# Water / Wastewater Industry Division

*Setting the Standard for Automation™*

**Calendar of WWID Events**

| | |
|---|---|
| Summer 2022 | **2022 Energy and Water Automation Conference (EWAC) –** Webinars |
| Oct 8-12, 2022 | WEF WEFTEC 2022 (includes WEF LIFT Challenge (2022) |
| Nov 7-9, 2022 | ISA Fall Leaders Meeting Galveston, Texas, USA |
| Nov 11, 2022 | ISA112 SCADA Management Standards Committee Meeting Galveston, Texas, USA |

**2022 EWAC WEBINARS – SAVE THE DATE**

Tues, Jun 7, 2022 ..... Cybersecurity
Tues, Jul 19, 2022 ..... rescheduled to Sept 27
Tues, Aug 16, 2022..... Digital Transformation
Tues, Sept 27, 2022..... Personnel Development, Standards & Certifications

**In this Issue:**



# Newsletter Summer 2022

## Director's Welcome

*Manoj Yegnaraman, Carollo Engineers, Inc.*

Hello and a warm welcome to all of you. Summer is here - the days are longer, and this is a great time to create a lot of good memories with our families and friends. And I specifically enjoy watching kids buzzing with summer activities. Our Water Wastewater Division has been very active as well. We had a great ConnectLive session led by Graham Nasby in April. He discussed several topics around the ISA112 SCADA standard, and we had a great discussion with our audience.

This is followed by our finalization of MOUs with AWWA and WEF. These MOUs strengthen our relationship with these organizations. These organizations have provided ISA WWID the ability to provide technical input to their annual conference program (ACE22 and WEFTEC 2022). Hassan Ajami and I will be presenting at ACE22 on behalf of ISA WWID.

Our Energy and Water Automation Conference (EWAC) Committee is getting ready to host our first webinar in June on Cybersecurity. The EWAC webinar dates for August 2022 and September 2022 have also been finalized. More details about EWAC can be found in this newsletter. Please register for all EWAC webinars by going to the ISA Events and Conferences page and searching under "Upcoming Webinars".

And finally, we added Slawek Wolski as a new Board Member for our WWID. Slawek will take the role of Assistant Newsletter Editor, supporting Graham..**(continued on page 2)**

## Newsletter Editor's Welcome

*Graham Nasby, Co-Chair ISA112 SCADA Standards Committee*

Welcome to the Summer 2022 issue of our Water/Wastewater Industries Division newsletter! In the ISA standards community, the concept of "lifecycle" has a very special meaning. In our major ISA standards, whether it be HMI design, safety systems, alarm management, etc., the concept of lifecycle is used to talk about providing frameworks for the long-term managements of various parts of our automation systems. For example, in our ISA112 SCADA management committee we take an approach, through the ISA112 lifecycle diagram, of providing a structured approach for managing SCADA systems over their entire lifespan, including design standards, initial design, development, upgrades, additions/growth, continuous improvement, and finally operations/maintenance.

In many ways our WWID is not much different – it's a "live system" that continues to grow and evolve over time, with new ideas and initiatives constantly being incorporated. It's hard to believe that I started my role as WWID newsletter editor back in the Summer of 2011, and now we are publishing the Summer 2022 issue, a total of 11 years later. Since 11 is a lucky number for me (it was the number on my rugby jersey back in high school), I felt now is a good time to be true to ISA's lifecycle approach and pass the torch to another person to lead our newsletter. Starting with our Winter 2023 issue, I'm pleased to announce that Mr. Slawek Wolski will be taking on the role of our new volunteer WWID newsletter editor. During the past eight years, I have had the pleasure of…**(continued on page 3)**

## WWID Director's Message
(continued from Page 1)

… Nasby. If you are interested in submitting a newsletter article, and/or if you would like to discuss specific topics during our future ConnectLive sessions, please send me an email.

In one of my previous newsletters, I mentioned the many accommodations and sacrifices we have all made, while hoping with our changing world, to provide clean water and waste management to our communities. One of those is obviously the way in which you perform your everyday job – working face-to-face, working remotely, or some form of a hybrid solution. While we had the opportunities to observe and modify ourselves based on the outcome of each approach, I've realized how important it is for our modified approach to be able to maintain our culture, relationships, and mentoring. If you have a lessons-learned or a success story on this topic, please let me know via email.

Enjoy the summer with your families and friends. I wish you all the very best.

Regards,

**Manoj Yegnaraman, PE**
Director, ISA WWID
Vice President, Carollo Engineers, Inc.
myegnaraman@carollo.com

WWID WEBINARS

## ISA & WWID Continue to Provide Virtual Events and Plan for 2022 and Beyond

*From the WWID program committee*

With the unprecedented cancellations of in-person events in 2020 and 2021 due to the COVID-19 pandemic, our industry has had to pivot to provide online events. Both the WWID, and ISA as-a-whole, have been actively working to adapt to this new format.

For the WWID, this has meant providing a series of technical webinars for our members. We organized 4 webinars in 2020, 3 days of multiple webinars in 2021, and have already started planning our 2022 events. The Webinars are free, so we encourage you to register and attend future events. Keep an eye on the ISA website for more announcements.

In addition to WWID-associated events, the ISA has also embarked on providing a wide range of online programming:

- Virtual Conferences
- Cybersecurity Series Webinars
- IIOT & Smart Manufacturing Webinars
- Digital Transformation Webinars
- Process Control and Instrumentation Webinars
- Division-Specific Webinars
- ISA Connect Live Events

Please visit www.isa.org/virtualevents for more information.

## Newsletter Editor's Welcome
(continued from Page 1)

…working with Slawek on several projects, both professionally as part of my day job and in several volunteer roles. Slawek, and his company Ulteig Engineering (with Canadian offices formerly known as NLS Engineering) have been strong supporters of my local ISA section, ISA Hamilton, so I felt it was only natural for him to get involved with our water/wastewater division. In addition, Slawek mentioned to me that he enjoys writing, so having him as your new newsletter editor role seemed like a natural fit.

Slawek currently holds the role of Engineering Supervisor (Water/Wastewater) at Ulteig Engineering. Hence, him taking on the role of WWID newsletter editor is both a timely and a win-win situation for both us and his career.

I have greatly enjoyed working with Slawek over the years so I am sure you will as well. See page 4 of our newsletter for a welcome article from Slawek to learn a bit more about his background and how he got involved in our industry. As part of the transition plan, Slawek will be holding the position of Assistant Newsletter Editor for our Summer 2022 and Fall 2022 issues, and then will be assuming the full Newsletter Editor role as of the Winter 2023 issue. Thus, I will be writing my last newsletter editor's welcome in our Fall 2022 issue, and from that point forward all of this will be in Slawek's capable hands.

I would also like to take this opportunity to announce that I have also taken on a new role in a new industry. Earlier this year, I was head-hunted by a major North American railroad to lead their OT security architecture team. Thus, as of June 6, 2022, I am no longer working in the municipal water/wastewater automation sector. Instead, I now hold the role of Senior Manager of OT Security Architecture for CN Rail, for which I report directly to their CSIO (chief security information officer). I am very much looking forward to the challenge and the opportunity to learn a new industry!

Looking back, I have greatly enjoyed my past 12 years in the municipal water/wastewater sector, five in the consulting world and seven on the utility side. In particular, I treasure all the wonderful friends I have made over the years through involvement in organizations such as the WWID, AWWA, WEF, OWWA, FSAWWA, CWWA, WEAO, NCAWWA, NC-One-Water, NRWA, etc. as well as through working with other water/wastewater utilities and consulting firms I have worked with over the years. I am also thankful for the many interesting projects I have been able to be part of over the years.

To this end, many of you will start to see me stepping back from several of my W/WW committee involvements, so that I can focus on the next chapter of my career. In particular, this includes various automation and cybersecurity committees with the AWWA and WEF, and corresponding local committees with my local OWWA and WEAO organizations. I will also be taking on a lesser role in the WWID, where I will be soon helping mostly as an advisor and, on the program committee, as a peer-reviewer. With that said, I will be continuing to stay involved with several cross-industry organizations such as the ISA, IEEE, PMI and standards committees such as ISA112, ISA18, ISA101, ISA99, CSA P125 and various IEC TC65/65A working groups. I'm looking forward to the challenge of getting involved with a new sector, and the various railroad-oriented industry committees I expect I will be soon be getting involved with.

Now, onto our current newsletter issue – Summer 2022! I am pleased to report that we have several notable articles in this quarter's publication. We start off with our traditional welcome messages from our director Manoj Yegnaraman, myself – our current newsletter editor, our soon-to-be-new newsletter editor Slawek Wolski, and our director-elect Hassan Ajami.

Then starting on page 6, we provide some information on the current online technical webinar programming that our WWID is currently offering for this year. (Yes, we are very much looking forward to getting back to an in-person conference for 2023, but in the meantime, we can offer webinars – no plane ticket required!)

We then have two excellent technical articles. The first is a very hands-on article about cybersecurity best practices, written by Jeremy Pollard. Jeremy is a long-time automation practitioner from the control community with over 45 years of experience. He also writes a regular column for Control Design magazine and has worked in a wide range of industrial sectors. Jeremy has also been a long friend of the water/wastewater automation community. He also happens to be Canadian, and lives about a 2-hour drive from my hometown.

This is then followed by a hard-core technical article about the possibilities of using Mesh networking with IoT (Internet of Things) devices. Graduate student Alex Towfigh has kindly written an article for us about the opportunities for using IoT mesh networking for doing remote water quality monitoring. An interesting read, but make sure to bring your reading glasses. It's a very detailed paper with lots of examples and footnotes.

We then close our newsletter with an ISA Standards update, covering how an OT technical report is being developed as a base for applying ISA-62443 to the electric power industry. Then our ever-popular Automation quiz and then a column by our 2022 ISA Society President Carlos Mandolesi. As always, we conclude with a call for WWID newsletter articles and contact information for our WWID volunteer committee. We are of course, currently looking to line up both technical and industry opinion articles for our upcoming 2023 newsletters.

I hope you enjoy reading our Summer 2022 newsletter!

