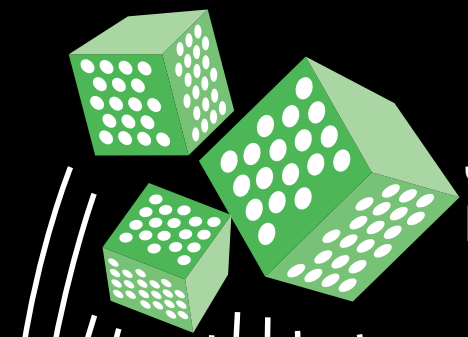
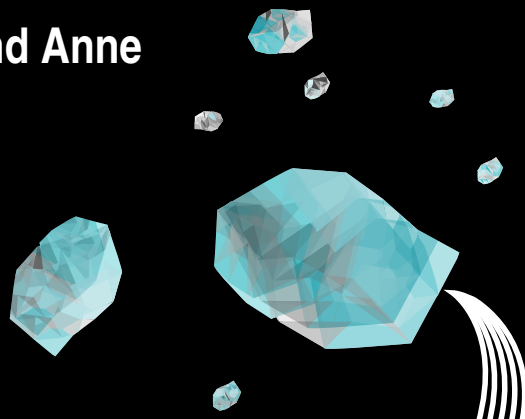
UNIVERSITY OF TWENTE.

Evaluating a process-aware IDS for smart grids on distributed hardware



Joint work with Kai Oliver Großhanten and Anne Remke



This research is conducted as part of the ISoLATE project (CS.016) funded by NWO.

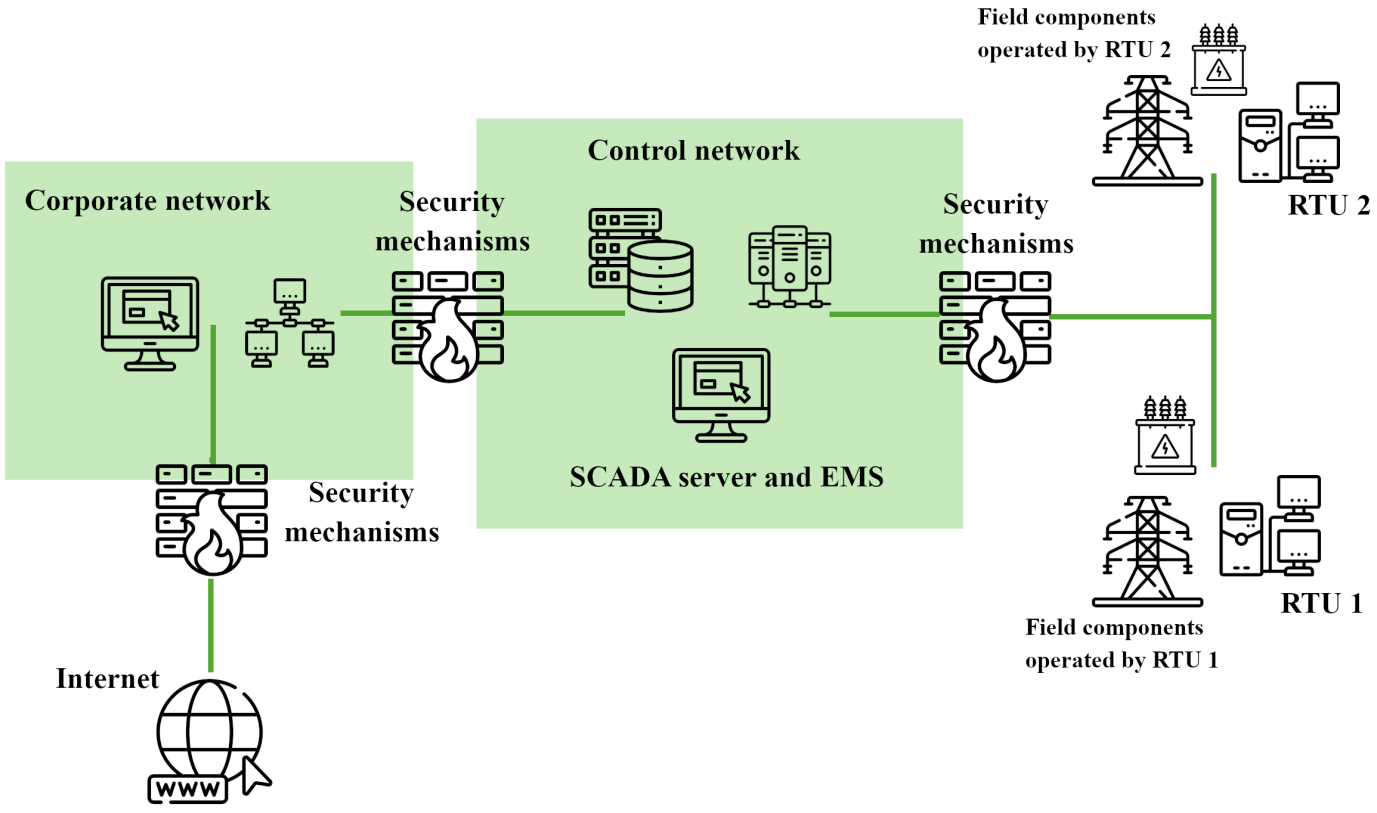
Overview

- Motivation
- Attack model
- Approach
- Truly distributed approach I
- Side Note I
- Side Note II
- Truly distributed approach II
- Properties for real-life test case
- Next steps

