Building a Digital Twin from the IED

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Overview of Thesis

Background:

- A research project with Sprecher Automation GmbH (power supply & automation) in Linz, Austria.
- Energy 4.0 reformation and the customer's alternative need.
- The research & innovation team wants to explore an option to get virtual replica of a physical system.
- The physical system is a protection device (IED device with Embedded Linux).

Issue:

Physical presence of operator needed, devices cost fortune, and accessibility is not intuitive.

Motivation:

Digitalization and Energy efficiency.

Goal:

To find best framework to bring a Digital Twin of physical system (SPRECON-EP).

Overview of Thesis

Introduction
Background and hypothesis.
Research questions, objectives, and outline structure.

State of the art
Related work, approach and problems to be further investigated.

Architecture
The framework in detail explained and discussed.

Implementation
System requirement, technologies, and manual procedure explained.

Evaluation
Data acquistion, testing and results are compared.

Epilogue
Conclusion, discussion and future work explained

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Introduction

- Industry 4.0 and Energy 4.0 are the biggest revolution for smart grids, cyber-physical system, IoT and energy efficiency.
- The diverged and distributed systems integration led to system inconsistency.
- Simulation is a vital part to solve real-time problems.

Research question:

What is the best approach to bring the Digital Twin directly into a web browser for simulation?

Is this new framework model (Digital Twin) performance impact acceptable?

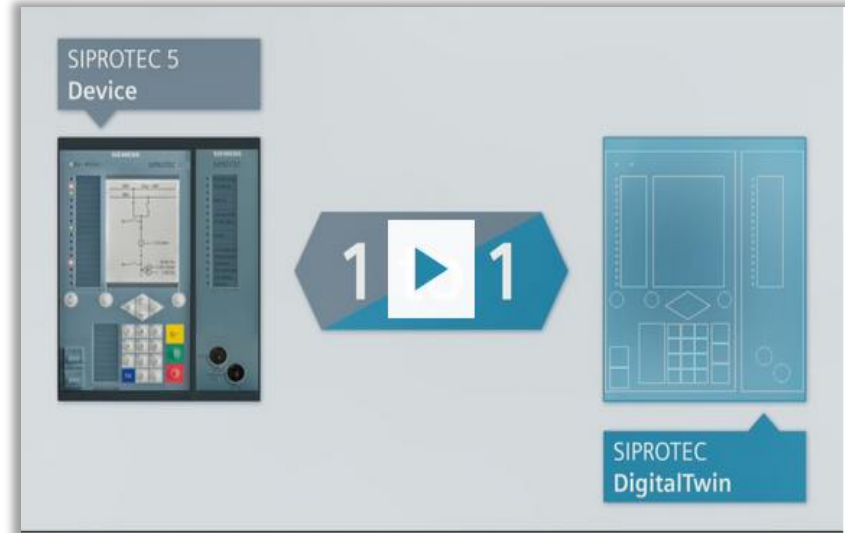The design should be available as a playground remotely?

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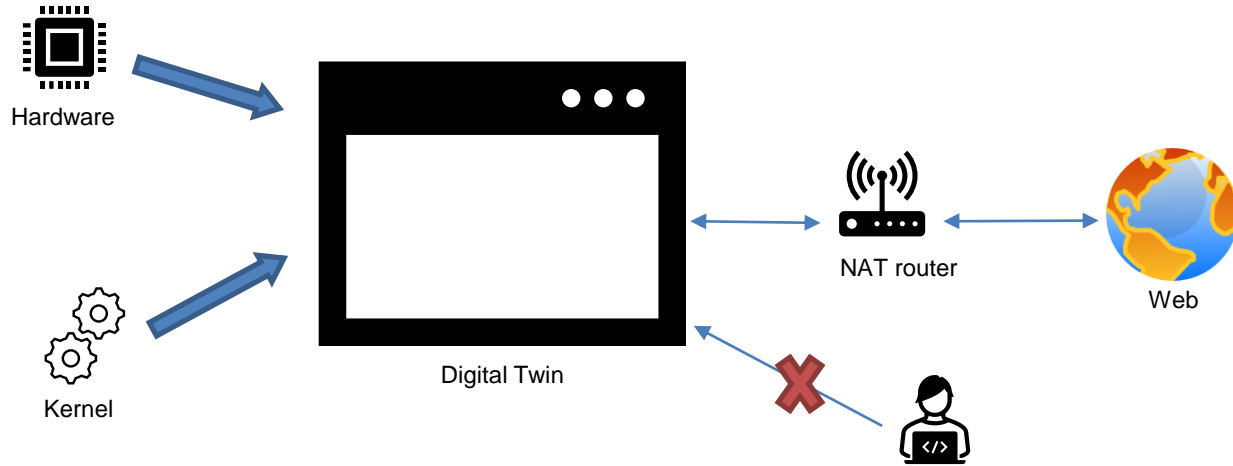UPPER AUSTRIA

