Real time asset inventory in ICS

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Industrial Control Systems (ICS)

- ➔ Combination of control systems
- ➔ Used to operate and automate industrial processes.
- ➔ Types: SCADA/DCS

[1]

Identify an ICS asset

- Active scanning
  - Probing the targeted device

- Passive scanning
  - Collecting and analyzing information by sniffing network traffic

- **Hybrid scanning**
  - Combination of Active and Passive

The Problem!

- ➔ Outdated network diagrams
- ➔ ICS components are fragile
- ➔ Active scanning can cause a lot of problems (e.g. Putting targeted devices out of service)
- ➔ Passive scanning collects small part of the device information

Research Questions

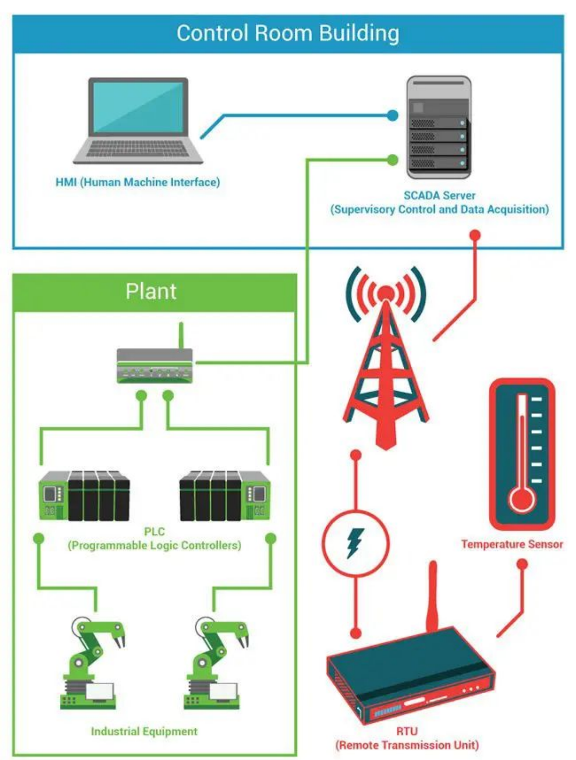
What are the added benefits of hybrid scanning compared to passive?

Research subquestions

- ➔ What are the problems that can occur by using hybrid scanning in ICS environments?
- ➔ How certain types of ICS devices behave under hybrid scanning and what are the problems that may arise in relation to these specific devices?

Components of ICS

- ➔ Programmable Logic Controller (PLC)
- ➔ Human Machine Interface (HMI)
- ➔ Remote Terminal Unit (RTU)



Control Room Building
HMI (Human Machine Interface)
SCADA Server
(Supervisory Control and Data Acquisition)
Plant
PLC
(Programmable Logic Controllers)
Industrial Equipment
Temperature Sensor
RTU
(Remote Transmission Unit)

[2]

Related Work

- Adam Wedgbury et al.(2015)
  - Problems that exist during an identification process on ICS.
- Mohammed Abdulrazzaq et al.(2018)
  - Definition of asset identification in ICS.
  - Introducing Hybrid scanning.
- Sergei Bantseev et al.(2003)
  - Available tools for network scanning.
  - No available tools that can do it all.

Methodology(1)

- Created an ICS environment with the help of:
  - OpenPLC
  - Scada Br
  - VMware Workstation
  - Kali Linux

- Conducted experiments using passive tool.
  - Grass Marlin

Methodology(2)

- Conducted experiments using hybrid approach, with the following combination of active and passive tools.
  - Nmap
    - Modbus-discover
  - Plcscan
  - Scadascan
  - Grass Marlin

- Analyzed incoming information and document the state of the devices.
  - Performance
  - Availability
  - Responsiveness

Background: OpenPLC

- OpenPLC is an open source tool developed by Thiago Alves.[3]
  - Aiming to **emulate** PLC programs in different environments

- Supports multiple programming languages.
  - Ladder Logic (LD)
  - Instruction List (IL)
  - Function Block Diagram (FBD)
  - Sequential Function Chart (SFC)
  - Structured Text (ST)

Background: Scada Br

- Open source tool.
  - Aiming for development of Automation, Data acquisition and Human Machine Interfaces (HMI).

- Useful tool for:
  - Universities
  - Automation professionals
  - Technical schools

Background: Scanning tools(1)

- Grass Marlin
  - Open source tool.
  - Passively sniff network traffic.

- Plcscan
  - Developed by Dmitry Efanov.[4]
  - Discovers PLCs by scanning for Modbus/TCP protocol.

