There and Back Again: Detecting OT Devices Across Protocol Gateways

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Part I

How did we get here?

OT, ICS, and SCADA oh my!

- ***Operational technology*** - an umbrella term describing technology that affects or monitors things in the real world…Includes things like ***Programmable Logic Controllers*** (PLCs), ***Computer Numerical Control*** (CNC) systems, etc.
- ***Industrial control systems (ICS)*** - systems that actual do the controlling of the hardware and sensors
- ***Supervisory Control and Data Acquisition (SCADA)*** - computers, networks, user interfaces, and other high-tech things to control machines and processes.

Mission Control

Image credit: Steag

Ground Truth

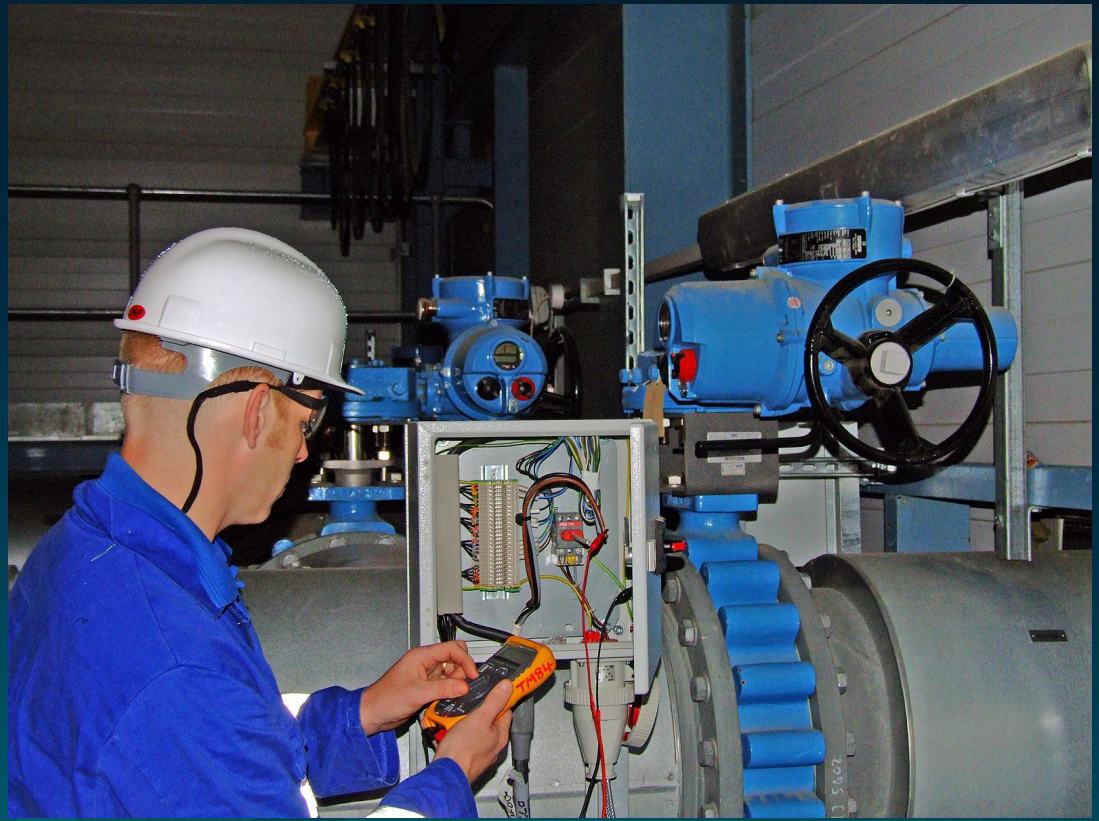

Image credit Wikimedia Commons

Industrial Control Technology

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Programmable Logic Controllers

