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Bridging the ICS 'Communication Gap'

September 2022

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Bridging the ICS 'Communication Gap'

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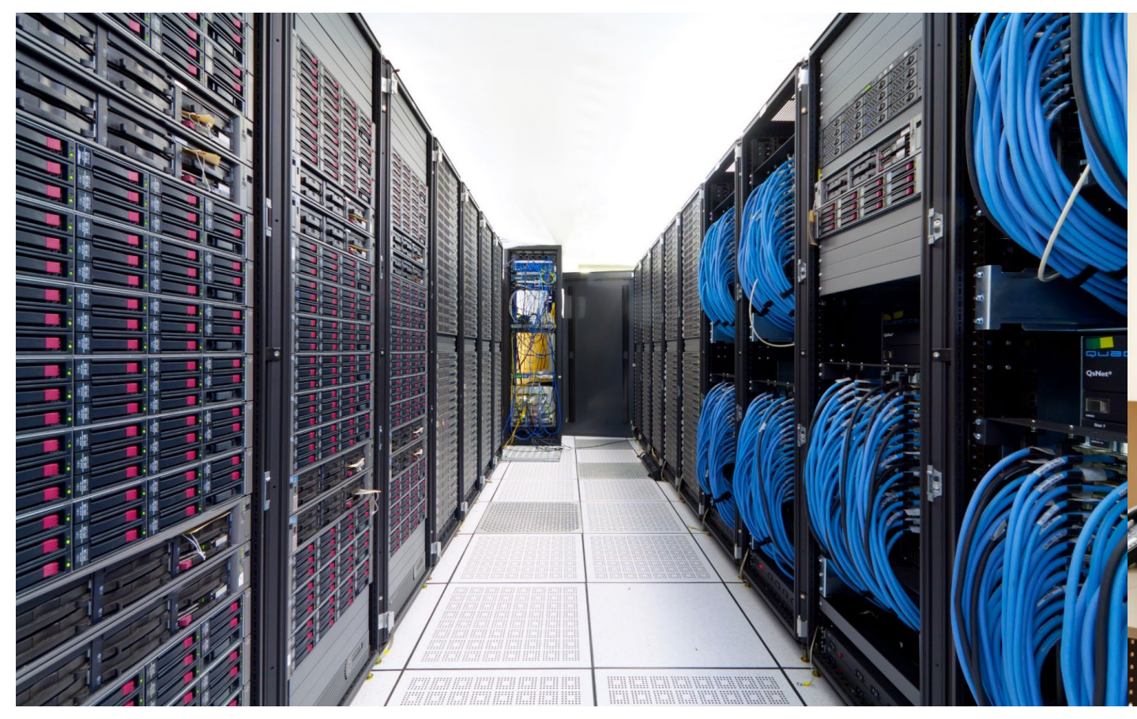
Bridging the ICS ‘Communication Gap’

Protocol Analytics Enabling Forensics of Industrial Control Systems

What networks within Critical Infrastructure can we monitor and protect today?

- A multitude of cybersecurity platforms and tools are available to monitor standard ‘IT-based’ networks



Information Technology (IT):

- *Cloud & data centers*
- *Servers & workstations*

Operational Technology (OT):

- *Control centers*
- *Engineering workstations*

What about Industrial Control Systems (ICS)?

- Some ICS devices communicate over Ethernet and can be protected with existing OT cybersecurity tools
- Other ICS networks are based on serial or industrial Ethernet protocols, which differ significantly from Ethernet in IT
  - ***Existing cybersecurity tools can’t protect these networks***

ICS networks (‘subnetwork’ within OT):