Regards,

**Graham Nasby, P.Eng.**
WWID Newsletter Editor
graham.nasby@grahmanasby.com

WELCOME MESSAGES

## Greetings from Our Newsletter Editor 2.0

*by Slawek Wolski, Our New Asst. Newsletter Editor*

*Editor's Note: We are delighted to announce that Mr. Slawek Wolski will be taking over as our new WWID Newsletter Editor starting in January 2023. After more than 11 years in the newsletter editor role, Graham Nasby will be passing the baton so that Slawek can lead this important WWID member benefit. For this issue and the upcoming Fall 2022 issue, Graham and Slawek will be jointly producing the newsletter, after which Slawek will take over the role of Newsletter Editor. Starting in January 2023, Graham will then be providing a regular column for the newsletter. Slawek has kindly provided the below introductory message for our readers:*

Being a nerd, I thought I would start this off with the iconic phrase of any new programming language: **"Hello World!"**

My name is Slawek Wolski, but my friends call me Swav; I am grateful for the opportunity to be the new Newsletter editor for the WWID. I look forward to working with the new group and filling the big shoes that Graham Nasby (former Newsletter editor) has left me to serve. I aim to continue the quality of content that Graham has provided over the years and follow in his footsteps.

To start this off, I'd like to provide a little bit of my past background. I have been working in the water and wastewater industry for the last 16 years. I graduated from an electrical control technologist program, but my experience and exposure to the electrical world had come way before. As a teenager, I worked with my father (an electrician) on all house and car repairs. My dad is one of my mentors, and the reason I became interested in electrical design and programming.

After graduating from Mohawk College (Hamilton, Ontario, Canada), I first worked at a multimeter repair shop. I worked with the owner who helped me understand electrical circuitry and create the foundation I would need to become the designer/programmer I am today. Shortly after that, I started my water/wastewater career as a drafter for a panel builder with a continuous urge to do PLC programming. It wasn't until my next position at a consulting company that I started getting exposed to PLC programming. However, even as a drafter, I had already started writing my own code and functions in AutoCAD to help increase productivity and ensure the excellent quality of designs. This was when I began wearing multiple hats. I would work directly with the senior electrical engineer, developing electrical designs and Process & Instrumentation Diagrams (P&IDs). I would be involved with the contract administration, site coordinator, and programmer on the same projects. Exposure to programming and electrical helped me provide accurate information for contractors in various scenarios. From there, I continued my career developing my skills with exposure to multiple platforms and programming languages and gaining continued knowledge of how to accurately read the electrical code and create electrical designs for stations and plants.

Later I decided that I wanted to learn more than just programming and jumped out of the programming and electrical world into a sales role. I learned an entirely different side of the industry and met a new mentor and now friend. I found this incredibly challenging but put every effort into making it successful. However, with life-changing challenges within my family after only a year, I decided to move back to consulting. It was here that I started working at NLS Engineering. After only a few years, I became the Associate Director of the Water and Process group, and now after the acquisition by Ulteig, my title has changed to Engineering Supervisor. My passion for knowledge of how things work does not stop. I am currently studying to get my CCNA designation, growing my engineering group, and surrounding myself with passionate and intelligent individuals.

I am married to my beautiful wife, Anya, and we enjoy travelling and photography outside of work. We have slept under the night desert sky in Morocco, travelled through Greece and multiple other countries, and experienced various cultures. We have had our share of bad and fantastic food and some questionable circumstances but enjoy the overall part of travelling. I like all sorts of music, including jazz, electric, alternative, instrumental, classical and dance/pop. I love anything outdoors. Every year I try to go camping and stay in a tent for at least two nights. I have done solo portaging in Algonquin park here in Ontario, Canada, and have encountered moose, bears, and typical raccoons, snakes, and squirrels. It has been quite a life so far, and my journey is just getting started.

If you have made it this far, I thank you for reading and hope to provide each issue with a brief introduction of what is new in the current issue and any recognitions. I welcome you to follow along in the journey, and I encourage you to desire more from your career and life. Never stop learning. Remember we all have the same amount of time each day. It's what we choose to spend our time on that determines the path of our lives.

Warmest Regards,

Slawek Wolski
Assistant Newsletter Editor, WWID
Engineering Supervisor (Water/Wastewater)
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**Slawek Wolski** is the Engineering Supervisor (Water/Wastewater) with Ulteig Engineering's Hamilton Ontario office. Ulteig Engineers is an employee-owned company with offices in Hamilton ON, Austin TX, Billing MT, Bismark ND, Boise ID, Cedar Rapids IA, Denver CO, Detroit Lakes MN, Sacramento CA, Sioux Falls SD, St. Paul MN, Williston ND, and head offices in Fargo ND. Slawek was an associate director with NLS Engineer, prior to it being acquired by Ulteig in 2021. Slawek has also held senior positions with Grey Matter Systems, Hatch Mott MacDonald, Insyght Engineering, Sirron Systems, and The Walter Smith Co. Slawek and his wife live in Etobicoke, Ontario, Canada which is part of Canada's largest city: Toronto.

WELCOME

## Director Elect's Welcome

*Hassan Ajami, PCI-Vetrix*

Greetings to our WWID members all across the globe! It's finally summertime here in the USA, which means kids are off from school and ready to enjoy the outdoors. Although our industry doesn't stop for breaks or long shutdowns, it's important to take personal time off to relax your body and mind. With inflation concerns all around us, normal summertime plans such as trips to far-away places might be relegated to the back burner and replaced with local activities.

Every year, I am amazed at how much there is to do in my home state of Michigan. Those of us raised in urban areas don't realize that the state is much larger than the Metro region. There are amazing sights to see that tell the history of the land and show the raw beauty of nature. If you get a chance, find these gems around your locale and enjoy them to the fullest.

Summertime brings with it some concerns as well, especially for utilities. Heat waves are becoming more common placing great burdens on the electric grid. Freshwater sources, already strained by droughts, are facing increased restrictions to try and preserve the resources. What we are seeing happen in Lake Mead, the largest reservoir in the USA which now sits at 26% capacity, with pictures showing the previously untouched walls of the reservoir that are now exposed, and how far away from the water marinas and docks are, something has to be done in the areas of water recovery and reuse. Droughts are impacted by climate change and there are long-term plans to address those issues, but we have to find solutions that can be implemented so we never face such dire circumstances in the future.

Innovation is the driver of any tech-related industry. New technologies, or different ways to use what we currently have, help us improve the services and quality that we provide. Showcasing innovation is a key to our Energy and Water Automation Conference, formerly the Water Wastewater Automation Conference (WWAC). These conferences provide a platform for our peers to present their innovative ideas and solutions. Attendees of past conferences usually return as speakers for the following years, creating a cycle of presenting and learning. Learning from each other is an excellent way to share information, new ideas, and best practices. This year, due to Covid restrictions, our EWAC event takes place over three webinar sessions covering topics that are important to the utility automation industry as a whole. We recently completed our first session focused on Cybersecurity. Our next two sessions will focus on Personnel Development, Standards and Certifications (July), and Digital Transformation (August). All sessions are free to attend; registration information is posted on the ISA Events page. Slides and recordings will be posted in our WWID library as well for future reference.

We are always open to volunteers who want to participate in the WWID group. Our work deals with planning for webinars and conferences, membership interaction, and coordination with partner organizations such as AWWA and WEF. We are also working with ISA on opportunities to publish presentation and papers in future editions on InTech, as well as a WWID-POWID eBook. If anyone has articles they would like to present, or publish in our newsletter, please reach out to anyone on the board.

I wish you all the best. Enjoy you summer and stay safe. We all look forward to another productive year for WWID.

Warmest Regards,

**Hassan Ajami, PE, CAP**
2021-2022 Director-Elect, ISA WWID
2021-2022 General Chair, ISA EWAC
Vice President / Lead Technical Officer
hajami@pci-vetrix.com

UPCOMING WEBINARS

## ISA & WWID Technical Webinars in 2022

*From the WWID Program Committee*

Instead of holding in-person events in 2022, the ISA & WWID are partnering together to provide a wide range of free technical webinars. The webinars are free to attend but require attendees to register beforehand via the ISA website.

Register at www.isa.org/events/

# Upcoming Webinars

### Empowering An Ever-changing Process Workforce

**19 July | 1:00 p.m. – 3:00 p.m. ET**
*Energy & Water Automation Spotlight Event*
Process Control & Instrumentation Series

### Performance Optimization in the Process Industry

**28 July | 1:00 p.m. – 2:00 p.m. ET**
*Sponsored by Siemens Industry Software, Inc.*
Process Control & Instrumentation Series

### Digital Transformation in the Power & Water Industries

**16 August | 1:00 p.m. – 3:00 p.m. ET**
*Energy & Water Automation Spotlight Event*
Process Control & Instrumentation Series

### Data Analytics: The Data is Bad, AI is Not Magic, but Occasionally We Find Something Interesting

**17 August | 1:00 p.m. – 2:00 p.m. ET**
*Energy & Water Automation Spotlight Event*
Process Control & Instrumentation Series

### Delivering Value in Process Automation Using Open Architecture Principles

**23 August | 10:00 a.m. – 11:00 a.m. ET**
*Presented by OPAF Business Group*
Process Control & Instrumentation Series

UPCOMING WEBINARS

## Other ISA Online Events in 2022

*From the WWID Program Committee*

The following other ISA online events are also scheduled to take place in 2022. Register at www.isa.org/events/

# OnPoint Online Events

Division-led technical presentations for ISA members

### OnPoint with the Process Measurement and Control Division

**20 July 2022 | 9:00 a.m. ET**
*Intro to Loop Tuning*

### OnPoint with the Process Measurement and Control Division

**24 August 2022 | 9:00 a.m. ET**
*Advanced Loop Tuning*

# ISA Connect Live

Technical discussion and networking in a live, virtual setting

### Connect Live with YPs

**24 August 2022 | 9:00 a.m. ET**
*When & How to Switch*

### Connect Live with YPs

**26 October 2022 | 9:00 a.m. ET**
*Virtual Networking*

### Connect Live with YPs

**7 December 2022 | 9:00 a.m. ET**
*Planning Your Year*

UPCOMING VIRTUAL CONFERENCES

## Other ISA Virtual Conferences in 2022

*From the ISA Conferences & Exhibits Oversight Committee*

As part of its re-start program, the ISA is starting to hold several online virtual conferences, which will soon be joined by more traditional in-person events. We look forward to being able to return to having our own dedicated ISA Water/Wastewater and Automatic Controls Conference in 2023 (fingers crossed).