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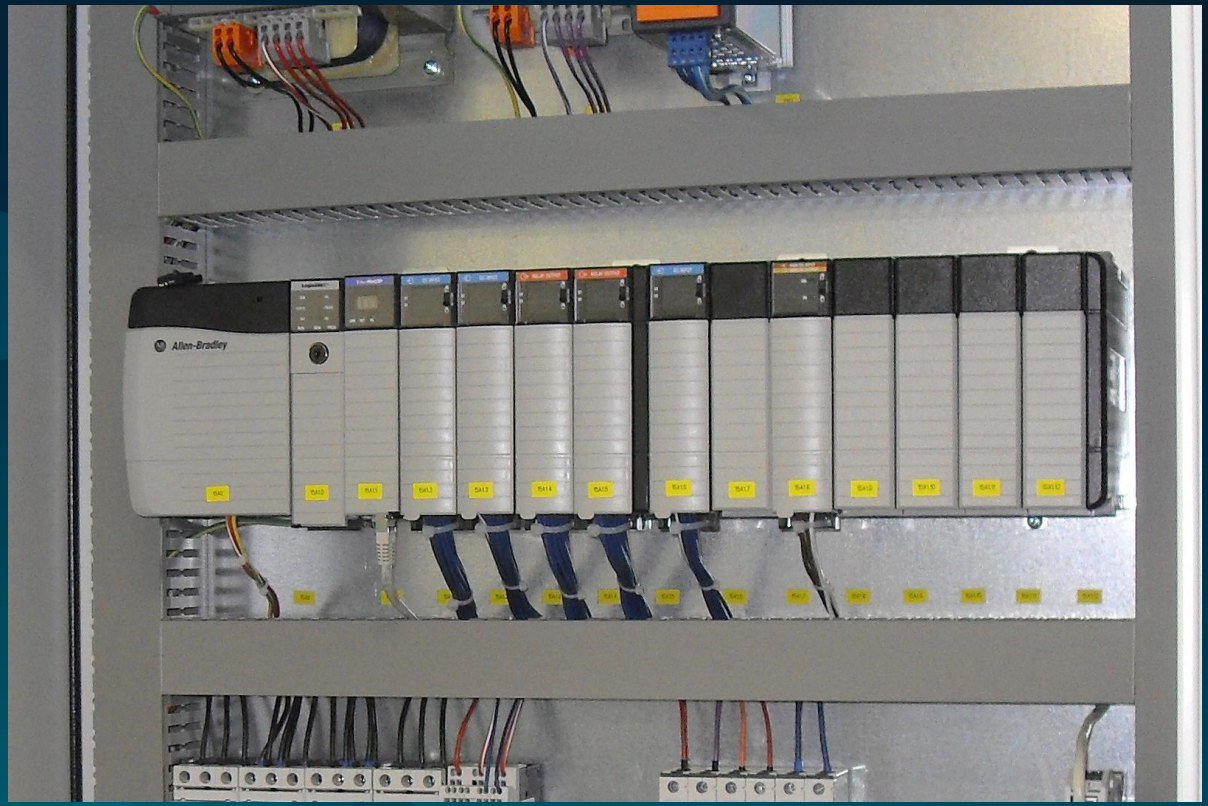
Backplanes, Modules, and Protocol Adaptation



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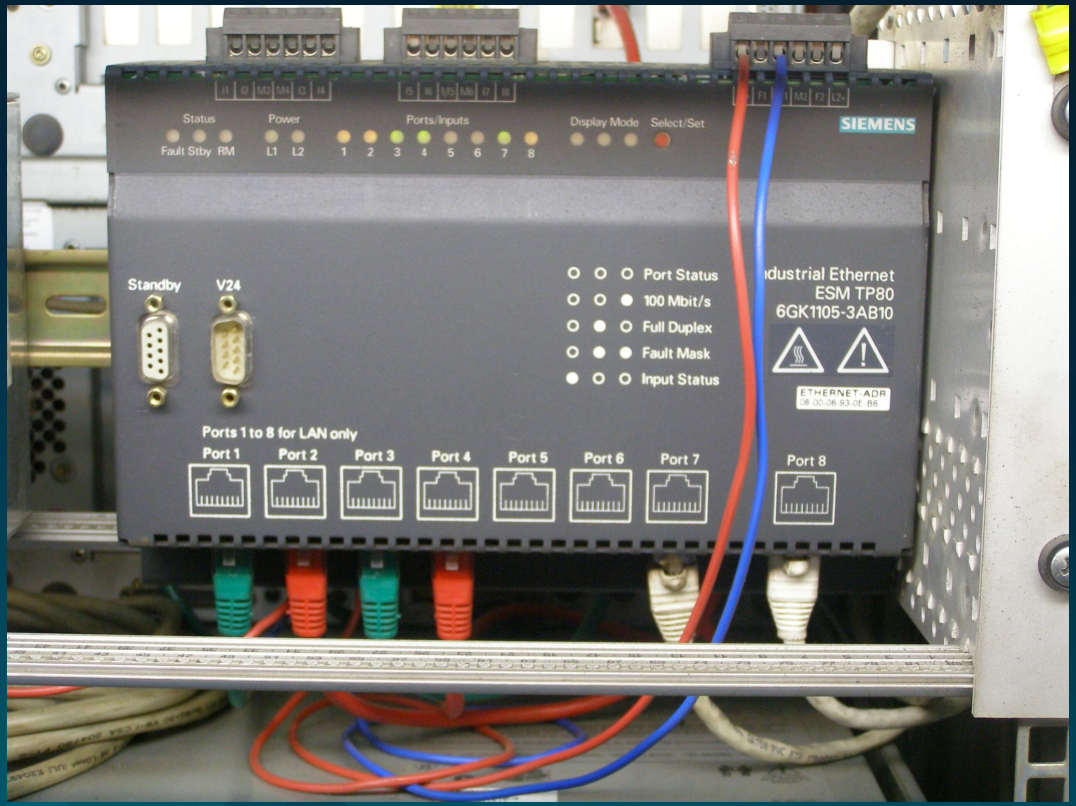
Part II

Convergence!