Motivation

- smart and decentralised (automated) energy management comes with risks
- we need more accurate data to work with flexible renewables
- legacy SCADA software is under more & more attacks

Motivation

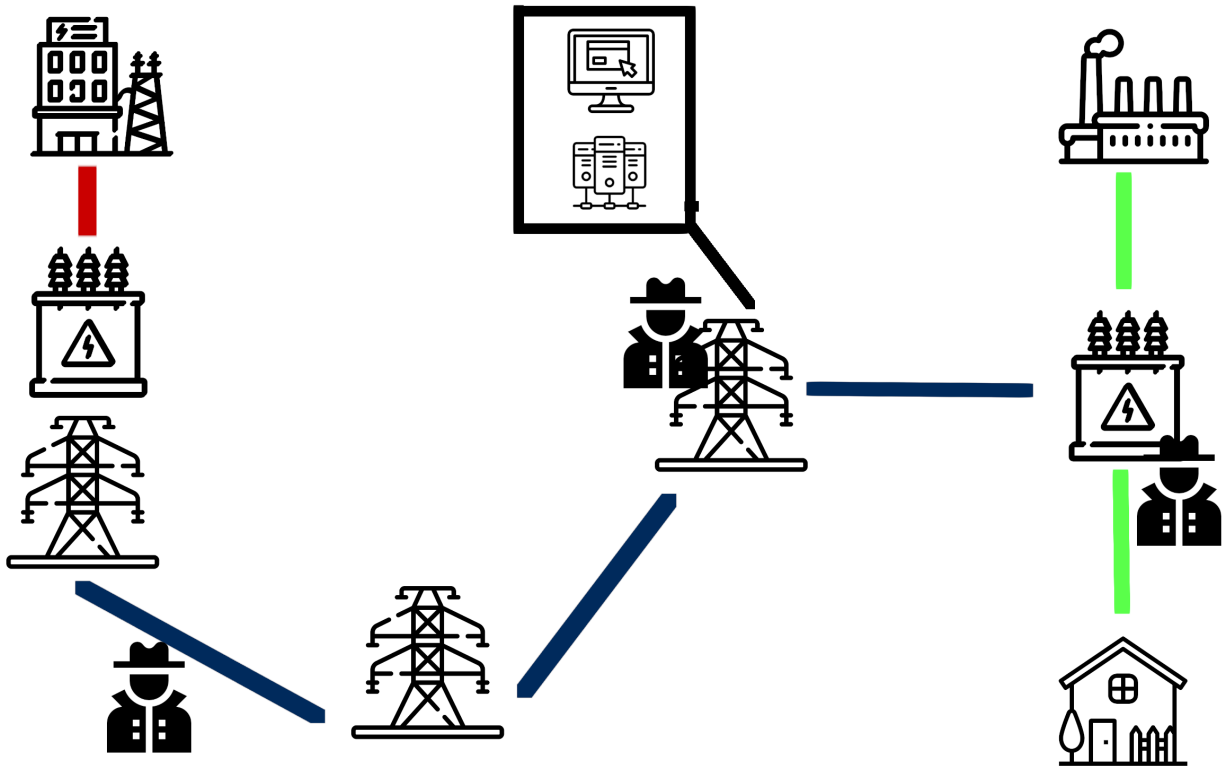


paradigm of *security through obscurity* and *air gap*

Motivation

- lack of (good) training data
- state estimation (SE):
  assumption communicated data is correct
- multiple security solutions are needed