### Upcoming ISA Conferences

**Registration will be opening soon for these upcoming ISA virtual conferences**

**ISA Digital Transformation Conference**

**25 August | 9:00 a.m. – 5:00 p.m. ET | Houston, TX, USA**

*Registration coming soon*

**ISA Digital Transformation Conference—India**

**20 September | 9:00 a.m. – 5:00 p.m. GMT +5:30**

**ISA Digital Transformation Conference—Malaysia**

**5 October | 8:00 a.m. – 5:00 p.m. GMT +8**

**ISA Cybersecurity Standards Implementation Conference**

**26 October | 9:00 a.m. – 5:00 p.m. ET**

*Registration coming soon*

**ISA Automation & Leadership Conference**

**7–9 November 2022 | Galveston, Texas, USA**

**ISA Cybersecurity Standards Implementation Conference—Middle East**

**6 December | 9:00 a.m. – 5:00 p.m. GMT +3**

*Registration coming soon*

ISA ANNUAL GENERAL MEETING

## ISA to Hold in-person face-to-face Annual General Meeting (AGM) and Technical Conference in Nov 2022 in Galveston, TX

*From the Leadership Conference Organizing Committee*

**Join ISA in Galveston, TX this November for the Automation Event of the Year!**

You will have the opportunity to network with ISA leaders and automation professionals from around the world—including managers, engineers, technicians, and subject matter experts.

- Attend society meetings and leadership presentations
- Attend vital technical sessions and access an array of technical subject matter experts from the US, Middle East, Brazil, Malaysia, Spain, and India
- Interact with other conference attendees—in person or virtually
- Visit exhibitor booths to gain insight and information on the latest products and technology in the industry
- Attend the ISA Honors and Awards Gala

- For more information visit: **https://www.isa.org/events-and-conferences/alc**

WEBINAR REPORT

# ISA Water/Wastewater Division Presented June 7, 2022 Webinar on Cybersecurity

*From the WWID Program Committee*

On June 7, 2022 the WWID held their first technical webinar as part of the ISA EWAC (energy water automation conference) series of webinars. Because of the covid-19 related challenges in early 2022, the decision was made to hold webinars instead of in-person events in 2022. Here is a summary of how the event went.

We had over 300 people tune in for our June 7, 2022 webinar on cybersecurity. The session featured three speakers:

Norm Anderson (Carollo Engineers)
**Developing an IACS Cybersecurity Program**

Josiah Long (Bechtel) &
Hassan Ajami (PCI Vetrix)
**Tactics for Defending Cyber-Physical Attacks**

Josiah Long (Bechtel)
**Monitoring you Cybersecurity Sandbox**

Each gave a talk form a slightly different perspective.

### Session 1: Developing an effective IACS Cybersecurity Program

In the first session, Norm Anderson focused on the ingredients for a successful cybersecurity program and how he developed a unique set of cybersecurity testing tools.

Some of the general cybersecurity program themes covered by Norm Anderson included:

- An Industrial Automation and Control System (IACS) Cybersecurity Program encompasses the management and operation of the entire IACS security and generally encompasses the following key areas:
  - IACS Organization
  - Policy and Procedure Management
  - Document Control Policies
  - Change Management Procedures
  - Work Order Policies
  - Improvement Projects
  - Cyber Security Management System (CSMS)
- Why is an IACS Cybersecurity Program needed?
- Develop the Team
- Develop Governance Policy
- Risk Analysis
- Addressing Risk with a Cyber Security Management System (CSMS)
- Monitoring and Improving the CSMS

### Session 2 – Physical Security

|In the second session Josiah Long and Hassan Ajami talked about the need to protect facilities from physical threats and unauthorized physical access.

Some of the key take-aways were:

- Tactics for Defending Cyber-Physical Attacks
- Physical and Environmental Protection – NERC-CIP categories
- Overview of Physical Control categories
- Where are your crown jewels?
- What does your site look like?
- Rings of Protection
- Security Vulnerability Assessment
- CCTV system considerations
- Intrusion Detection Device options
- Options for electronic access points
- NERC-CIP's requirements – CIP-006, CIP-014

### Session 3 – How to Build a Cybersecurity Lab

In the third session, Josiah Long talked about how to build a safe "sandbox" for doing malware testing and vulnerability assessments. In his case, he has built an extension test rig using Raspberry PI microcontrollers.

Some of the key topics he covered were:

- Monitoring Your Cybersecurity Sandbox
- Key elements of a cyber program
- Cybersecurity Tools
- Basics of your system
- Knowing your Data Flows
- Rules
- Setting up an Intrusion Detection System (IDS)
- Hardware for a basic cyber lab

*Figure 1 – one of the cyber test labs that Josiah Long from Bechtel talked about during his presentation.*

TECHNICAL ARTICLE

## One Door To The Floor (ODTHF) – Remote Access Risks & Protecting Our Critical SCADA Systems from Cyber-Attack!

*By Jeremy Pollard, CET*

I prepared a presentation for ISA on Remote Access in 2017 which I presented somewhere around 4 times at various conferences. There have been some changes to the security landscape and strategies, but I feel the basic premise of my research to prepare that presentation still remains.

Much like a medieval castle, your universe should be secure from the inside out. You do not want your enemies (hackers and data stealers) to be able to penetrate your universe from the outside, yet they do on a regular basis.

In 2011 a twenty-something hacker revealed his exploits to CNET[1], stating that connecting your SCADA (supervisory control and data acquisition) systems and machinery to the internet is silly and stupid. Agree.

But numerous vendors are still touting the ability to connect your PLCs and SCADA systems "directly" to the internet. What could go wrong?

The main reason for this of course is to have the ability to directly access these devices remotely, and control and monitor your process from wherever you are. Data everywhere has been a mantra for a while now.

Nothing scares me more than having process control on your own cell phone. BYOD (bring your own device) to the factory floor is insane in my view. I recently read an article that links third-party apps to many 'in the wild' hacks, that most didn't even know happened. Authentication schemes are present to protect said devices, however if an app asks you for access to the Wi-Fi network and you say yes, you are giving them access to the connectivity it provides.

This puts systems and data at risk. The data is no longer at rest – it can be dynamic. What's worse, your credentials can be tracked so that hackers anywhere can gain access since some interfaces can be browser-based.

There are many opportunities for bad actors to access the control system. Advanced Persistent Threats (APTs), multiple attack surfaces and zero-day threats are part of an array of holes that can be penetrated.

This leads us to risk assessment – this is where it all starts. With remote access, most control people will accept what they are being told by the IT group, or rely on vendor guidance, which can be a mistake.

There are many risk assessment and management standards available from various bodies including ISA. These deal with how you should setup your systems for the highest level of security. VPNs, encryption and Firewalls are three of the most accepted methods of preventing breaches, but as we have seen in the past this may not be the panacea we wish for. Many firewall configurations leave incoming TCP ports open which then can be used for remote access.

Remote access is the number one tool to gain access to systems for espionage, equipment destruction (Stuxnet), ransomware, and even non-destructive process monitoring.

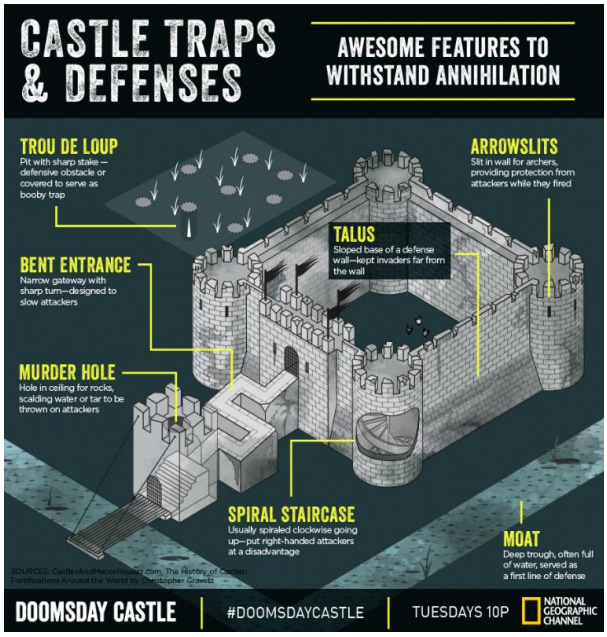


*Figure 1 – The many layers of defense of a strong castle (image courtesy of National Geographic Channel)*

Remember that the Target financial hack[2] was facilitated by stealing remote access credentials from an HVAC (heating, venting and air conditioning) company. That was an ah-ha moment for the industry. One would wonder how the HVAC system was ever connected to the internal network. No risk assessment was done, I'm sure.

It brings to light the need for authentication. At the very least 2 factor authentication has to be used. 3 factor is better.

My One Door to the Floor mindset stems from the belief that when someone is on-site at their place of work, they have a computer by which they have access to the system from their desk. The security rules and firewall setup are all in place.

The licenses for the programming and SCADA software for access and development are typically on this engineering workstation, which are not cheap as we know.

The utilities for monitoring and controlling the process are in fact bound by the walls of the network. The problem comes in when we try and take those walls and extend them to the outside world.

The remote engineer has a laptop (maybe his own BYOD) which now needs a VPN connection to the network. He has to

[1] https://www.cnet.com/home/smart-home/hackers-go-wild-an-overview-of-recent-incidents/

[22] https://www.zdnet.com/article/anatomy-of-the-target-data-breach-missed-opportunities-and-lessons-learned/

have all the software required to control and monitor the PLCs and SCADA devices. There may be many engineers in this position and of course operating personnel as well. Managing access to the network becomes unwieldly.

I have known companies to have a fleet of "approved" laptops on a shelf which you have to sign out in order to remotely access the control and system networks. The "risk surface" of this approach is high.

There are many documented issues with VPNs, where a compromised VPN has allowed an attacker to infiltrate a seemingly secure SCADA system[1].. While that is outside the scope of this article, the reason for remote access is to "replicate being physically there". From the user's perspective, providing remote access is to provide the convenience of access without compromise.

The One Door to the Floor mantra (see Figure 1) is to make access to that person's plant floor device available, and only to that device. Having full and unfettered access to the system network advances the risk profile immensely.

One of the main solutions for this is TeamViewer which is a widely used remote access tool which uses an ad-hoc VPN with encryption to access the remote device. Another solution is MobiKEY from Route1.COM. These solutions allow for ODTTF without a huge investment in DMZ servers, remote login servers and the like. However, in both cases it is software that must be constantly patched to be kept up to date against emerging threats and are best used in conjunction with other protection methods.