Industrial Ethernet



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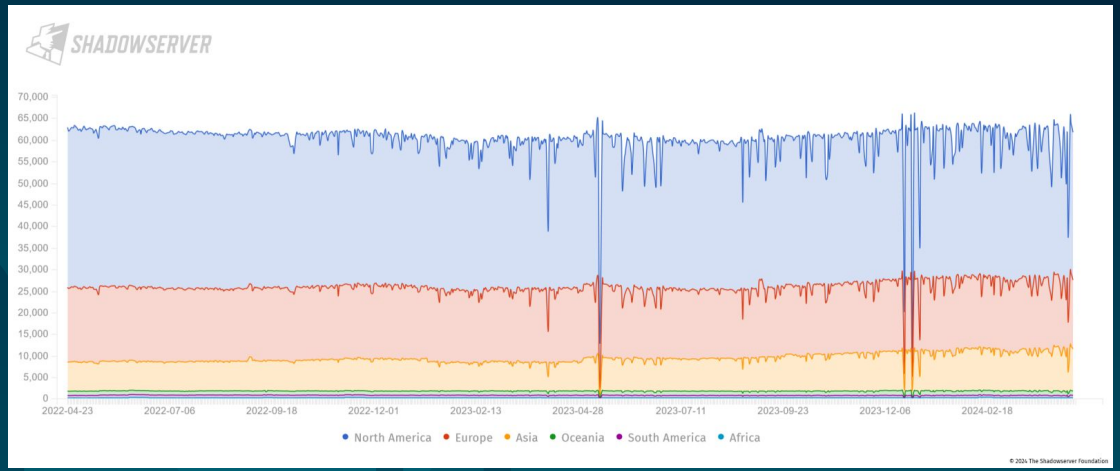
IT and OT are Converging

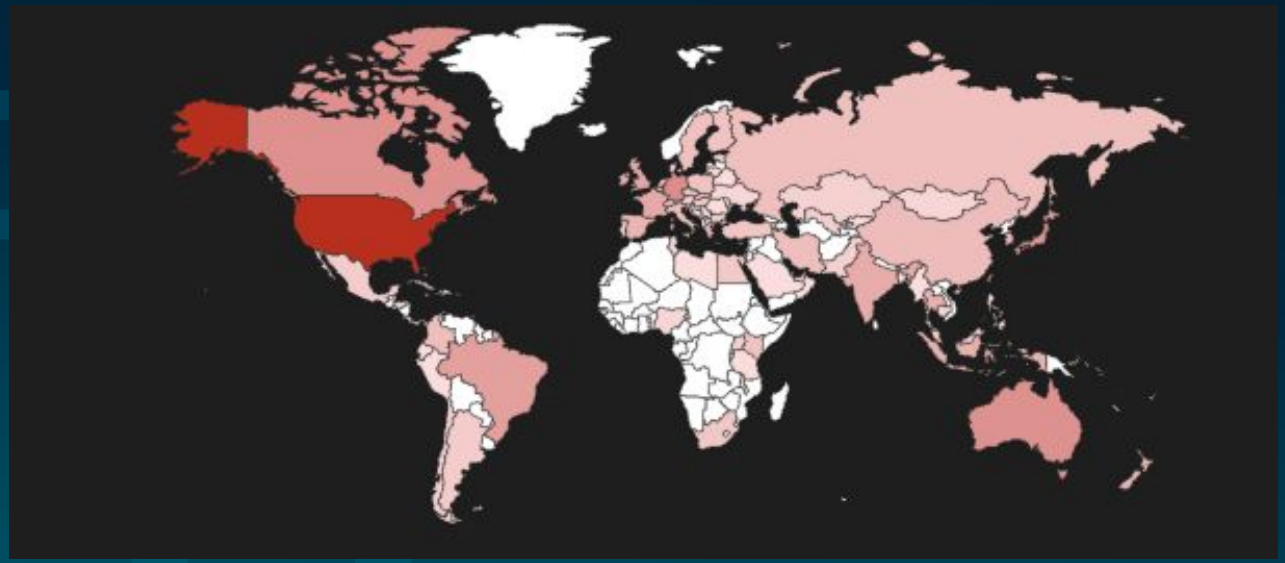
"IT/OT convergence will be the end state"

- CISOs are increasingly taking responsibility for OT
- OT continues to be internet-exposed (7%)



https://isc.sans.edu/diary/It+appears+that+the+number+of+industrial+devices+accessible+from+the+internet+has+risen+by+30+thousand+over+the+past+three+years/30860

Automatic Tank Gauges – Worldwide Exposure



Up	Type	Hardware	Outlier	Attack surfaces
●	PLC	Siemens LOGO! PLC	1	External
●	Ethernet Gateway	Wiesemann & Theis Com-Server Highs...	2	External
●	Data Logger	Schneider Electric ComX	1	External
●	PLC	Allen-Bradley 1766-L32BXBA	2	External
●	Ethernet Gateway	Schneider Electric PowerLogic EGX1...	1	External
●	Power Device	SMA Solar Technology AG Sunny WebB...	1	External
●	PLC	Rockwell Automation PLC	1	External