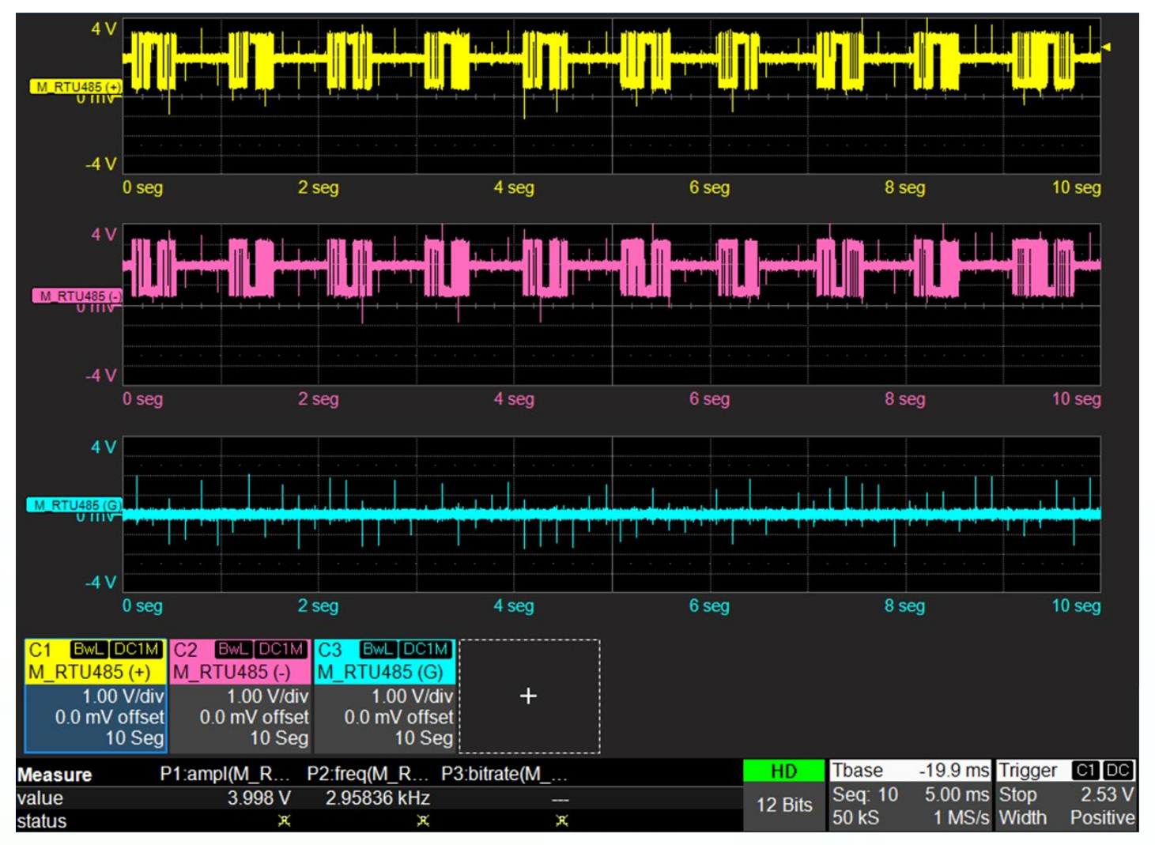
- *ICS devices: PLCs, HMIs, etc.*
- Safety systems
- Embedded controllers
- Smart sensors & actuators