In recent years many vendors have developed remote access routers and access points which require the use of a similar device outside the firewall. The connection between the two devices creates an ad-hoc VPN and you now have access to any device that happens to be on that network. Ewon and Tosibox are two of the vendors who provide these devices. You still need to have local product licensing on the remote device if you want to connect to the remote devices such as PLC programming software.

While this is much more secure than a standard VPN, you would still need to have software running at both ends to access the target devices.

The best practice is, however, to strive towards the control system network not having a surface on the internet, period. However, Security by Obscurity (making the connection point hard to find) and airgaps (complete 100% isolation) are not distinct solutions.

The risk assessment for remote access has to be documented so that weaknesses can be identified. In this day and age, using 2FA (two factor authentication) technology is a must-have, and it must be done in addition to other protection technologies.

Remote access has to be initiated from behind the firewall. Incoming connection requests can be intercepted by Man-in-the-Middle attacks and spyware on your mobile device as well as your BYOD laptop. We are not computer gurus, so we would probably not even notice that we are really connected to a remote router running on a laptop on the guy sitting next to me in a coffee shop. He has just stolen your credentials.

One of the challenges with SCADA and OT systems, is that they don't tolerate any downtime. IT systems, on the other hand, such as email and file services can usually tolerate some downtime after hours, but SCADA systems cannot. Thus, protecting OT and SCADA systems from cyberattacks is much more challenging than protecting IT systems. The lifeblood of a manufacturing facility is its ability to produce. Unscheduled downtime is not acceptable in most cases. Mistakes cannot be made in the process, so all things considered; the OT network has to be available 100% of the time.

Thus, remote access hack/interruption on an OT system, such as SCADA, is simply not acceptable on critical sectors such as the water/wastewater sector!

Mitigation, before things happen, is where we need to start. We have discussed 2FA, and ODTTF. Another way we can protect our systems is to pay attention to device software and firmware patches.

Many PLC/PAC devices in the wild can be considered to be a computing device that has an operating system. One such instance was made public by Rockwell Automation. The firmware of their CompactLogix PAC could be compromised by a malformed CIP message which could initiate a non-recoverable fault (denial of service) which could result in a ransomware attack[2].

There are many bad actors and attack vectors out there in the wild just ready to get to you and remote access is a primary target[3]. In one internet scan, it was discovered that over 3.3 million building automation devices had an attack surface just begging to be hacked[4]. There is a YouTube video which shows a drone that hacked a building that uses the Philips HUE smart lighting system[5]. The video shows the lights going on and off to music[6]. Funny and yet very disturbing.

Remember that anything with an internet surface is a target, and the main way in is through remote access. Mitigate with policies, risk management and proper authentication and always keep all of your systems patched. VPNs are only as secure as the connected devices.

This is from a hardware VPN provider – "Yes, it is possible for

[1] https://www.ontariopipeline-digital.com/owwq/0222_summer_2022/MobilePagedReplica.action?pm=2&folio=20#pg20
[2] https://www.cisa.gov/uscert/ics/advisories/ICSA-13-011-03
[3] https://www.cvedetails.com
[4] https://www.securityindustry.org/wp-content/uploads/2018/08/BACS-Report_Final-Intelligent-Building-Management-Systems.pdf
[5] https://www.pcmag.com/news/philips-smart-lights-hacked-using-a-drone
[6] https://www.youtube.com/watch?v=Ed1OjAuRARU

a virus or other malicious payload to be transferred through the [VPN] tunnel".

I revert back to my initial mantra – remote access is to "replicate being physically there". Plan and implement well.

**Further Reading:**

"**A Taxonomy of Cyber Attacks on SCADA Systems**" Bonnie Zhu, Anthony Joseph, Shankar Sastry. Department of Electrical Engineering and Computer Sciences University of California at Berkeley, California, USA. August 2021. Contact: bonniezeecs.berkeley.edu. weblink: https://people.eecs.berkeley.edu/~adj/publications/paper-files/ZhuJosephSastry_SCADA_Attack_Taxonomy_FinalV.pdf

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TECHNICAL ARTICLE

# IoT Mesh Networking Solution for Remote Water Quality Monitoring

*by Alex Towfigh, UC San Diego*

According to The Water Project, a non-profit international water charity, in developing countries, approximately 80% of illnesses are linked to poor water and sanitation conditions ("Global Water Shortage: Water Scarcity & How to Help - Page 2"). Furthermore, at any one time, patients suffering from water-borne diseases occupy half of the world's hospital beds. In developed countries, there are large amounts of chemicals used in daily life that can make their way into water sources (Myers). For instance, in Flint Michigan, a water crisis was caused after lead from pipes leached into the drinking water supply, ("Flint Water Crisis", 2019). Furthermore, according to the Government of New South Wales EEs, poor water quality can have a negative impact on public and environmental health, recreational activities, farming and other activities (NSW, 2019). Therefore, water quality monitoring is a critical tool for managing freshwater resources and providing crucial information regarding the chemical, physical and biological composition of the water, in order to identify any emerging issues ("Monitoring water quality and wastewater", 2016).

**Introduction**

In developing countries, water quality monitoring has not been effectively implemented due to a lack of funds, technical ability, appropriate technology, and because of the ineffectiveness of traditional approaches and skills availability ("Monitoring water quality and wastewater", 2016). Furthermore, the traditional approach to water quality monitoring has been through the manual collection and analysis of water samples and surveys. Therefore, new approaches for water quality monitoring are being developed and implemented with the aid of technology to address this issue.

One approach is to implement a distributed network of water quality sensing devices, in the form of Wireless Sensor Networks (WSN), throughout a desired region. The data gathered can be used to provide valuable information regarding the potential presence of chemicals or pollutants in the water. WSN can be composed of a variety of communication standards, common ones include IEEE 802.15.4, ZigBee, Bluetooth low energy (BLE), Long-range wide area network (LoRaWAN) and SigFox. The choice of standard depends on the needs and requirements of a specific application. One major challenge in monitoring water quality is being able to collect a large amount of data samples to produce an accurate and dependable analysis. Furthermore, the ability to connect a scalable network of sensors in real-time gives WSN's a significant advantage in being able to provide large amounts of distributed data at a fast enough rate to allow for an early warning capability in the case of contamination.

However, for this particular application of monitoring water quality, a specific implementation of WSN, called a Wireless Mesh Network (WMN), could prove to be more advantageous. In WMNs each node acts as both a router and a client, meaning that each device is responsible for both receiving and transmitting data (Akyildiz, Wang, & Wang, 2005). The advantages of WMNs over traditional WSNs are a low upfront cost, robust networking capabilities and easily scalable networks. In the context of water quality monitoring, an approach that utilizes a WMN could decrease reliance on existing technologies like GSM (Global System for Mobile Communications) or cellular for connecting individual devices. The advantage is that the mesh network can provide a more robust, lower power consumption and lower-cost connection between individual devices than most cellular implementations. Furthermore, a WMN implementation would incorporate a few designated cellular transmission nodes, responsible for remotely sending sensor data to an end-user.

**Literature Review**

Numerous studies have been conducted that implement WSNs, both mesh and non-mesh based, for the construction of a distributed network of water quality sensing devices. For instance, in 2011, Muhammad Nasirudin, Ummi Za'bah and O.Sidek, from the Universiti Sains Malaysia, constructed a WSN system with the ability to conduct real-time water quality data collection in fresh water sources like rivers and lakes (Nasirudin, Zabah, & Sidek, 2011). They utilized a ZigBee protocol mesh network to connect individual water quality sensor nodes to the master node, or network coordinator, responsible for sending the data remotely via GSM network. The researchers proposed to measure water Temperature, pH, Turbidity and Dissolved Oxygen, but clarified that the project was in a preliminary stage and had not deployed the sensor framework in the environment or conducted any complete water quality experiments. The primary purpose of the paper was to illustrate a principle of a working mesh-based framework that could potentially be deployed to gather water quality data.

A team at the Autonomous Systems Laboratory in Brisbane, Australia, deployed a WSN for monitoring water quality in a remote tropical area of northern Australia (Dinh, et al., 2007). The study focused specifically on monitoring the amount of water being pumped out from the region being monitored, and the impacts of water extraction on water quality, with the goal of designing a sustainable water irrigation system. Furthermore, as opposed to transmitting the data gathered by the sensors via GSM to enable remote data access by an end user, the team focused on using a high-performance radio transmitter to send the data directly to the laboratory via an Asymmetric Digital Subscriber Line (ADSL) gateway. Furthermore, each device in the network had an independent connection with the end-user (laboratory) and a mesh network (WMN) was not used. The researchers concluded that their sensor network could be a feasible solution for maximizing the amount of water pumped out from a region while minimizing impacts on water quality.

In 2013, Adinya Odey and Li Daoliang from the China Agricultural University in Beijing, China, designed and implemented a WMN for water quality management and aquaculture (Odey, 2013). The researchers used a variety of communication technologies to both construct the mesh

architecture and transmit the data gathered in the network remotely. Similar to the previously mentioned project from Malaysia, the researchers used the ZigBee protocol to comprise the mesh network, in conjunction with a Waspmote mesh sensor node, WIFI gateway and GPRS for transmitting the data remotely. To test their design, the researchers deployed a six node WMN at a laboratory fishpond, three of the nodes were designated for data collection and equipped with sensors for PH, Electrical Conductivity (EC) and Dissolved Oxygen (DO). The other three nodes served as gateway nodes, with one of those three being the designated GPRS node for remote data transmission. The results of the testing showed that the mesh network was effectively able to transmit the water quality data to a remote server, send an alert if the set threshold for a measured value is exceeded, and allow for a clear monitoring of changes between measured values over time.

In 2015 researchers Wang, Zhou, Lu, Wang and Leung proposed a real-time online water environment monitoring terminal, powered by a mesh network architecture (Wang, Zhou, Lu, Wang, & Leung, 2015). They cited three main challenges for online water quality monitoring: the high price of water sensors, the geographically spread-out nature of the monitoring stations requires high performance, low-cost and wide coverage networking, and the complex requirements of a water quality monitoring network. They outlined the advantages of mesh networking over traditional networking as: broadband transmission, independent network with no reliance on existing infrastructure for communication between nodes, long transmission distance (due to scalable architecture), robust and reliable and low cost.

The team then conducted performance testing of their data acquisition board by monitoring four conventional parameters (temperature, pH, conductivity and turbidity), and comparing the impedance of the monitored data to data collected directly from the instrument. The researchers concluded that their mesh-based water quality monitoring system performed successfully and had sufficient reliability and validity.