Part III

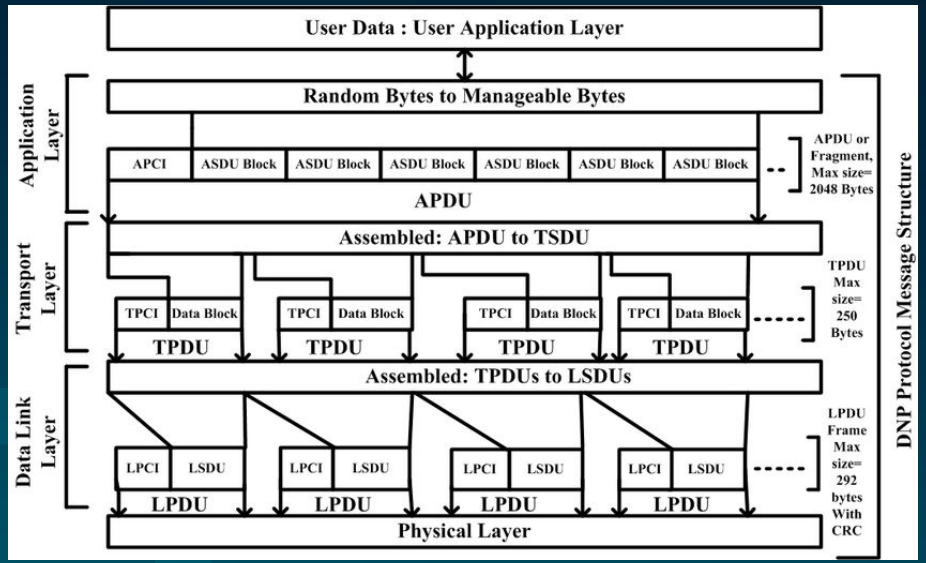
Discovery!

Discovery - Modbus Style

modbus.modelName	PX2-2146R
modbus.productCode	iPDU
modbus.productName	iPDU
modbus.revision	3.0.2.5-41550
modbus.vendor	Raritan
modbus.vendorURL	http://www.raritan.com
protocol	modbus

Distributed Network Protocol 3 (DNP3)

- Includes its own network and transport layers to be medium-agnostic
- Has its own complex checksumming/validation mechanisms



Shahzad, Aamir & Lee, Malrey & Kim, Hyung & Woo, Seon-mi & Xiong, Naixue. (2015). New Security Development and Trends to Secure the SCADA Sensors Automated Transmission during Critical Sessions. Symmetry. 7. 1945–1980. 10.3390/sym7041945.

Distributed Network Protocol 3 (DNP3)

dnp3.destination	0x0001
dnp3.deviceID	ID_CODE
dnp3.deviceName	RZHQ-OT-914
dnp3.hardwareVersion	DNP3 Outstation
dnp3.location	India
dnp3.manufacturer	FreyrSCADA Embedded Solution
dnp3.model	DNP3 Protocol Library
dnp3.serialNumber	21.05.025
dnp3.softwareVersion	21.05.026
dnp3.source	0x0002

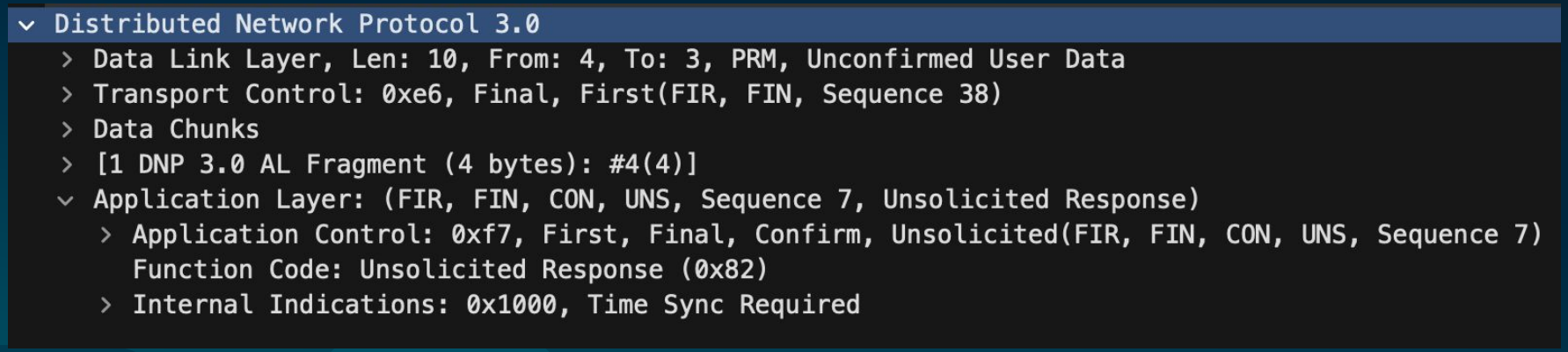
DNP3 Dual-Layer Addressing

- 16-bit address, with some reserved, leaving 65531 possible addresses.
- A designated *primary* device and multiple *secondary devices*.
- Secondary devices only talk to their preconfigured primary.
- You might have to guess the primary *and* secondary addresses!