Attack model



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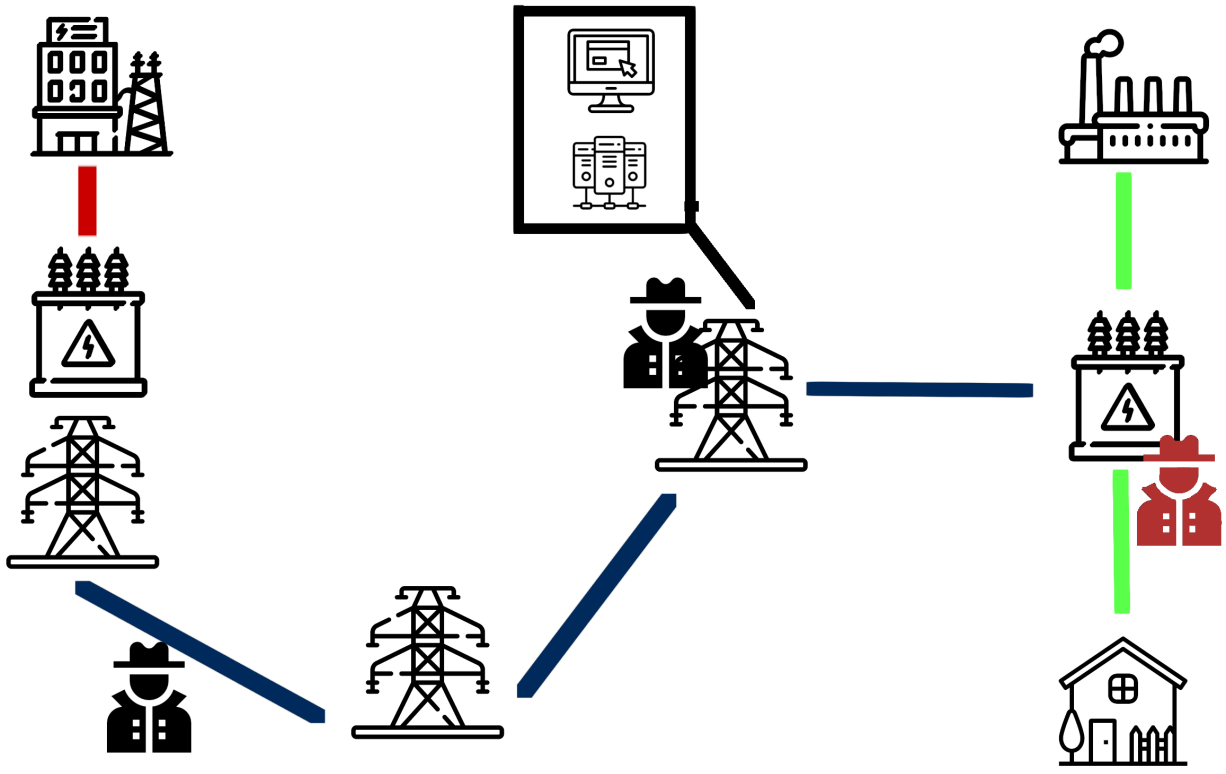

Attack model

- able to get into SCADA communication
- eavesdrop, intercept, manipulate and exchange messages
- knowledge about protocols and common grid architecture

Approach

- process-awareness[1]

[1] J. J. Chromik, A. Remke, and B. Haverkort, “An integrated testbed for locally monitoring SCADA systems in smart grids,” Energy Informatics, vol. 1, pp. 1 29, 2018.

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Approach

- process-awareness[1]
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- local evaluation: attacks within a field station
- neighbourhood evaluation[2]: attacks against a complete field station

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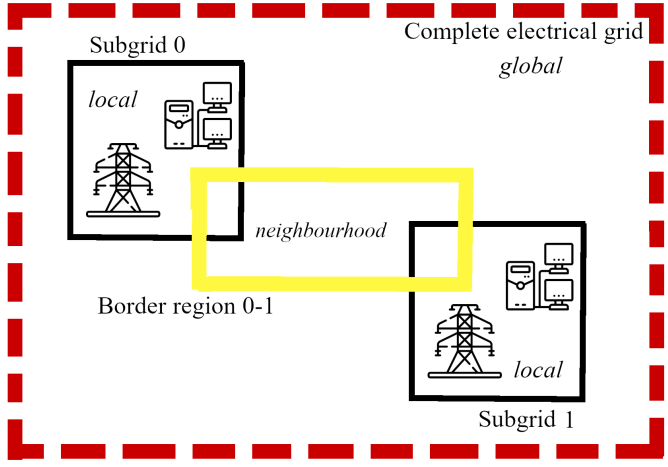
- two field stations supervising each other



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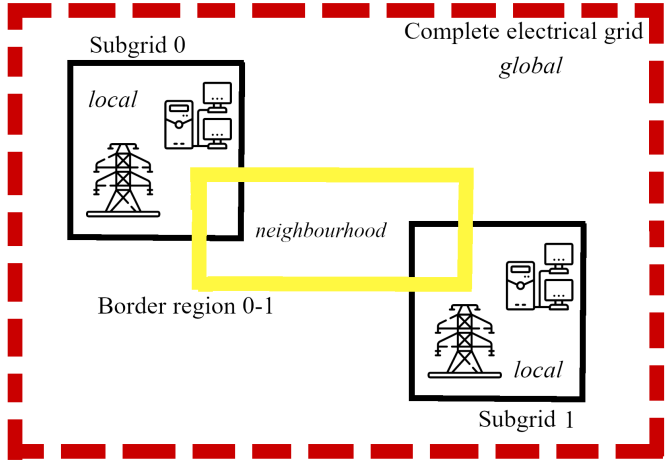