In 2017, researchers Kamarul Kamaludin and Widad Ismail from Universiti Sains Malaysia, suggested a water quality monitoring implementation based on an Internet of Things (IoT) framework, using WSN and IP-based communication (Kamaludin & Ismail, 2017). The proposed system consisted of sensor nodes and network gateways. Similar to previously noted studies the IEEE 802.15.4 ZigBee protocol was used for mesh communication. PH and ambient temperature were the measured parameters for the performance evaluation during the real-world environmental deployment. Furthermore, the researchers developed a mobile application to display data captured from sensors in real-time. They conducted the pH measurement at a local

lake and measured average percentage deviation, power consumption and maximum WSN read range were also measured. The researchers concluded that their proposed system had an average percentage deviation within the maximum acceptable tolerance of 10%, and therefore the study was successfully designed and implemented.

In 2017 researchers Cho Myint, Lenin Gopal, and Yan Lin Aung designed an IoT based water quality monitoring system with a Field Programmable Gate Array (FPGA) board design, sensors and ZigBee based communication, and a personal computer (PC) (Myint, Gopal, & Aung, 2017). The proposed system was able to collect water data on pH, level, turbidity, surface carbon dioxide, and temperature in real-time, from five sensor nodes. For data transmission, they used the XBee RF module for wireless communication to send the data collected on the sensor nodes to a designated PC for final analysis. To test their proposed water-quality monitoring system the researchers designed an experiment as follows: an ultrasonic sensor was placed on the lake bank at ground level, facing the water's surface for measuring the distance between the ground level and water surface.

The sensors for measuring pH, temperature, and turbidity were placed in the lake water, while the $CO_2$ sensor was placed 2 inches above the water's surface. The gathered data was displayed on a PC near the sensor nodes. They concluded that the data gathered by the proposed system had no significant variances with the measurements conducted in a laboratory for data verification, and therefore their system could be a reliable and feasible option for actual monitoring applications. The team noted that their WSN system could be improved by adding more sensors to increase the measuring area.

One limitation that could be inferred from this study is the battery limited operation time (6 hours as tested), which could be a significant issue for long term deployments, one solution is using a renewable power source, like a solar panel, in conjunction with a battery, to provide consistent and reliable power delivery. Additionally, in this case, the data collected by the sensor nodes is transmitted to a nearby PC, meaning that there is no technique presented to transmit the data remotely to an end user, this can be solved by directly transmitting the gathered data to a remote end-user or server by using a designated GSM/cellular transmission node.

In 2015, researchers Vijayakumar, N., and Ramya, R. from Rangasamy College of Technology in Namakkal, India presented a design for a low-cost real-time water quality monitoring system through IoT (Vijayakumar & Ramya, 2015). They measured the temperature, PH, turbidity, conductivity and dissolved oxygen content of the water. Data gathered from the sensors was processed by a Raspberry PI B+ core controller and could be viewed on the internet by an end-user via cloud computing. Although the results of any experiments conducted by the proposed system were not mentioned, the researchers emphasized the importance of the system being low cost, efficient and capable of processing and displaying the data remotely as critical factors. They noted an intention to install and test the system in several locations for further development.

Although the aforementioned studies have well-documented procedures and methodologies for designing and implementing WSN for water quality monitoring, through IoT and mesh-based techniques, in my opinion, the majority present a specific proof-of-concept that lacks the environmental testing and short-term deployment necessary for bringing the system from a

working prototype stage to a practical and feasible option for long-term operation. Therefore, there remains a significant research gap for conducting short term environmental deployment and testing of an IoT mesh-based water quality monitoring system, in a specific environment or region. As noted by researchers Adinya Odey and Li Daoliang, the primary purpose of their study (Odey, 2013) was to illustrate the feasibility and advantages of a WMN for water quality monitoring, and therefore an implementation of the system into an environment for further study was not conducted. A similar conclusion was drawn by researchers Muhammad Nasirudin, Ummi Za'bah and O.Sidek (Nasirudin, Zabah, & Sidek, 2011). To clarify, although a majority of studies have conducted preliminary testing, the experiments were conducted with the primary purpose of showing potential feasibility and to prove that a proposed approach could perform as intended.

In my experiment, I hope to move beyond the stage of preliminary proof of concept testing and conduct a short-term deployment of a IoT mesh network-based water quality monitoring framework, in a specific location. Another key goal of my research will be to develop a solution that's more scalable, easier and more feasible to implement for potentially long-term use cases while maintaining a low-cost and high performance.

**Methodology:**

I chose an experimental research method, a logical way of developing a solution which can effectively function to remotely monitor water quality and gather water quality data. First, I began the hardware design for the water quality monitoring units, key design aspects included making a device that would have sufficient network performance, be low-cost, robust enough to hold up to the outdoors, and easily reproducible for the 6 total devices. Of the 6 units, 2 were designated cellular and mesh master nodes, for sensor data collection and remote transmission, while the other 4 units were designated mesh-only units, meaning they collected sensor data and transmitted it locally to the cellular master node via the mesh network.

The reason for splitting the designs into 2 types was to minimize reliance on cellular services, meant solely for remote transmission, and thus more effectively leverage the benefits of a mesh network over a traditional cellular connection for data transmission between sensor nodes including. Benefits include lower costs (cellular plans only need to be purchased for a designated remote transmission node), reliability (less risk of spotty cellular service affecting entire network performance), and scalability (easier and neater to attach or remove mesh nodes from a network).

For the cellular and mesh capable master nodes (used for remote transmission) hardware components included: a watertight Pelican case to house components, Particle.io Boron mesh development kit, solar panel as a remote power source, LiPo battery to store solar power, mesh antenna, cellular antenna, pH, temperature, turbidity and ORP water sensors. Particle.io mesh technology was chosen for it's low-cost, ease-of-use in terms of hardware interface and software integration with cloud services used for data collection and display, and sufficient network performance. The sensors were chosen for their common use in water quality monitoring, and some were also used in studies by Nasirudin, Zabah, & Sidek, 2011 and Odey, 2013 mentioned in my literature review.

For the mesh-only capable nodes, hardware components were similar to the cellular nodes with the exception of Particle.io Xenon kits instead of Boron kits, the absence of a cellular antenna, and water quality sensors being limited exclusively to temperature and turbidity. The sensor variety was more limited due to funding constraints and the experimental nature of this project.

After the hardware components were constructed, all sensors were calibrated and tested to ensure reliability and performance. Then, the 6 mesh units were split into 2 groups, each with 1 cellular and 2 mesh-only nodes, so that 2 separate networks could potentially be used in separate deployments for varied data. However, it turned out that one deployed network, with three nodes, would be sufficient to conduct and illustrate the experiment, so the other mesh network was used for other testing purposes.

Next, the software for the 2 identical mesh networks was written in Arduino, via the Particle.io web IDE. The software has the following functionality:

1. Each device in the network collects data from attached sensors via a serial or digital connection.

2. Each device uses a built-in function to send sensor data throughout the mesh network to the "master" cellular node, which is automatically published remotely. Although the "master" cellular node does not send data throughout the rest of the mesh network, it uses the same built-in function to publish data remotely.

3. Data is automatically published from the "master" cellular node via an LTE data connection to the Particle Device Cloud, where it can be viewed and sent for processing.

Once initial tests were conducted to ensure that hardware and software components were working as mentioned, the IoT mesh network was ready to be deployed for real world testing. I obtained permission from a nearby nature preserve to deploy my solution along a waterway. I chose to deploy at nature preserves because they emulate a real-world environment with a body of water, where a solution like this would be most beneficial for remote water quality monitoring.

After the devices were successfully deployed into their respective field-testing environments, they were powered-on and reconfigured to operate and send data through the mesh network and publish to the Particle Device Cloud. An integration feature with Google Maps was also available through the Particle Device Cloud to enable geo-tracking on the deployed devices, although this wasn't tested throughout the experiment.

After water quality data from the test environments was successfully gathered and displayed remotely on the Particle Device Cloud, it was logged to Google sheets via an IFTTT integration for storage and monitoring. Device statistics from the master cellular node were also logged to Google sheets for storage and monitoring. Finally, the solution was left deployed in the real-world test environment for the next few weeks to illustrate reliability.

**Results:**

The IoT sensor devices were deployed at a local nature preserve site managed by the Bureau of Land Management (BLM) for wetlands restoration and placed close to each other along the bank of a lake. As one of the goals of the research was to create a solution that was easy to install and required minimal maintenance, I was able to install the devices with ease along the riverbank and place the sensors in the water.

| | | | | |
|---|---|---|---|---|
| 369 | turbidity | 2.49 | Mesh_Node1 | February 11, 2020 at 02:57PM |
| 370 | turbidity | 1.39 | Mesh_Node2 | February 11, 2020 at 02:57PM |
| 371 | turbidity | 7.37 | master_node1 | February 11, 2020 at 02:58PM |
| 372 | temperature | -1000 | Mesh_Node1 | February 11, 2020 at 04:57PM |
| 373 | ORP | 2000 | master_node1 | February 11, 2020 at 04:58PM |
| 374 | temperature | 17.94 | Mesh_Node2 | February 11, 2020 at 04:57PM |
| 375 | turbidity | 1.62 | Mesh_Node2 | February 11, 2020 at 06:57PM |
| 376 | pH | 0 | master_node1 | February 11, 2020 at 06:58PM |
| 377 | turbidity | 0.65 | Mesh_Node1 | February 11, 2020 at 06:57PM |
| 378 | temperature | -1000 | Mesh_Node2 | February 11, 2020 at 08:57PM |
| 379 | temperature | -1000 | Mesh_Node1 | February 11, 2020 at 08:57PM |
| 380 | temperature | -1000 | master_node1 | February 11, 2020 at 08:58PM |
| 381 | turbidity | 1.76 | Mesh_Node2 | February 11, 2020 at 10:57PM |
| 382 | turbidity | 0.23 | master_node1 | February 11, 2020 at 10:58PM |
| 383 | turbidity | 1.07 | Mesh_Node1 | February 11, 2020 at 10:57PM |
| 384 | temperature | -1000 | Mesh_Node1 | February 12, 2020 at 12:57AM |
| 385 | temperature | -1000 | Mesh_Node2 | February 12, 2020 at 12:57AM |
| 386 | ORP | 1956.44 | master_node1 | February 12, 2020 at 12:58AM |
| 387 | turbidity | 1.64 | Mesh_Node2 | February 12, 2020 at 02:57AM |
| 388 | turbidity | 1.13 | Mesh_Node1 | February 12, 2020 at 02:57AM |
| 389 | pH | 0 | master_node1 | February 12, 2020 at 02:58AM |

*Figure 1 - Snippet of data shown in tabular format with time/date stamps coming directly on Particle Cloud event stream.*

The devices were then powered on and their connections with the Particle Cloud were checked. However, I initially faced issues getting the devices to connect together into a mesh network, but this was likely due to software glitches/inconsistencies in the built-in Particle device firmware. These connection issues were also the reason why the devices were placed closer together than expected. After reconfiguring and resetting the devices, the network issues were solved.