Address Guessing

- Addresses range from 0 to 65k
- *Usually* addresses are assigned sequentially starting at 1
- *Usually* addresses are in the first part of the address space, say no more than 512
- ...this still means potentially guessing 262,144 address pairs 😐

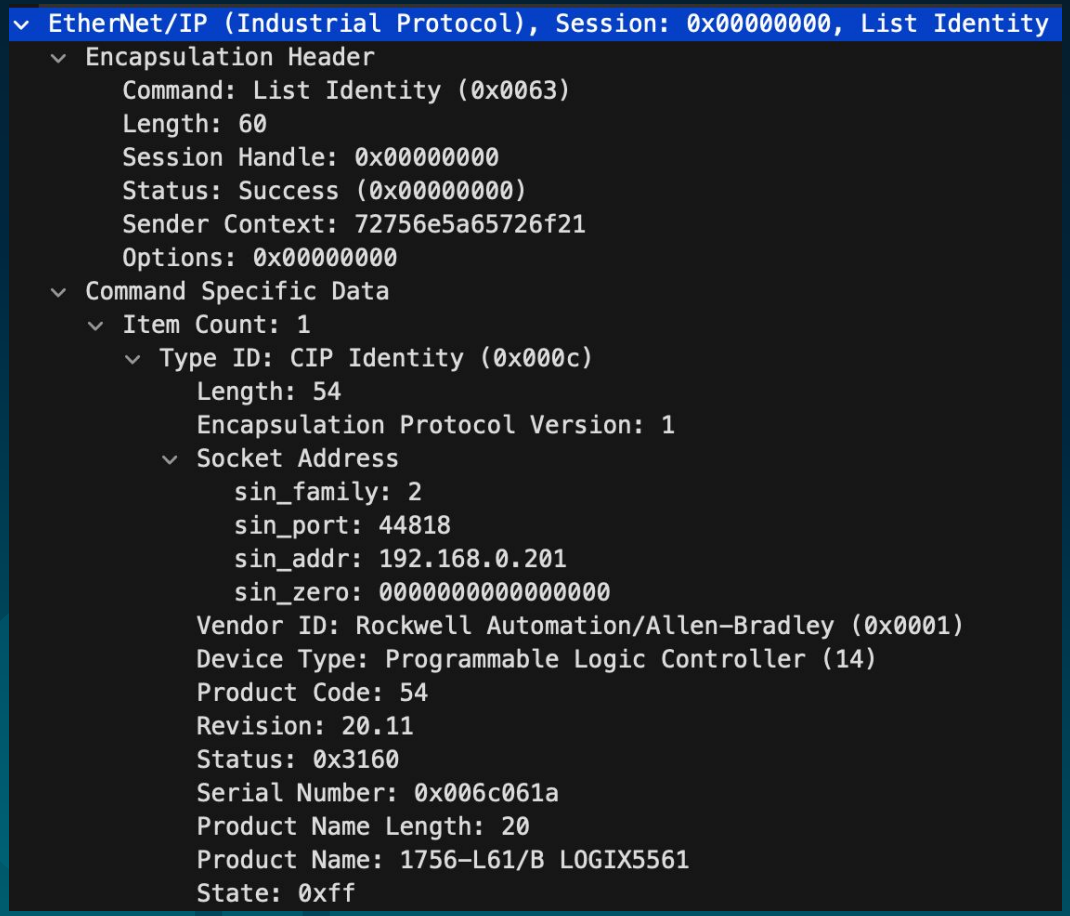
The Good News: Banner Sniffing!