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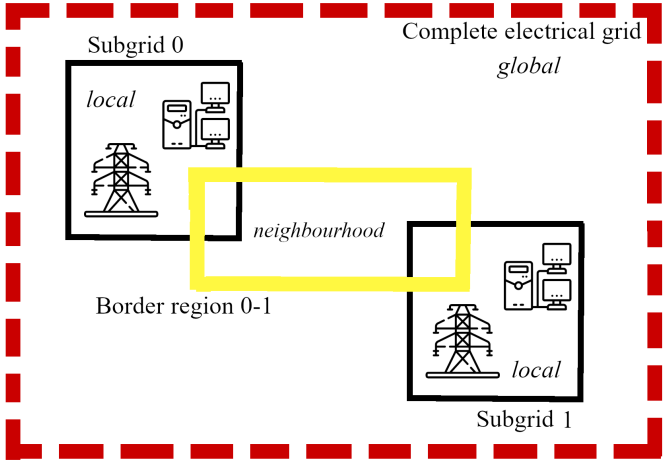

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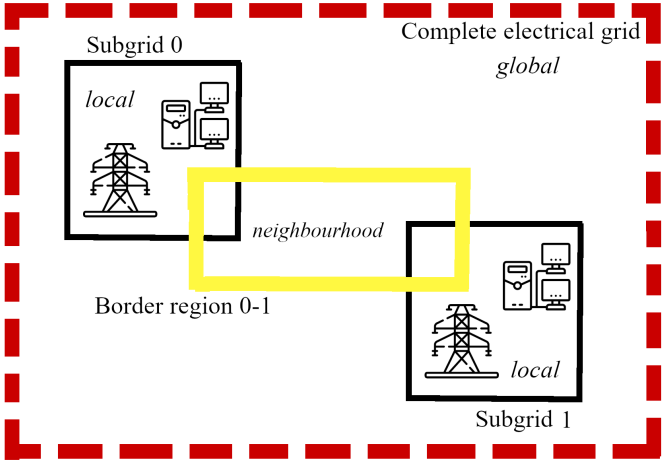
- OPC-UA



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- formal model for splitting the grid & set of requirements

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  - attack within a subgrid, without causing local alerts

Truly distributed approach I

- before: docker is great!

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- but still one piece of hardware ...

Truly distributed approach I

- before: docker is great!
- but still one piece of hardware ...

- now: testbed, monitors and control and command server each on their own Raspberry Pi

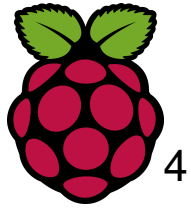
Side note I: docker

[3]

- OS-level virtualization to deliver software in containers
- free (and premium) platform as a service
- makes it easy to start multiple containers in light-weight environments, functioning every time

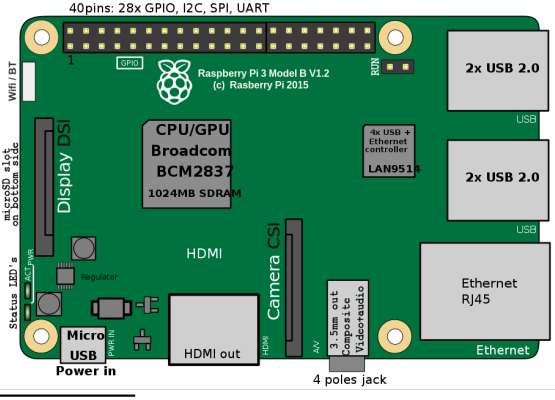
[3] https://en.wikipedia.org/wiki/Docker_(software)#/media/File:Docker_logo.svg

Side note II: Raspberry Pi



[4]

- popular single-board computer for education and DIY projects
- modular system to equip with all different sorts of additions
- here: Raspberry Pi 3 Model B V1.2



[5]

[4] https://en.wikipedia.org/wiki/File:Raspberry_Pi_Logo.svg

[5] https://commons.wikimedia.org/wiki/File:RaspberryPi3B.svg

Truly distributed approach II

Adaptions:

- need to configure wheels for ARM architecture

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Truly distributed approach II

