Eagles_Landing_30_1_LS; 04/16/21; 15:08:58	Reset Totals
30-2 Parkside Preser...	Online	69 ms	Apr 16, 2021, 10:18:04 PM	Apr 16, 2021, 10:18:20 PM	47 bytes	34.11 KB	11.72 MB	R10.4b	GRV-EPIC-PR1	22 ms	Parkside_Preserve_30_2_LS; 03/05/21; 14:28:58	Reset Totals
32-1 Cooley Lake	Online	66 ms	Apr 14, 2021, 10:58:28 PM	Apr 14, 2021, 10:58:39 PM	48 bytes	30.59 KB	51.91 MB	B10.3c	GRV-EPIC-PR1	24 ms	Cooley_Lake_32_1; 10/28/20; 10:29:25	Reset Totals
33-1 Millpointe	Online	30 ms	Apr 19, 2021, 10:39:19 AM	Apr 19, 2021, 2:22:58 PM	65 bytes	19.35 KB	2.09 MB	R10.4b	GRV-EPIC-PR1	31 ms	Millpointe_33_1_LS; 04/19/21; 14:31:18	Reset Totals
32-2 Meadowgreene	Online	43 ms	Apr 17, 2021, 4:45:51 PM	Apr 17, 2021, 4:46:49 PM	47 bytes	31.97 KB	4.59 MB	R10.3b	GRV-EPIC-PR1	22 ms	Meadowgreene_32_2; 02/19/21; 10:27:51	Reset Totals
33-2 Oregon	Online	93 ms	Apr 15, 2021, 8:22:55 PM	Apr 15, 2021, 9:31:54 PM	65 bytes	30.72 KB	2.22 MB	R10.3b	GRV-EPIC-PR1	29 ms	Oregon_33_2; 09/30/20; 08:42:28	Reset Totals
34-1 Wenonah	Online	159 ms	Apr 13, 2021, 9:43:34 AM	Apr 13, 2021, 9:43:45 AM	65 bytes	28.83 KB	559.0 KB	B10.3c	GRV-EPIC-PR1	32 ms	Wenonah_34_1; 10/28/20; 10:33:44	Reset Totals
35-1 Wyman	Online	18 ms	Apr 15, 2021, 3:22:43 PM	Apr 15, 2021, 3:22:50 PM	65 bytes	28.11 KB	12.48 MB	B10.3c	GRV-EPIC-PR1	29 ms	Wyman_35_1; 10/28/20; 10:37:58	Reset Totals
35-2 Cass Lk	Online	36 ms	Apr 17, 2021, 5:57:29 AM	Apr 17, 2021, 5:57:35 AM	47 bytes	28.43 KB	28.26 MB	R10.3b	GRV-EPIC-PR1	21 ms	CassLake_35_2_LS; 09/30/20; 08:27:21	Reset Totals

Waterford's new infrastructure increased the speed of data updates from minutes to less than a second.

hosted in an Oregon, USA data center. In time, he will likely set up full server redundancy.

Russ Williams recognizes that Waterford is leading digital transformation in the public sector.

"I was at a FEMA training not that long ago, and they were adamant about not having an internet connection on your SCADA system," he says, "but everything we are looking at will be more secure than we could do from [the office because then] you make a building a single point of failure."

In fact, a recent internet outage at the Department of Public Works offices provided an unexpected test of their new system, which kept on working without interruption.

"We only lost the old system," says Frank. "Our internal stuff couldn't reach out, of course, but our iPads could connect through Verizon... and I was able to get back in touch. In a situation like this, the old system couldn't send out alarms because it depended on a local connection. The new system didn't even notice or care because it's not running anything local."

MORE TO COME

Waterford will continue to manage a few sites through their legacy SCADA system until the end of 2022, by which time they expect to complete all remaining upgrades.

With huge increases in bandwidth, the low administrative overhead of MQTT Sparkplug, and *groov* EPICs providing spare data processing at the edge, Waterford can continue expanding their system for a very long time. Each new device or application they add only needs a connection to the MQTT broker in order to produce or consume data for or from the whole system.

By integrating residential meter data, for instance, they could help the system stay balanced against demand. If

they can talk other agencies and neighboring counties into sharing data, they see the potential to build an advanced warning system that would improve their reaction time to system disturbances.

"We are still trying to figure out what else we can do with this," Frank says. "We have a lot of other instrumentation that we want to be able to pull data from out in the field that wasn't really feasible before… not just at our lift stations and our treatment plants but throughout the organization. Where can we use it with flowmeters? Where can we use it throughout all of our assets to give us a better overview? We're just beginning that journey."

When asked what he thought other engineers needed to understand most about MQTT, Kevin Finkler pointed out that "the client-server communication is essentially handled for them. Before there was [a lot of code] that handled all the communication. It was a lot of work to maintain. Now you just mark a tag as 'public' [in *groov* EPIC] and that's all handled for you. It's less work, so it's less money spent on engineering time."

And less money spent on engineering time means teams can tackle bigger challenges, moving critical infrastructure closer to a true digital transformation.

Contact information

For more information, visit www.perceptivecontrols.com or contact Frank Fisher at ffisher@waterfordmi.gov

***groov* EPIC System**

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**:

Phone: **800-321-6786** (toll-free in the U.S. and Canada) or **951-695-3000**
Email: systemseng@opto22.com

OPTO 22 www.opto22.com
43044 Business Park Dr. Temecula, CA 92590-3614

SALES sales@opto22.com
800-321-6786 • 1-951-695-3000

SUPPORT support@opto22.com
800-835-6786 • 1-951-695-3080