EtherNet/IP and CIP

Image credit ODVA

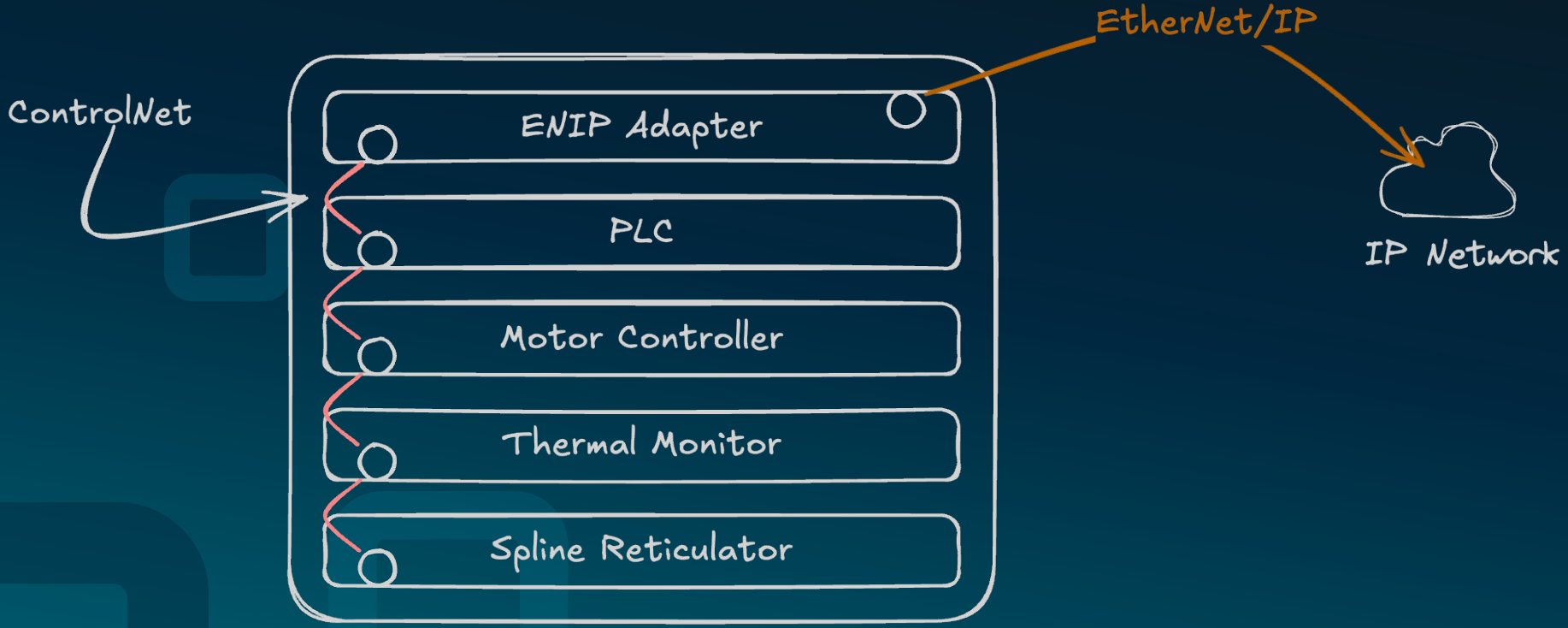
EthetNet/IP Connected Device Discovery



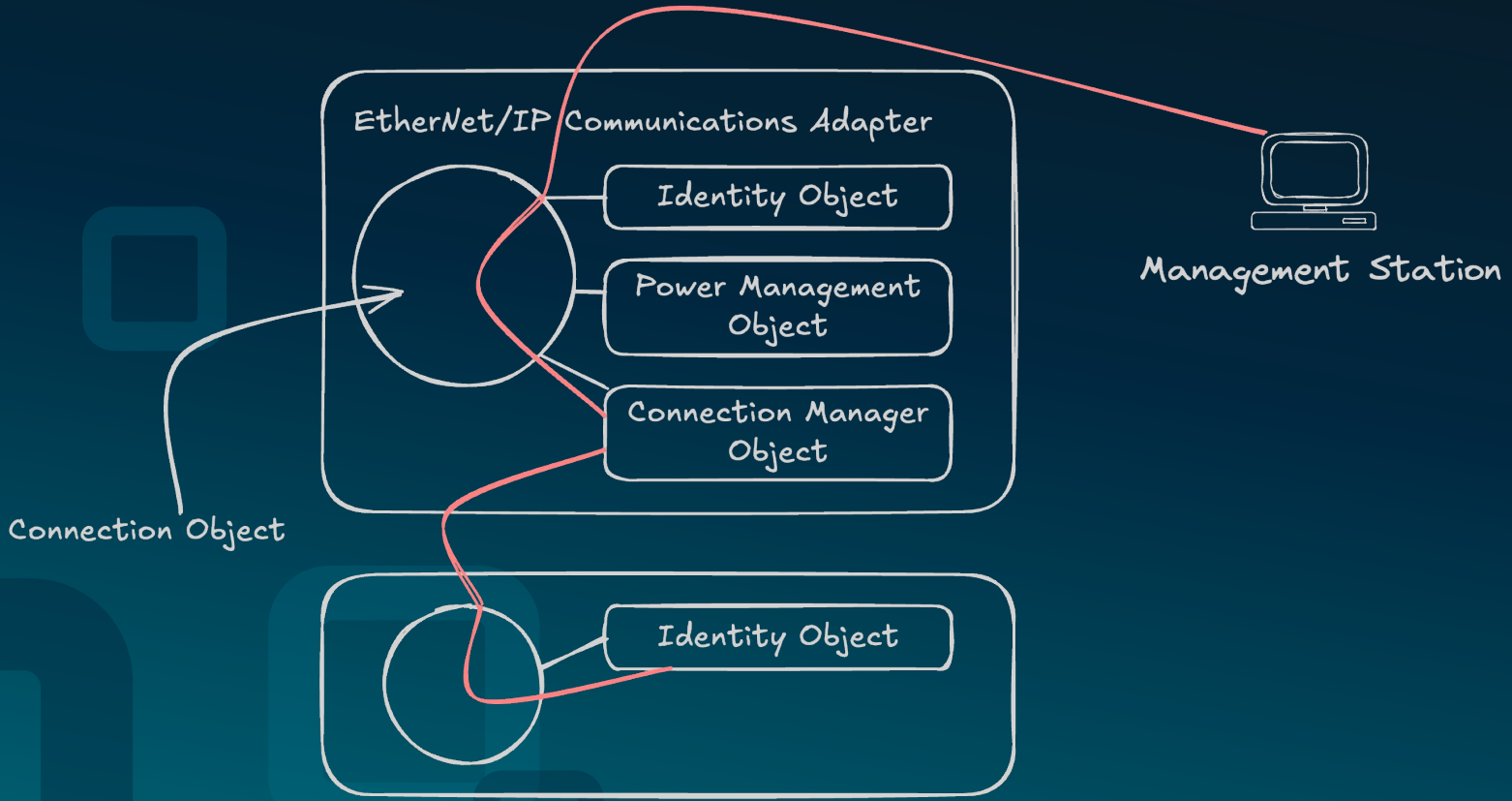
EtherNet/IP List Identity

192.168.40.9 - 44818/udp	
ethernetip.address	192.168.40.9
ethernetip.deviceType	Generic Device (keyable)
ethernetip.port	44818
ethernetip.product	IO-Link master EIP 8P IP20
ethernetip.productID	1030
ethernetip.revision	1.4
ethernetip.serialNumber	2516058524
ethernetip.vendor	ifm efector, inc.
fp.hw.device	Generic Device (keyable)
fp.hw.match	runzero-ethernetip
fp.hw.product	IO-Link master EIP 8P IP20
fp.hw.serialNumber	2516058524
fp.hw.vendor	ifm efector, inc.
fp.hw.version	1.4
protocol	ethernetip
ts	Oct 29 2024 4:48PM [UTC-5] (Tue)