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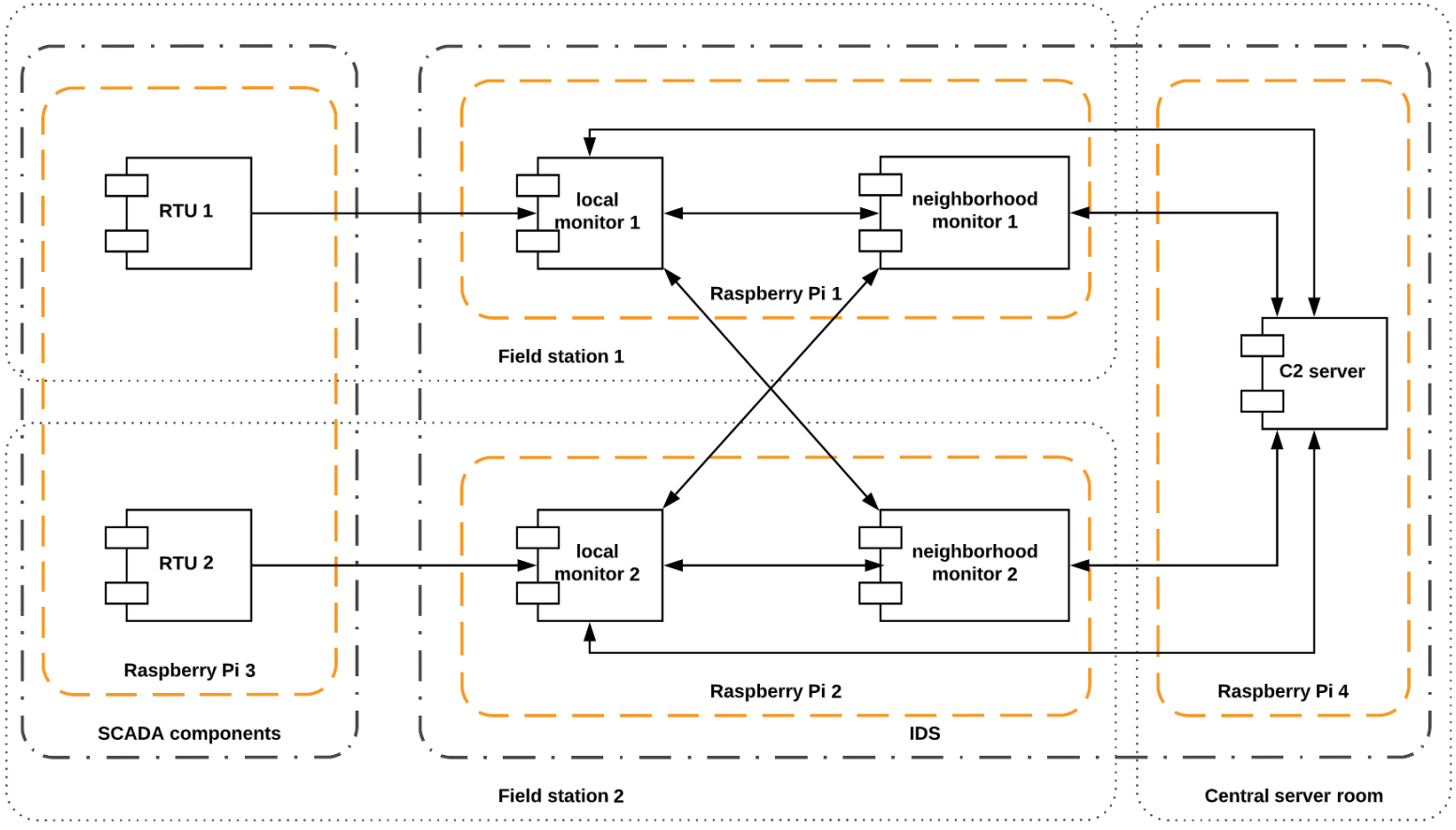

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No value smaller than 85% idle was observed.

Truly distributed approach II

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- increased speed of new measurement is no problem
- evaluation is quick