Water quality data and device statistics (connection health, battery power/charging) were monitored for the duration of the week-long deployment to ensure that the solution was reliable and feasible for real-world use. The following is a snippet of data gathered through Google Sheets via an IFTTT Webhook integration:

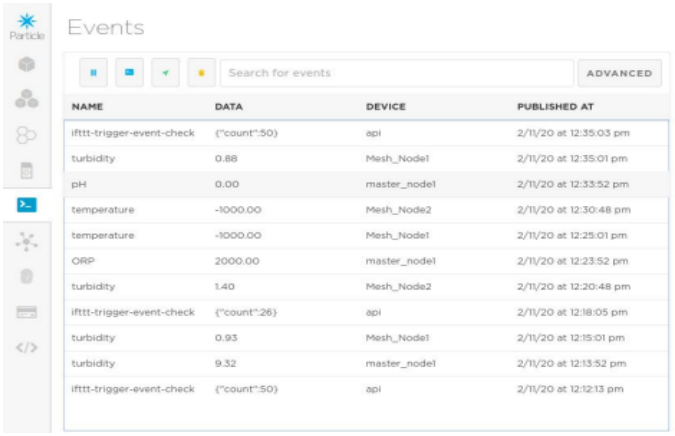



*Figure 2- Sample of an event entry captured by the software*

As shown by the data, the solution was successfully able to send data through the mesh network devices and transmit remotely through the cellular master node for remote access.

Device connection statistics were also gathered for the main cellular node:

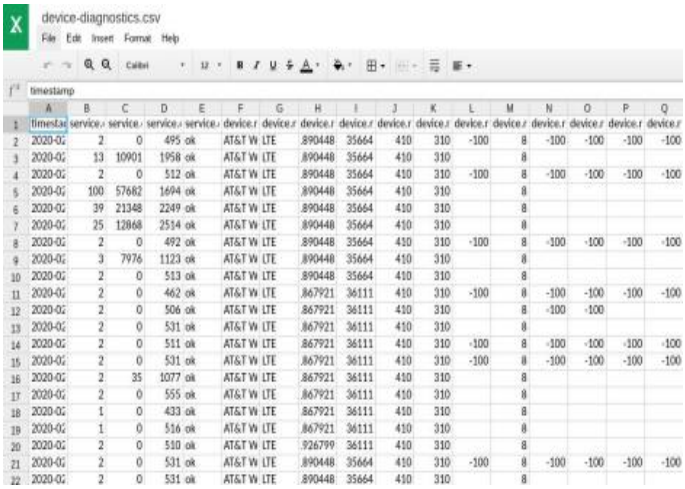



*Figure 3 – Device connection statistics that were generated*

Regarding the data, sensor readings are inaccurate due to calibration issues, however, the data was successfully relayed by the devices through the mesh network and sent remotely for storage/logging by the designated cellular node. Device statistics show a healthy cellular connection between the field deployed cellular node and the Particle Device Cloud. Issues also arose with battery charging via solar, however this was likely due to lose power connectors and/or insufficient sunlight.

**Discussion:**

To reiterate, the original goal of this research project was to move beyond the stage of preliminary proof of concept testing and conduct a shor- term deployment of an IoT mesh network-based water quality monitoring framework, in specific locations. Another key goal of my research was to develop a solution that's more scalable, accessible and feasible to implement for potentially long-term use cases while maintaining a low-cost and high performance.

As mentioned in the results, the concept and deployment were feasible and successful. Specifically, in respect that the devices can be produced at a low cost using off the shelf components, be easily scalable, easy to deploy (no technical skill or programming needed for setup, just plug and play, and verify devices are sending data), and successfully deliver data remotely to an end-user through the cloud. Furthermore, the streamlined integration features with external services provided through the Particle Cloud would allow for straightforward integrations with notification services like IFTTT or others. This would enable direct notifications to end-users for water quality alerts and can either be configured by the user or developer.

Some unforeseen issues and limitations included a significant amount of firmware constraints and bugs in the Particle.io Mesh software (closed source) which led to numerous issues when setting up the devices in a real world environment, although in theory the setup should've been seamless. This led to issues with range and thus reduced spacing between devices, where they had to be placed close (within feet of each other) to connect to each other via the mesh network. I also faced issues with sensor calibration, as the factory calibration and described steps to conduct user calibration were not effective enough to get accurate/useful sensor data readings. However, for the purpose of this project the goal is that the data can be gathered remotely from sensors, not necessarily the quality/usefulness of said data.

**Reflection:**

The overall concept and deployment were a success and all questions were answered successfully. However, there is much improvement to be made in terms of network reliability/performance and easy sensor calibration, most of which are a result of bugs in closed-source firmware only repairable by the company producing the devices.

**Conclusion & Future Work:**

A key implication of this research project is to eneable remote water monitoring in remote and developing regions, where there's a lack of infrastructure for monitoring the cleanliness and potability of water. As this research project moves beyond existing research to prove the potential effectiveness and feasibility of the solution, it's possible for a commercially viable product to be developed and deployed using the fundamental findings of this research, where further refinement and development will be required to address some of the limitations expressed in the discussion.

The impact on the field is that a real-world deployment and experiment has been conducted with an IoT water quality monitoring solution with mesh-networking, which goes beyond the existing research limited only to brief and minimal proof-of-concept experiments.

These findings also help build upon existing studies, such as the one by Nasirudin, Zabah, & Sidek, 2011, and justify the feasibility of an IoT mesh-networking based solution for remote water quality monitoring through the successful operation of a real-world deployment. Which goes beyond existing small scale and theoretical experiments. This also provides another option for researchers using more customized radio transmitters for local data transmission, such as Dinh, et al., 2007, who sent sensor data directly from the devices to their laboratory.

A mesh network-based architecture, such as mine would allow for remote cloud data transmission, allowing for the data to be accessed and monitored by users outside of the local radio-accessible range provided by the radio transmitters on the sensor devices. By expanding their potential user base through the remote access cloud integration, the researchers would be able to implement a more comprehensive and scalable solution, that could be more beneficial when commercially deployed or used in communities. Hopefully, this experiment will also inspire other members of the scientific community to further explore the field of IoT mesh-networking and develop even more sophisticated and effective solutions.

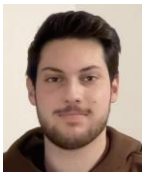
Regarding future work, as of writing this paper Particle.io has recently announced deprecation of their mesh networking technology (January 2019) due to a variety of reasons, including issues I faced such as network limitations it may be beneficial to look into other types of network technology. One such technology is LORA (low-power wide-area), which allows for low-power, long-range transmission between devices, and could be substituted for my existing mesh devices into a similar implementation.

Originally, I chose not to implement LORA technology due to its high-priced components and complexity of implementation. However, recently Arduino, a producer of popular microcontrollers, released a new line of boards, one of which, the MKR WAN 1300, supports LORA connectivity. This would allow for lower-cost devices and easier implementation and integration with existing IoT cloud services. Although an implementation of this LORA technology would require a full hardware and software revamp to my existing solution, the concept and techniques proven in this paper justify its potential feasibility.

Furthermore, as LORA is a commonly used standard in industry for IoT and data transmission, as opposed to the now deprecated Particle mesh technology, a switch would likely address firmware limitations and networking bugs experienced with the Particle solution.

I'd also like to give a special thank you to Particle.io, Pelican Cases, Data Alliance.net, Chicago Electronics Distributors, Taoglas, Tessco, DFRobot and Voltaic Systems for donating the majority of the components for this project. I'd also like to thank researchers from the United States Geological Survey (USGS) for their mentorship and advice, and the Cosumnes River Preserve & BLM for graciously offering a real-world deployment location.

**About the Author**



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ISA TRAINING

## ISA Training Program: Automation Project Management Specialist Certificate

*From ISA website – isa.org/training*

The ISA Automation Project Management (APM) Specialist certificate program was developed by leading automation project managers from around the world. By leveraging their combined experience, this program offers real-world, practical lessons that you can apply to your job today.

This program was designed to specially address the unique and complex challenges of automation and process control projects, including:

- Integration of multiple engineering disciplines (software, computer systems, networks, and instrumentation)
- High dependency on user requirements of disciplines outside of automation
- Integration of requirements from many areas (business, engineering, safety, environmental)
- Delays in other project areas that propagate over to the automation area
- New technology or technology constraints

The program is well-suited for project managers who need to understand how to execute automation projects effectively. It is also ideal for automation professionals who need to gain an understanding of core project management principles.

Earning the APM certificate will provide you with the Automation Project Management Specialist badge, which can be easily shared via social media with your employer and/or professional network.

**APM Specialist Certificate Requirements**

There are no required prerequisites or applications for this program. To earn the APM Specialist certificate, you must successfully complete the Automation Project Management course and pass the multiple-choice exam. Choose one of the following formats:

- Classroom (MT01)
- Self-Paced Modular (MT01M)
- Try Module One of MT01M - Free

For more information, visit https://www.isa.org/training

ISA STANDARDS

## ISA Leading Effort to create OT Security Profile for Electric Power Industry under 62443 Series of Cyber Security Standards

*From ISA news release*

The U.S. Department of Energy (DOE), global equipment suppliers, and other stakeholders announced the establishment of the *Electric Energy OT Security Profile* working group hosted by the International Society of Automation ISA99 standards committee.

The *Electric Energy OT Security Profile* will be a cybersecurity work product utilizing the ISA/IEC 62443 series of standards. The final product will be a formal ISA/IEC 62443 application guide, recognized globally as the consensus work product for securing various control systems used in electric energy generation, transmission, and distribution operations.