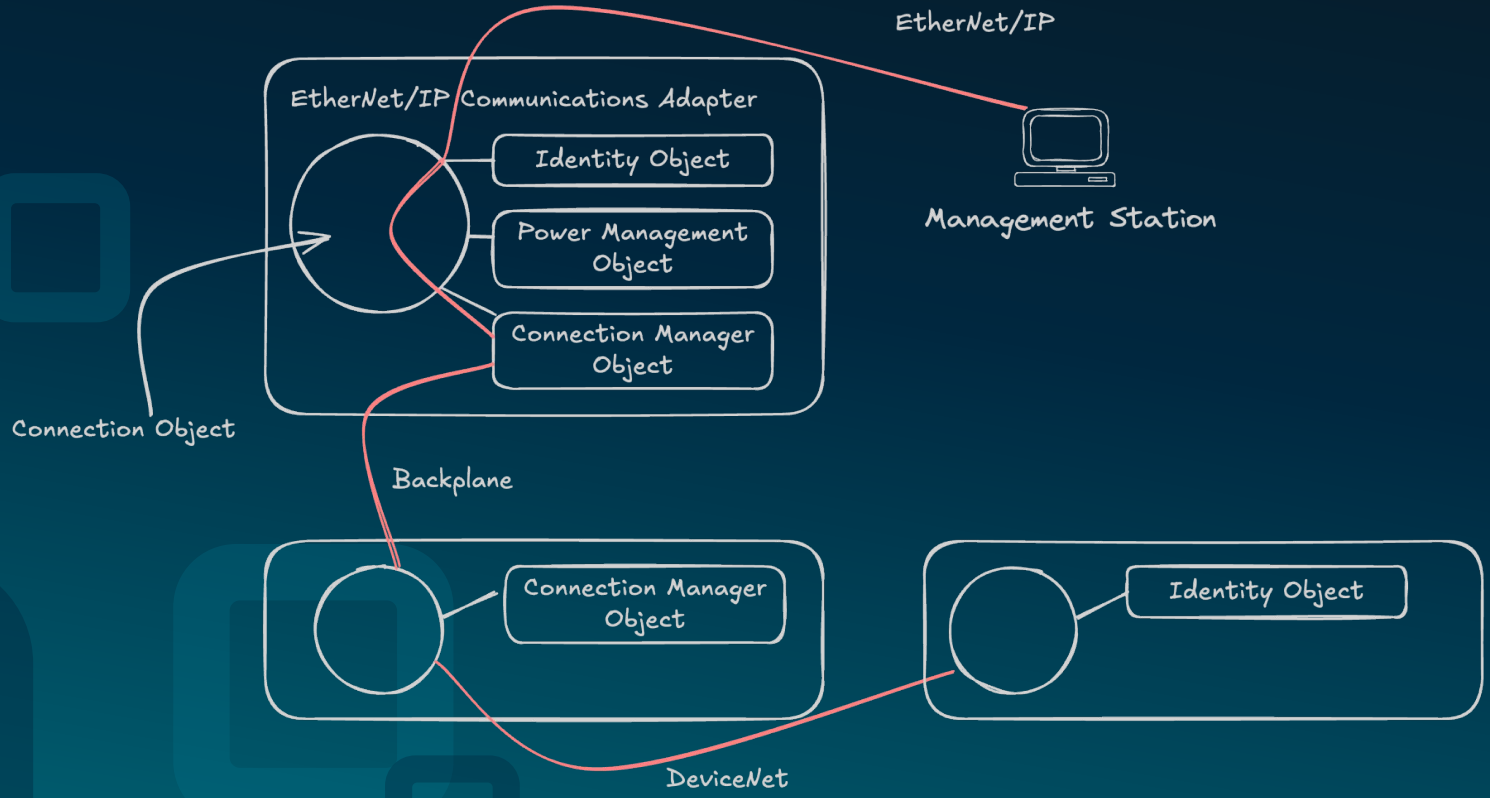
Example Rack



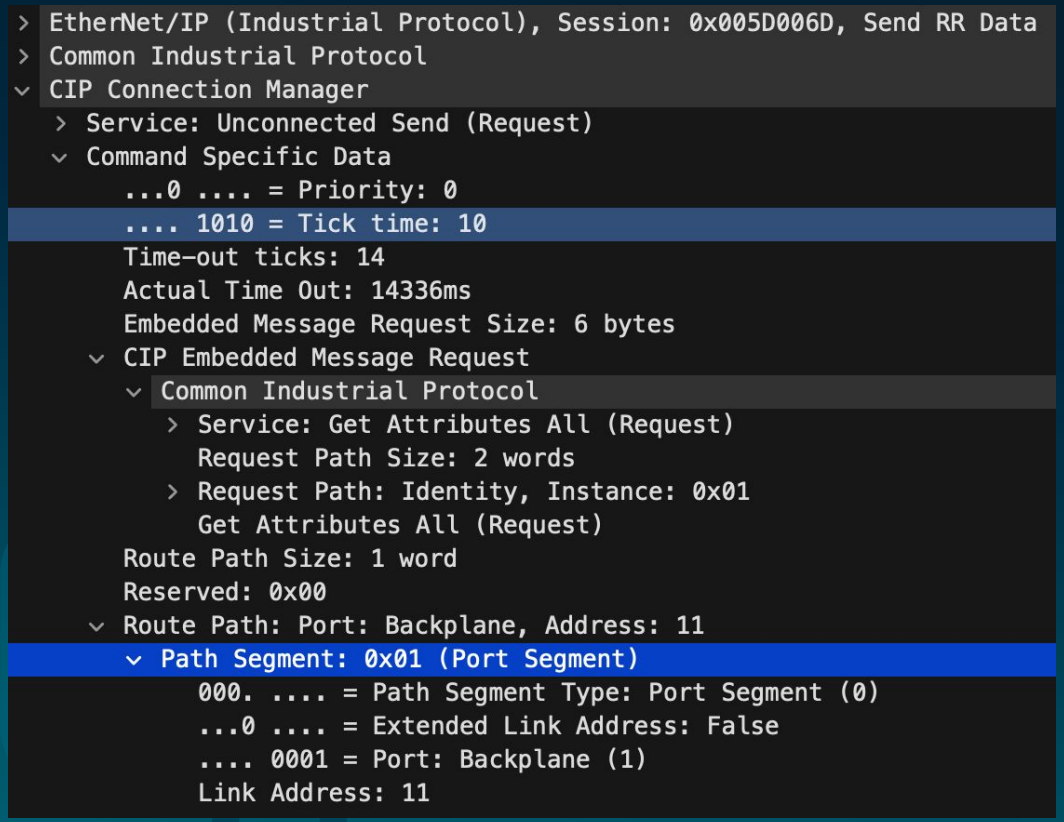
CIP Forwarded Messages



CIP Forwarded Messages



Source Routing and Path Construction



Walking the Backplane


```
[
  "1": {
    "identification": {
      "vendor": "Rockwell Automation/Allen-Bradley",
      "type": "General Purpose Discrete I/O",
      "product": 1140,
      "revision": [
        30,
        14
      ],
      "status": 97,
      "serialNumber": 0
    },
    "name": "24VDC 16PT INPUT & 16PT OUTPUT",
    "slotNumber": 1
  },
  "2": {
    "identification": {
      "vendor": "Rockwell Automation/Allen-Bradley",
      "type": "Unknown (115)",
      "product": 110,
      "revision": [
        4,
        3
      ],
      "status": 97,
      "serialNumber": 0
    },
    "name": "1734-232ASC/C RS-232 ASCII",
    "slotNumber": 2
  },
```

Thank you!

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