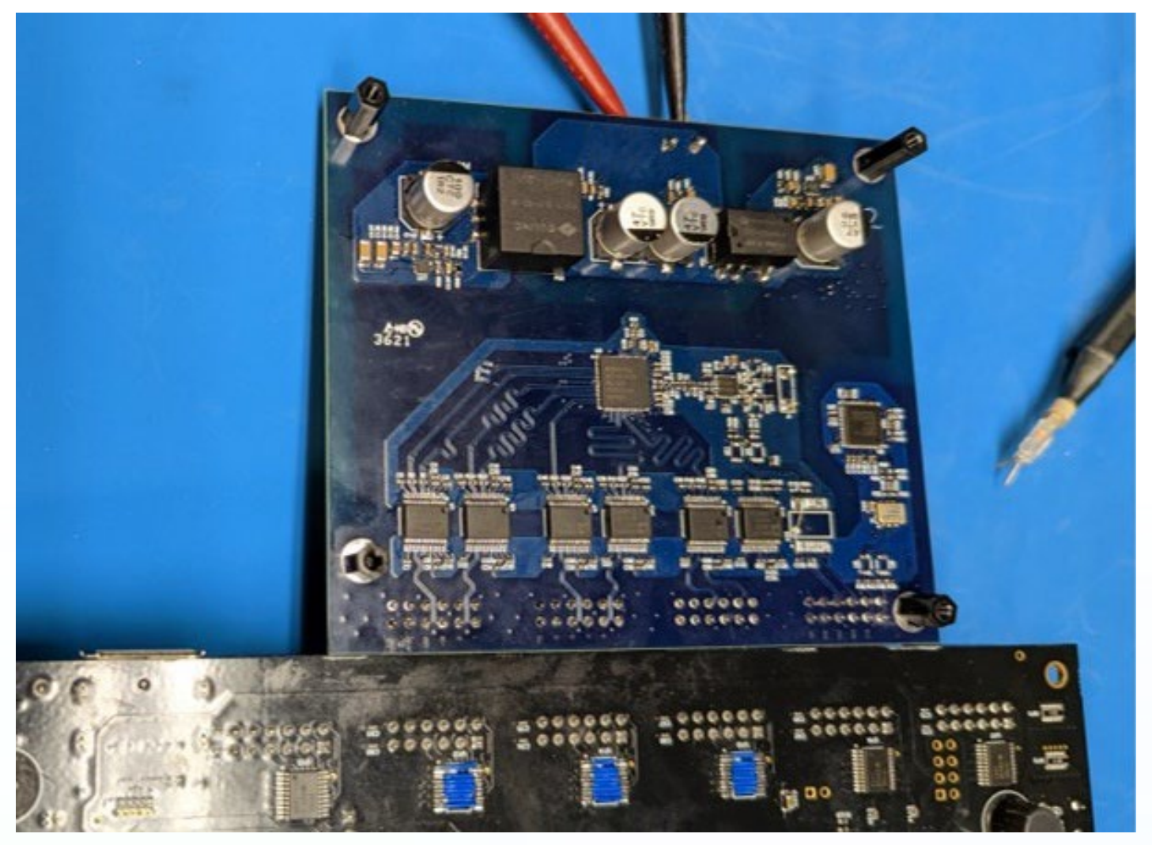
Technical challenges impede the development of cybersecurity tools for ICS environments:

- 40+ communication protocols with significant differences:
  - Physical & electrical properties, signal encoding schemes
- Performance degradation or disruption of ICS devices and networks can cause physical processes to fail

PAFICS researchers set out to discover how overcome technical challenges in the lab…

- Research focused on 13 ‘key’ ICS protocols representing the spectrum of electrical, physical, and signal variations
- Researchers worked to capture, identify, and decode known data communicated between ICS devices:
  - Captured signals with a high bandwidth digital oscilloscope
  - Analyzed captured signals, identified defining characteristics
  - Developed protocol signatures and identification algorithms
  - Discovered how to build decode algorithms for each protocol
- Algorithms were then validated through bench-top testing:
  - Evaluated the effectiveness of identification algorithms
  - Analyzed output from decode algorithms and verified accuracy