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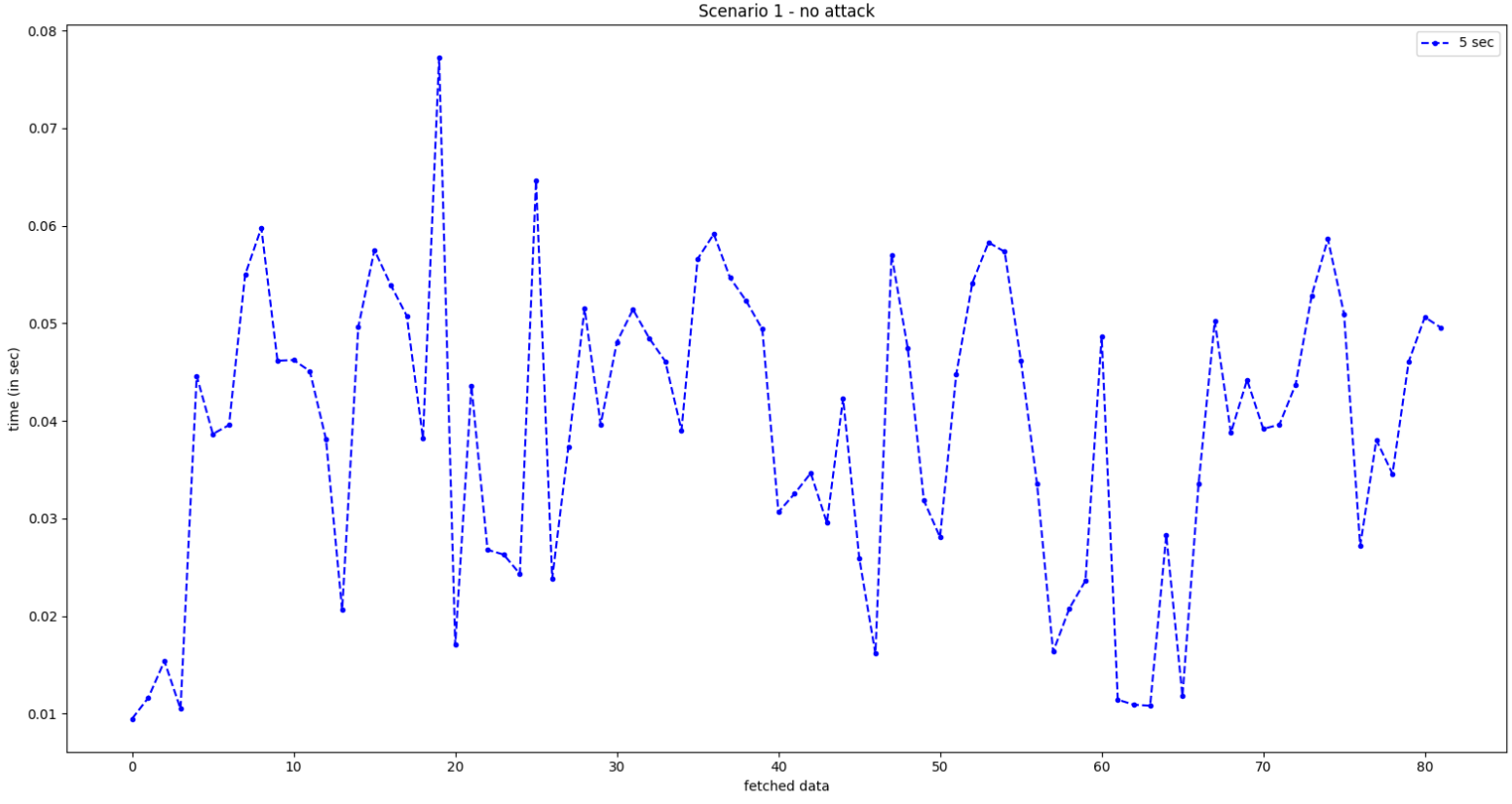

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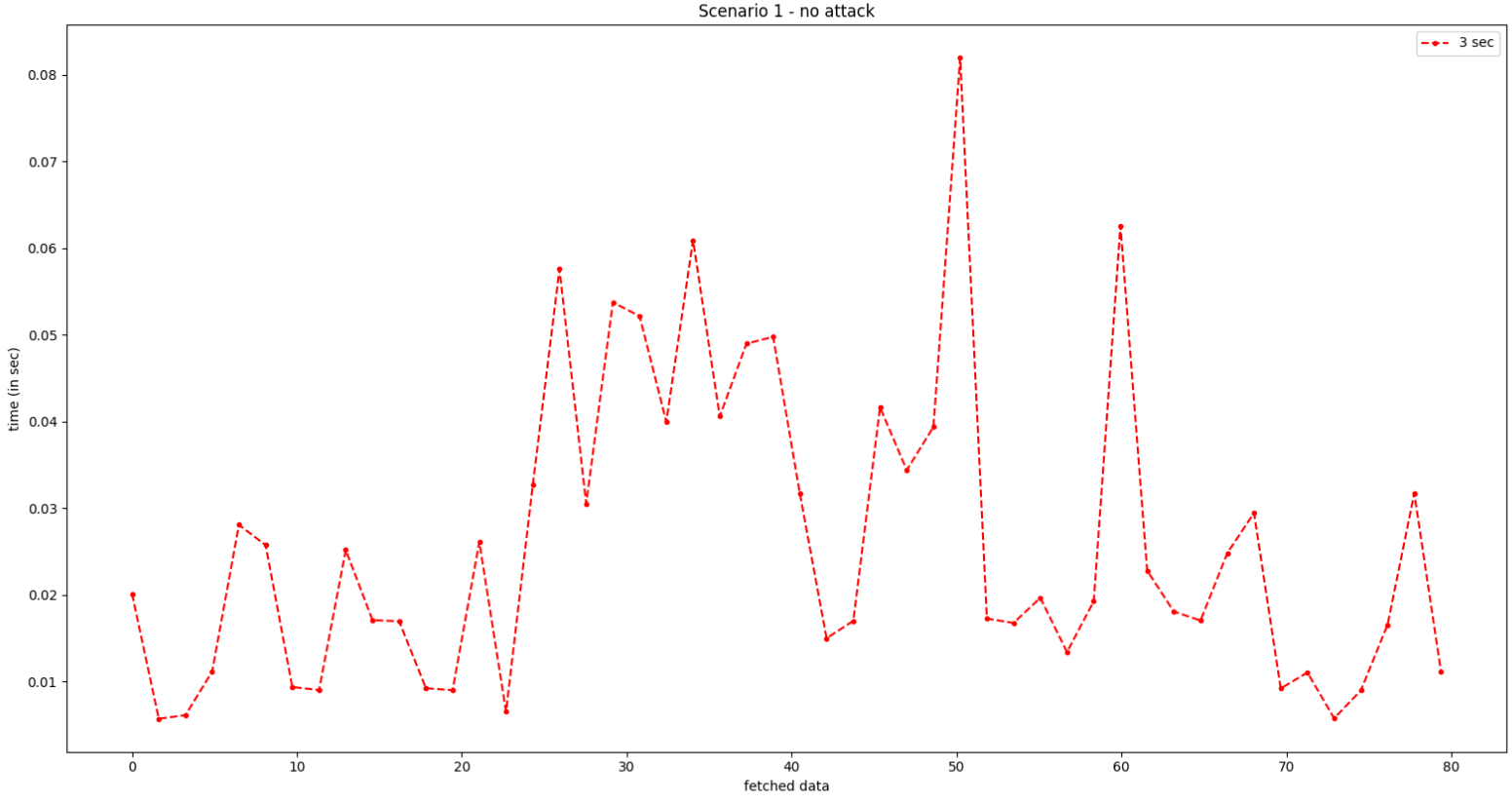