The ISA/IEC 62443 standards are designated as a horizontal standard, applicable to many industry sectors and applications. Industry groups leverage the ISA/IEC 62443 standard series as the basis for securing industrial control systems (ICS). DOE's Securing Energy Infrastructure Executive Task Force (SEI ETF) evaluated available industry standards and recommended the electric energy OT applications be formalized as ISA/IEC 62443-5 security profile applications—gaining international energy sector consensus on applying ISA/IEC 62443 to electric energy OT applications.

The ISA *Electric Energy OT Security Profile* working group is seeking participation from industry groups, including the Institute of Electrical and Electronics Engineers (IEEE), the International Electrotechnical Commission (IEC), the International Council on Large Electric Systems (CIGRE), and other industry stakeholders to ensure consideration of and alignment with other cybersecurity work product development efforts.

The initiative will leverage the DOE SEI ETF's Reference Architecture and Profiles for Electric Energy OT as a foundation for the ISA/IEC 62443-5 application profile development. The SEI Reference Architecture and Profiles and associated whitepaper will be available on the DOE website in the upcoming weeks.

"The Securing Energy Infrastructure Executive Task Force developed an OT-specific reference architecture for electricity systems to provide a common language for control system environments that can be used to design and assess security applications," Puesh Kumar, Director, DOE Office of Cybersecurity, Energy Security, and Emergency Response (CESER). "The ISA Working Group represents an opportunity to validate these profiles and put them into practice for the energy industry. CESER is excited to see energy sector stakeholders carrying forward the task force's reference architecture work."

The *Electric Energy OT Security Profile* will be publicly available at no charge for asset owners, manufacturers, standards organizations, and other industry stakeholders. The application profiles will be used as a basis for designing, implementing, testing, and maintaining electric energy OT systems and their cybersecurity capabilities. They will also be useful by third-party assessment organizations and regulatory authorities around the globe.

Eric Cosman, Co-Chair of the ISA99 Standards Committee, noted that, "Global standards and supporting specifications provide efficiencies for end users, product suppliers, and system integrators that design, deliver, and support products and systems all around the world. One specification and one globally recognized certification provides needed transparency and reduces the regulatory burden on manufacturers."

Companies and individuals interested in participating in the *Electric Energy OT Security Profile* working group should contact Eliana Brazda at ebrazda@isa.org to be added to the working group roster.

**About the International Society of Automation**
The International Society of Automation (ISA) is a non-profit professional association founded in 1945 to create a better world through automation. ISA advances technical competence by connecting the automation community to achieve operational excellence and is the trusted provider of standards-based foundational technical resources, driving the advancement of individual careers and the overall profession. ISA develops widely used global standards; certifies professionals; provides education and training; publishes books and technical articles; hosts conferences and exhibits; and provides networking and career development programs for its members and customers around the world. Learn more at isa.org.

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AUTO-QUIZ: BACK TO BASICS

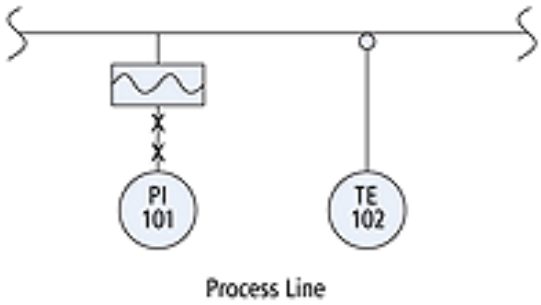
## P&ID Determination for Temperature and Pressure Sensors

*From the ISA Certification Program*

This automation industry quiz question comes from the ISA Certified Automation Professional (CAP) certification program. ISA CAP certification provides a non-biased, third-party, objective assessment and confirmation of an automation professional's skills. The CAP exam is focused on direction, definition, design, development/application, deployment, documentation, and support of systems, software, and equipment used in control systems, manufacturing information systems, systems integration, and operational consulting.

**Question:**

Instrument technicians often use piping and instrumentation diagrams (P&ID) as a reference to identify what type of instrumentation is installed and how this instrumentation is installed in the process. Referencing the process line depicted in the post image from a typical P&ID, which of following statements is true:




a) TE-102 is shown as a surface-mounted temperature sensor, and pressure sensor PI-101 is "directly-connected" to the process

b) temperature sensor TE-102 is inserted into a thermowell, and pressure indicator PI-101 uses a filled capillary system and diaphragm seal to isolate it from the process fluid

c) PI-101 and TE-102 are wired directly to a DCS controller

d) temperature sensor TE-102 is a bulb-type sensor, and pressure sensor PI-101 is electrically connected to an electromagnetic isolator

e) none of the above

**Answer:**

Answer A cannot be correct because a directly connected pressure sensor would not use a diaphragm seal or capillary system. Surface-mounted temperature sensors do not use wells and would be shown without the circle touching the process line.

Answer C is incorrect because no information is given about wiring connections. In fact, the lack of this information and the absence of a transmitter for each sensor would indicate the instruments shown are local indication only.

Answer D is incorrect because, although the P&ID symbol for TE-102 somewhat looks like a bulb thermometer, it is not. The wavy line inside the symbol for the diaphragm seal for PI-101 should not be confused with the P&ID interconnection symbols for electromagnetic signals.

The correct answer is B, temperature sensor TE-102 is inserted into a thermowell, and pressure indicator PI-101 uses a filled capillary system and diaphragm seal to isolate it from the process fluid. A diaphragm seal is shown on a P&ID as a box with a "wavy line" inside. This represents the isolation that a diaphragm seal provides between the process fluid and the instrument. A capillary (filled) system is identified easily by the "X's" in the connection line between the PI and the diaphragm seal. For the temperature sensor, we do not know what type of sensor is installed (RTD or thermocouple), but the circle touching the process line indicates that the sensor is installed in a thermowell.

Reference: ANSI/ISA-5.1-2009 - Instrumentation Symbols and Identification

**About CAP and CCST Certification**

ISA CAP and CCST certification programs provide a non-biased, third-party, objective assessment and confirmation of an automation professional's skills.

The CAP exam is focused on direction, definition, design, development/application, deployment, documentation, and support of systems, software, and equipment used in control systems, manufacturing information systems, systems integration, and operational consulting.

Certified Control System Technicians (CCSTs) calibrate, document, troubleshoot, and repair/replace instrumentation for systems that measure and control level, temperature, pressure, flow, and other process variables.

*Question originally appeared in the ISA Certified Automation Professional; (CAP) program column of https://blog.isa.org.*

*Reprinted with permission.*
*(https://blog.isa.org/autoquiz-pid-determination-temperature-pressure-sensors)*

SOCIETY NEWS

## Good News: In-Person Events and Travel are Back!

*By Carlos Mandolesi, 2022 ISA Society President*

In my last article, I talked about the International Automation Professionals Day. Today, I will talk about one of the things that all automation professionals love to do: Attend in-person events and network with other automation professionals.

During the pandemic, ISA had to migrate from our traditional in-person events to the world of virtual events. Most of our members and automation professionals missed the opportunity of networking during our in-person events, which is one of our most valued ISA benefits. This type of crisis presented big challenges for us, but at the same time, brought big opportunities. ISA managed to pivot from in-person events to virtual events, and now to hybrid (combination of in-person and virtual) events. These new models increased our audience and allowed members from all around the world to attend.

ISA officers, in addition, couldn't travel to visit sections, districts, and attend conferences or shows during this time. This year, we're finally returning to the new normal, and I have already attended two major conferences. I am also planning to meet and greet our members in US, Brazil, India, and Europe.

**ISA Automation & Leadership Conference**
***7–9 November 2022 | Galveston, Texas, USA***
**Register**: **https://www.isa.org/events-and-conferences/alc**

This is a new event that combines ISA's leadership conference with two days of technical presentations on trending industry topics including digital transformation, cybersecurity, industrial internet of things (IIoT), smart manufacturing, and process automation. By attending this conference, you will have the best of both worlds combined in one event:

- An automation technical conference
- An ISA leadership conference

You will have the opportunity to network with ISA leaders and automation professionals from around the world—including managers, engineers, technicians, and subject matter experts. You can also:

- Attend society meetings and leadership presentations
- Attend vital technical sessions and access an array of technical subject matter experts (SMEs) from the United States, Middle East, Brazil, Malaysia, Spain, and India
- Interact with other conference attendees—in person or virtually
- Visit exhibitor booths to gain insight and information on the latest products and technology in the industry
- Attend the ISA Honors and Awards gala

As part of our strategic objective to increase our international audience, we are expanding our participation in US and international events both virtual and in-person. Below are two conferences that I've attended thus far.

**IoT Solutions World Congress and Cybersecurity Conference**
***Barcelona, Spain***

IOT Solutions World Congress (IOTSWC), the leading international event devoted to industry transformation through disruptive technologies, closed its sixth edition after three days of debates and knowledge sharing with the aim of setting a roadmap towards the digitalization of all industries. The show held 330 exhibitors, 95 conferences and panel sessions, over 270 speakers, and was jointly held with the Barcelona Cybersecurity Congress and Integrated Systems Europe (ISE), the world's leading professional audio-visual and systems integration show.


*ISA had representatives at the IOT Solutions World Congress in Barcelona, Spain on May 10-12, 2022*

The third edition of the Barcelona Cybersecurity Congress (BCC), organized by Fira de Barcelona and the Agència de Ciberseguretat de Catalunya, underlined the importance of cybersecurity as one of the most critical challenges that an increasingly digitized world is facing. The sessions held at the cybersecurity auditorium registered high attendance throughout the event and tackled topics such as hardware protection, hacker pattern tracking, industrial network monitoring, protection layers for autonomous cars, and zero-trust architecture. The IOT Solutions World Congress will return in 2023 for its seventh edition, scheduled from January 31st to February 2nd.

ISA was responsible for the technical program in the Cybersecurity Congress. We partnered with the cybersecurity group of ISA's Spain section that worked to identify speakers and put the program together. The program was chaired by one of the Spain section SMEs, Agustin Valencia. During the

event we had the opportunity to meet with the leaders and members of ISA Spain and talk about ISA's strategy and ways to better collaborate with our local sections.

**ARC Forum**
**Orlando, Florida, USA**

The theme of this year's ARC Forum was "accelerating industrial digital transformation and sustainability." As we return to a new normal, industrial innovation is accelerating. A renewed focus on sustainability, the circular economy, and climate change is sparking innovation and powering transformational and technological change throughout the industrial sector. Resilience has been prioritized in the supply chain and throughout production operations.