Background: Scanning tools(2)

- ScadaScan
  - Written in Perl
  - Identifies Modbus slaves
  - Identifies Distributed Network Protocol 3 (DNP3) slaves

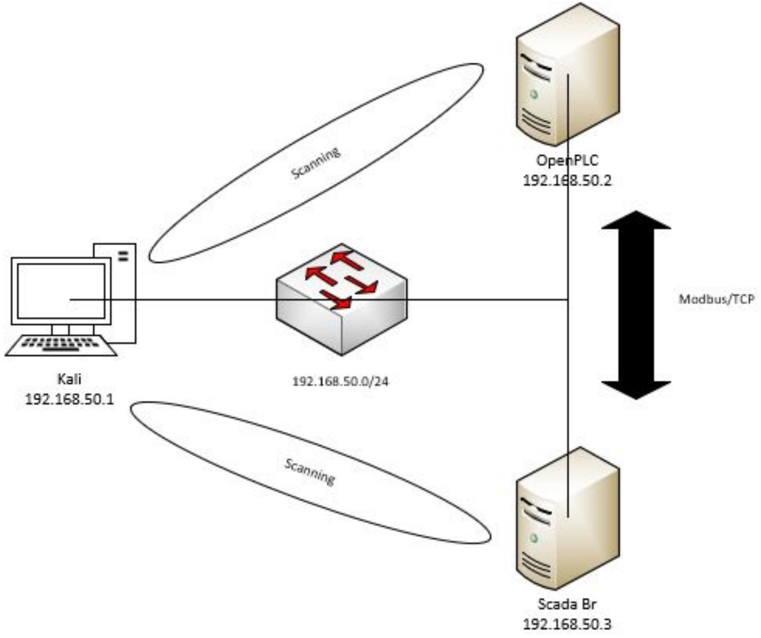
- Nmap
  - Modbus-discover

Setup

- ➔ Test environment

- ➔ Scanning OpenPLC and Scada Br

- ➔ Collected information and necessary results

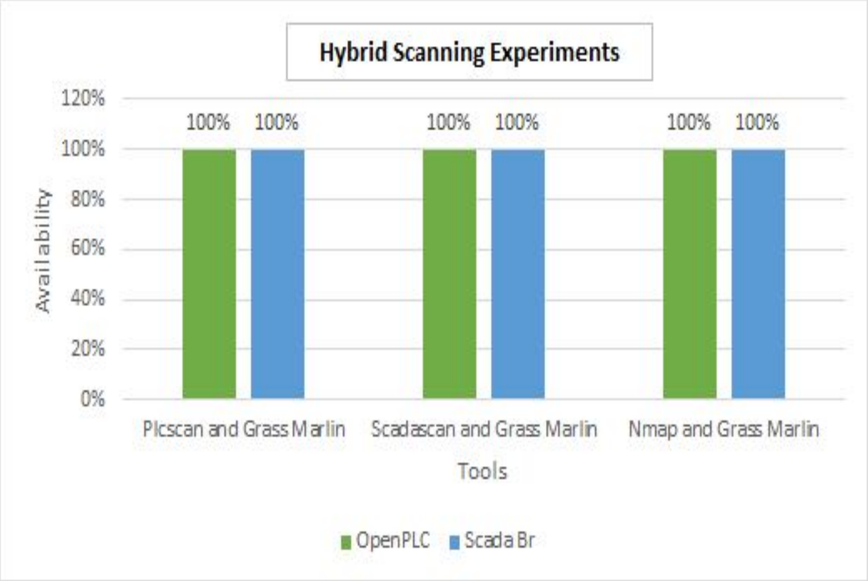


Results(1)

- ➔ OpenPLC and Scada Br remained stable during the hybrid scan, using Plcscan and Grass Marlin.

- ➔ Hybrid scanning with Scadascan script and Grass Marling, also resulted to a stable operation.

- ➔ Modbus-discover script and Grass Marling (hybrid scanning) confirmed the continuous availability of the devices.



Results(2)

- Passive scanning provided information regarding:
  - Manufacturer
  - ICS Protocol(Modbus)
  - Role (Master/Slave)
  - Operating System

- Hybrid scanning also provided the above information with the following additions:
  - Open port number, Unit ID (Plcscan)
  - DNP3 slaves (ScadaScan)
  - Slave ID data (Nmap: Modbus-discover)

Discussion

- ➔ The results indicate that
  - ◆ Hybrid approach did not arise any fragility on the targeted devices.
  - ◆ Hybrid scanning offered more information of the targeted devices compared to passive scanning.

- ➔ Limitations of this research:
  - ◆ This approach was not tested on physical devices due to COVID-19 restrictions. → The results may differ when the experiments are conducted on physical devices.
  - ◆ Only specific devices included in the research

Conclusion(1)

What are the added benefits of hybrid scanning compared to passive?

- Collection of more details for the targeted devices.
- Variety of tools can be chosen for scanning.
  - Flexibility to choose appropriate tools depending on the targeted devices.

Conclusion(2)

What are the problems that can occur by using hybrid scanning in ICS environments?

➔ Based on the virtualized environment that hybrid scanning was tested, **no problems arose regarding**
  - ◆ **Performance**
  - ◆ **Availability**
  - ◆ **Responsiveness**

Conclusion(3)

How certain types of ICS devices behave under hybrid scanning and what are the problems that may arise in relation to these specific devices?

- OpenPLC and Scada Br
  - Stable operation
  - No interruptions

Future Work

- ➔ Expand the scope of the research using physical equipment, like Siemens or ABB PLCs.
- ➔ Investigate what is the methodology of scanning that vendor’s tool use, and what are the possibilities of integrating these methods to the hybrid approach.

Thank you!

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Questions

References

[1] E-Spin, “Understanding industrial control system(ics) basic: E-spin group,” Apr 2020.

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[3] T. Alves, “The openplc project,” 2018.

[4] M. S. Javate, “Study of adversarial and defensive components in an experimental ma-chinery control systems laboratory environment,” tech. rep., NAVAL POSTGRADU-ATE SCHOOL MONTEREY CA, 2014.