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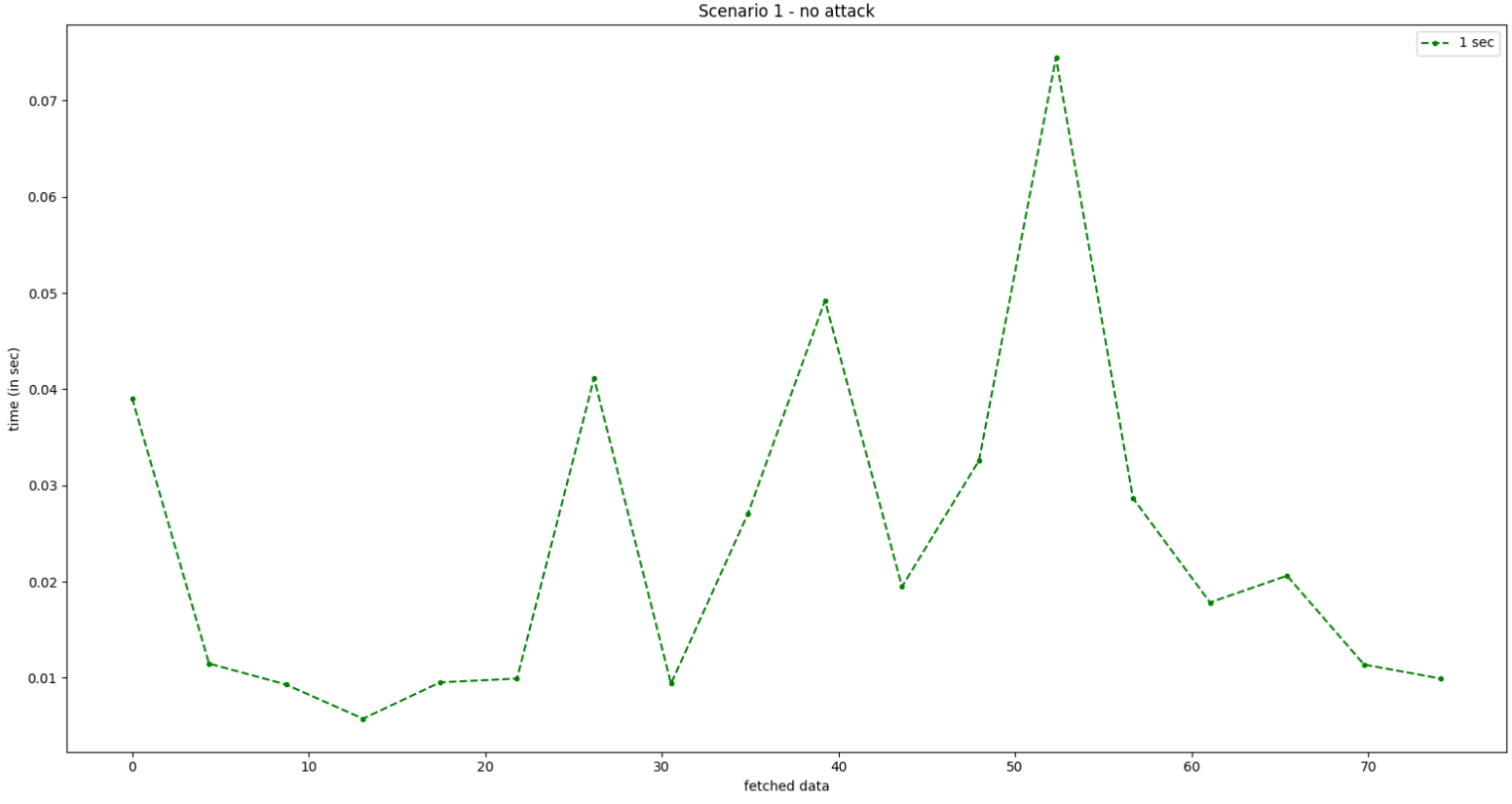