*ISA had delegates at the 26th Annual ARC Forum on June 20 – 23, 2022, in Orlando Florida at the Renaissance Orlando at SeaWorld Resort Hotel*

Digital leaders have now validated their strategies against the real-world challenges brought on by the pandemic. Many companies supported "connected" remote and frontline workers far earlier than they anticipated and will now do more. Having seen the power of disruptive technologies to transform business operations and competitive strategies, improve resilience, reduce costs, and better serve customers, it is full speed ahead.

***Even as a post-pandemic event, the ARC Forum was well attended by professionals who were eager to learn/network.***

Technologies like cloud, machine learning, edge computing, internet of things (IoT), cybersecurity, additive manufacturing, augmented reality, and more are enabling new business processes and obscuring traditional functional boundaries. Operational technology (OT), information technology (IT), and engineering technology (ET) teams are growing their skills and capabilities and transforming real-time operations.

Governance and compliance, workforce and skills, customer-centricity, competitive excellence, and change management all need management attention. Seeking to be among the winners in the new normal, executives charged with driving this transformation are seizing this moment to innovate and deliver real value. Call it digital transformation, smart manufacturing, smart cities, or industry 4.0, there is a rush to innovate, transform, and accelerate the future.

The main topics of discussion at the forum were:

- Cybersecurity
- Digital Transformation
- Open Process Automation (OPA)
- Sustainability

During the forum, I had the opportunity to meet with various ISA members, Automation.com staff, and industry leaders to listen to their demands and promote ISA's mission. It's very important for us to attend these types of events to validate our perception of market needs and adjust our strategies as needed.

Andre Ristaino from ISA presented the work developed by our consortia, including the ISA Global Cybersecurity Alliance (ISAGCA), ISA Secure, and LOGIIC. He also presented the ISA100 Wireless Compliance Institute's ISA100 Wireless Excellence in Automation Award. This award is presented each year to an end-user company that has demonstrated outstanding leadership and innovation in the use of ISA100 Wireless technology. The award is intended to highlight the use of the technology rather than any specific supplier.

The 2021 award was presented to EnQuest at their Sullom Voe Terminal in Scotland for their novel application of ISA100 Wireless technology in new approaches to gas detection, achieving a safe and secure gas detection system upgrade on a vast scale. Cybersecurity and reliability were key considerations in the gas detection system upgrade.

The Sullom Voe Terminal is operated by EnQuest and handles production from many oilfields in the east and west Shetland Basin in the North Sea. Fourteen different companies have ownership interests in the terminal, which receives production through the Brent and Ninian 36" pipeline systems.

Previous award recipients include Fuji Oil Company (2020), ILBOC (2019), BACPO (2018), ALCOA (2017), Phillips 66 (2016), Petronas (2015), Nippon Steel (2014), and RasGas (2013). The first award was presented in 2013.


*One of the many panel discussions at the ARC Forum*

I was so glad to see many mentions of ISA's standards such as the ISA/IEC 62443 cybersecurity series of standards. Various examples of the adoption of ISA standards included ISA 18.2 (Alarm Management), ISA 84 (Batch), ISA 95 (Integration), and ISA101 (HMI), mentioned at presentations or presented at the various software vendors present in the exhibition hall.

During the Open Process Automation Standard (OPAS) update, it was mentioned that ISA/IEC 62443 is the *standard of standards*. Some of the standards adopted by OPAS include ISA 95 (IEC 62264) for technical architecture, ISA/IEC 62243 for cybersecurity, and ISA-18.2/IEC 62682 for alarm management (implemented with the OPC UA alarms and conditions standard to achieve uniform alarm and event messaging throughout the system).

I also attended the first ISA 95 standard committee in-person meeting that was organized during the forum, after quite some time of just having virtual meetings!

Contact the President

I love to connect with our members and listen to your opinions about automation, what ISA is doing now, and what ISA should be doing to answer your needs. Please connect with me on ISA Connect, LinkedIn, or send an email to president@isa.org.

Carlos Mandolesi
2022 ISA Society President

**About the Author**

**Carlos Mandolesi** is an electrical engineer, graduating from the Federal University of Itajubá (UNIFEI) in 1992 and post-graduated in Business Management from the University São Francisco in 2006. He has a career of over 25 years in the field of industrial automation and industrial networks, having worked in companies like General Electric (GE) and Sigma Automation. Carlos currently serves as Project Portfolio Manager at Trinity College Dublin in Ireland. See Carlos on ISA Connect.

## Latest News from ISA

- **We have great news!** The execution of our strategy is progressing very well. **Our membership growth target for 2022 is 2%, and we have grown 4.3% to date**. However, we can't celebrate yet. Our challenge is to retain the existing members and keep these figures until the end of the year. Your engagement is essential for our success.
- Please check the updated Key Results at our **Strategy Dashboard** where you can monitor our progress. You can access the Dashboard from the ISA Connect homepage, or here.
- Vote now on ISA's Society Election! ISA members can elect the Society's leaders and directly influence the future. This year, we have various candidates for the positions of President-elect Secretary, Treasurer, and the Executive Board. Voting ends on 30 June 2022. Click here to know more about the candidates and cast your vote.
- Check out ISA's 2022 Events Calendar and register for FREE today.
- Did you know that members have access to all standards developed by ISA here?
- *InTech* magazine recently published another great article entitled Optimize Energy Efficiency and Sustainability.
- Have you read the latest ISA blog posts? Check them out here!
- Are you using ISA Connect? There are a lot of great discussions happening on the ISA Connect Technical Discussion Forum.
- Have you invited anyone to join ISA? If you are interested in inviting your colleagues and would like to learn more about what ISA Membership has to offer, please refer to our brochure.

## Call for Newsletter Articles

The WWID newsletter is published four times a year (winter, spring, summer, and fall) and reaches the WWID's 2,000+ members. Each issue is approximately 16-32 pages long and is electronically printed in color PDF format. A notification email goes out to all WWID members, and it is available for public download at www.isawaterwastewater.com.

We are always on the lookout for good articles, and we welcome both solicited and unsolicited submissions.

Article submissions should be 500-2000 words in length and be written for a general audience. While it is understood that the articles are technical in nature, the use of technical jargon and/or unexplained acronyms should be avoided. We actively encourage authors to include several photos and/or figures to go along with their article.

We actively welcome articles from all of our members. However, we do ask that articles be non-commercial in nature wherever possible. One or two mentions of company and/or product names for the purposes of identification are acceptable, but the focus of the article should be technical content and not just sales literature. If you are unsure of whether your article idea is workable, please contact our newsletter editor for more information – we are here to help.

Some examples of the types of articles we are looking for include:

- Explanatory/teaching articles that are meant to introduce or explain a technical aspect of automation and/or instrumentation in the water/wastewater sector.
- Biographical stories about personalities and/or leaders in the water/wastewater sector.
- Case Studies about plant upgrades and/or the application of new technologies and techniques. This type of article must include at least two photos along with the article text.
- Pictorial Case Studies about a plant upgrade consisting of 4-6 photos plus a brief 200-500 word description of the project undertaken. The article should ideally include one to two paragraphs about lessons learned and/or advice for other automation professionals.
- Historical reflections on changes in technology pertaining to specific aspects of instrumentation or automation, and how these changes point to the future.
- Discussions about changes in the water/wastewater sector and how these affect automation professionals.

Once we receive a submission, we will work with you to edit it so it is suitable for publication in the newsletter.

Article submissions can be sent to the WWID newsletter editor Graham Nasby at graham.nasby@grahamnasby.com or Slawek Wolski at slawek.wolski@ulteig.com . .

## WWID Newsletter Advertising

The WWID newsletter is an excellent way to announce new products and services to the water/wastewater automation community. With a distribution of 2,000+ professionals in the automation, instrumentation and SCADA fields, the WWID newsletter is an effective targeted advertising tool.

The WWID newsletter is published quarterly, on the following approximate publication schedule:

- Winter Issue – published in January/February
- Spring Issue – published in April/May
- Summer Issue – published in July/August
- Fall Issue – published in October/November

Advertising in the newsletter is offered in full page, half-page and quarter page formats. Advertisements can be purchased on a per issue basis or for four issues at a time. The newsletter itself is distributed as a full-color PDF, so both color and black/white artwork is acceptable.

The current advertising rates are as follows:

Per Issue:
- Full page, full color (7" x 9"): $500
- Full page, full color, (8.5x11"), with bleed $600
- Half page horizontal, full color (7"x4.5"): $350
- Half page vertical, full color (3.5"x9"): $350
- Quarter page, full color (3.5" W x 4.5" H): $250

Per Year: Apply 20% discount if purchasing 4 ads at a time

Other sizes of advertisements are available but are priced on an individual basis. Contact us for more information.

Please book advertising space as early as possible before the intended publication date. Artwork for advertisements should be submitted a minimum of two weeks prior to the publication date; earlier is always better than later. Artwork for advertisements can be submitted in EPS, PDF, PNG, JPG or GIF formats. EPS, PDF and PNG formats are preferred. Images should be at least 300dpi resolution if possible. A complete list of ad specs can be found at www.isawaterwastewater.com .

The ISA Water/Wastewater Industry Division is run on a non-profit basis for the benefit of its members. Monies raised from the sale of advertising in the newsletter are used to help offset the cost of division programming and events. Like its parent organization, the ISA, the WWID is a non-profit member-driven organization.

For more information, or to discuss other advertisement sizes not outlined above, please contact the WWID newsletter editor Graham Nasby at graham.nasby@grahamnasby.com or Slawek Wolski at slawek.wolski@ulteig.com .

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ISA Connect (ISA members-only community): connect.isa.org
ISA Connect – Direct-Link to WWID Community: www.isa.org/wwid/
LinkedIn: https://www.linkedin.com/groups/2031271/
Facebook: https://www.facebook.com/ISAWaterWastewater/

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### About the ISA Water/Wastewater Industries Division

The ISA Water / Wastewater Industry Division (WWID) is concerned with all aspects of instrumentation and automated-control related to commercial and public systems associated with water and wastewater management. Membership in the WWID provides the latest news and information relating to instrumentation and control systems in water and wastewater management, including water processing and distribution, as well as wastewater collection and treatment. The division actively supports ISA conferences and events that provide presentations and published proceedings of interest to the municipal water/wastewater sector. The division also publishes a quarterly newsletter, and has a scholarship program to encourage young people to pursue careers in the water/wastewater automation, instrumentation and SCADA field. For more information see www.isa.org/wwid/ and www.isawaterwastewater.com