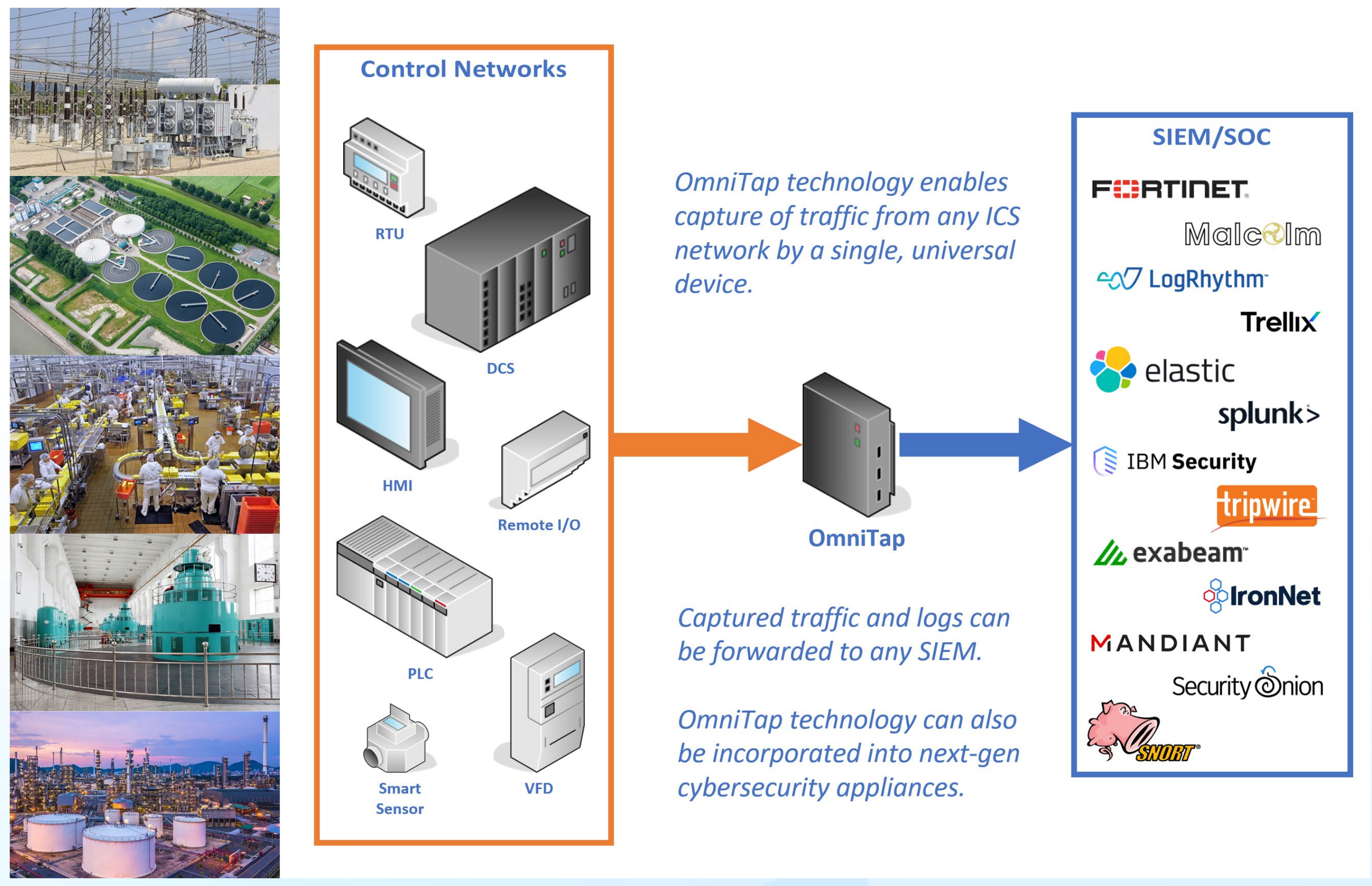


…And develop the technology to capture all ICS communication with a single device

- Analyzed available data to formulate requirements for a passive, disruption/distortion free, capture interface
- Developed a prototype capture device compatible with most if not all ICS communication protocols
  - Selected a commercial FPGA/CPU SOM with carrier PCB
  - Developed a passive input circuit with broad electrical compatibility
  - Incorporated input circuit into a prototype capture PCB
  - Tested prototype with representative signals to validate performance
- Implemented identification & decode algorithms on CPU/FPGA
- Tested the prototype hardware on live communication between ICS devices, iterating through several of the ‘key’ protocols
  - Additional testing at scale remains to be completed in the future

Technology resulting from PAFICS, called ‘OmniTap’, is patent pending and is being licensed for commercialization

- OmniTap technology makes development of a universal ICS capture/translation device possible
  - U.S. provisional patent (Nov 2021),
  - U.S. patent and PTC to be filed Nov 2022
- Commercial License with GoldenWolf LLC is in progress:
  - INL researchers in will participate in development
  - Easy to deploy device captures, translates, and forwards traffic to existing cybersecurity tools
  - Universal compatibility with ICS protocols, serial & Ethernet-based, up to 1Gbps (copper media only)



OmniTap technology enables capture of traffic from any ICS network by a single, universal device.

Captured traffic and logs can be forwarded to any SIEM.

OmniTap technology can also be incorporated into next-gen cybersecurity appliances.

OmniTap will shift the ICS cybersecurity paradigm:

- Enable existing cybersecurity tools to monitor and protect ICS networks
- Go beyond ‘Defense in Depth’ toward comprehensive ICS cyber-defense
- Align IT, OT, and ICS best security practices
- Embrace connected control devices such as IIoT, armed with tools to keep them secure
- Mitigate ICS market fragmentation, encouraging new cybersecurity tool development

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