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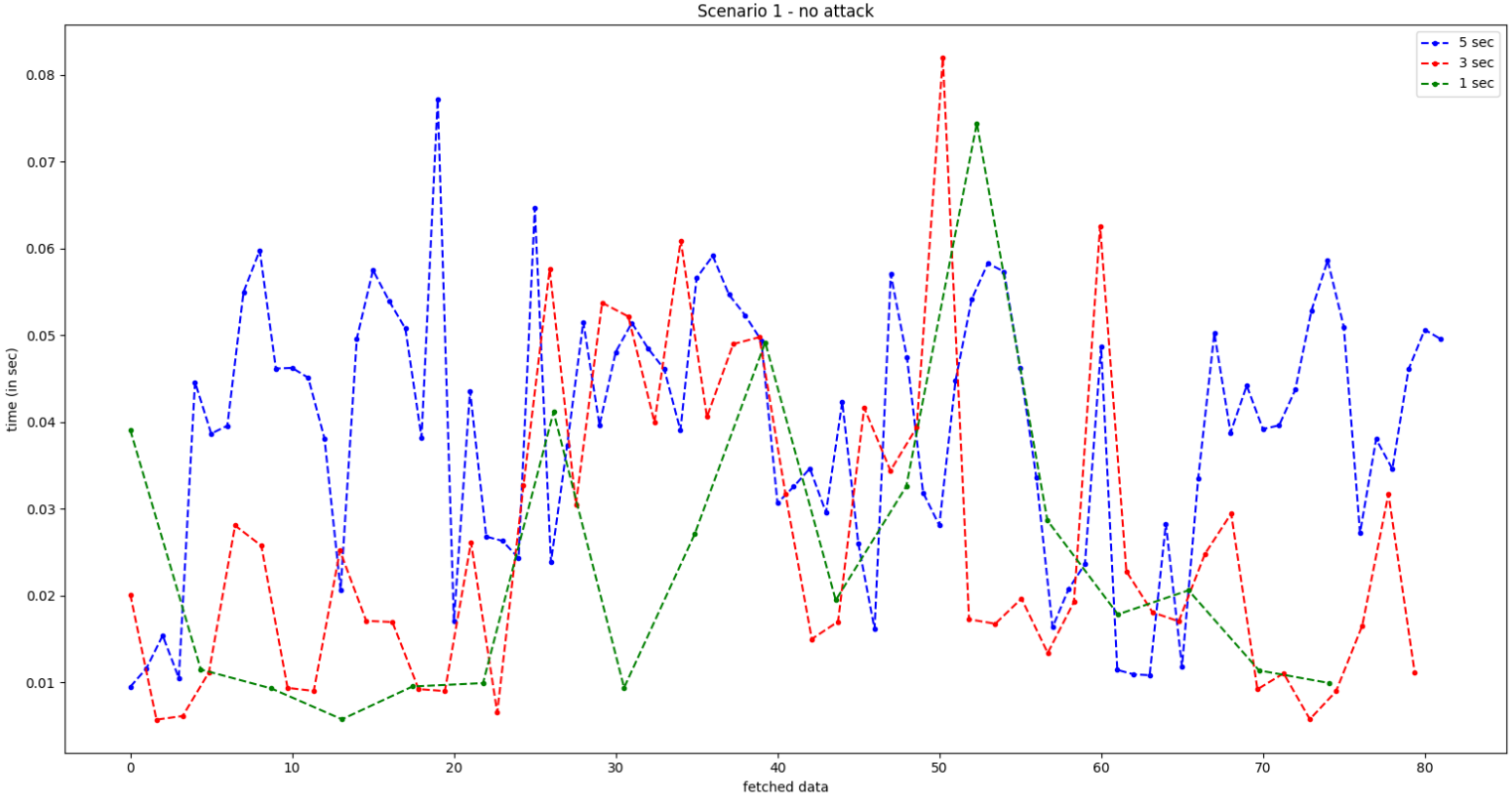

Properties for real-life test case

- Confidentiality
- Integrity
- Availability

Properties for real-life test case

- central command and control sever:
  traditional data center protection

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  - BUT we can detect it quickly :-)

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- in general: OPC-UA is a good choice (for C, I and A)

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  - BUT we can detect it quickly :-)
- in general: OPC-UA is a good choice (for C, I and A)
- VPN could be an addition

Next steps

- real-world data
- thresholds
- more scenarios, more Raspberry Pis
- other HW
- experimenting with different monitor positions

- questions?