State of the Art
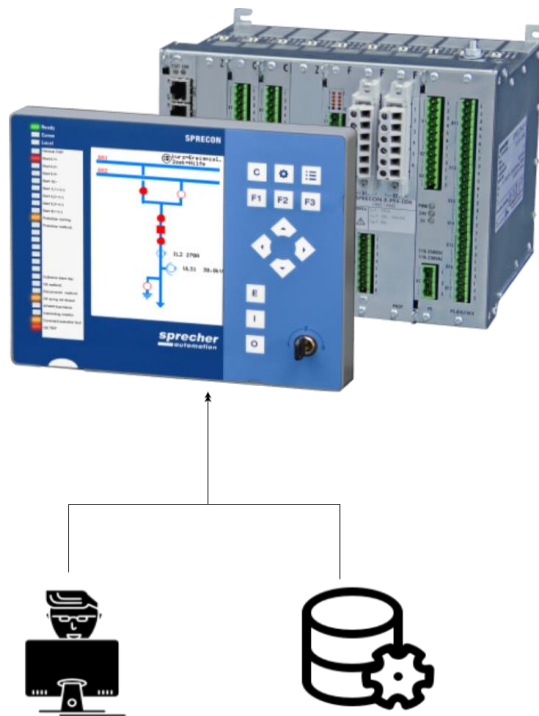
GE DigitalTwin
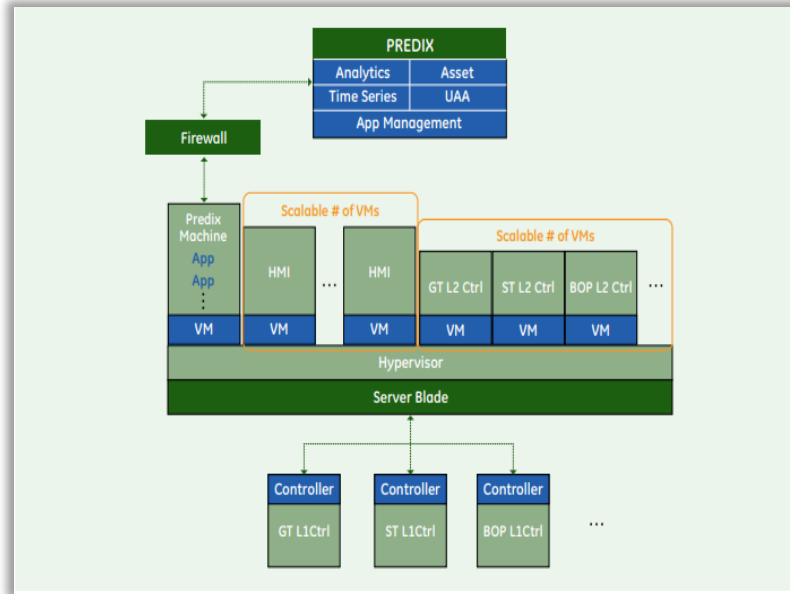
Siemens DigitalTwin

Source: GE, Siemens

Cont..

Issue: In-bound traffic to the web browser must be further researched.

Architecture

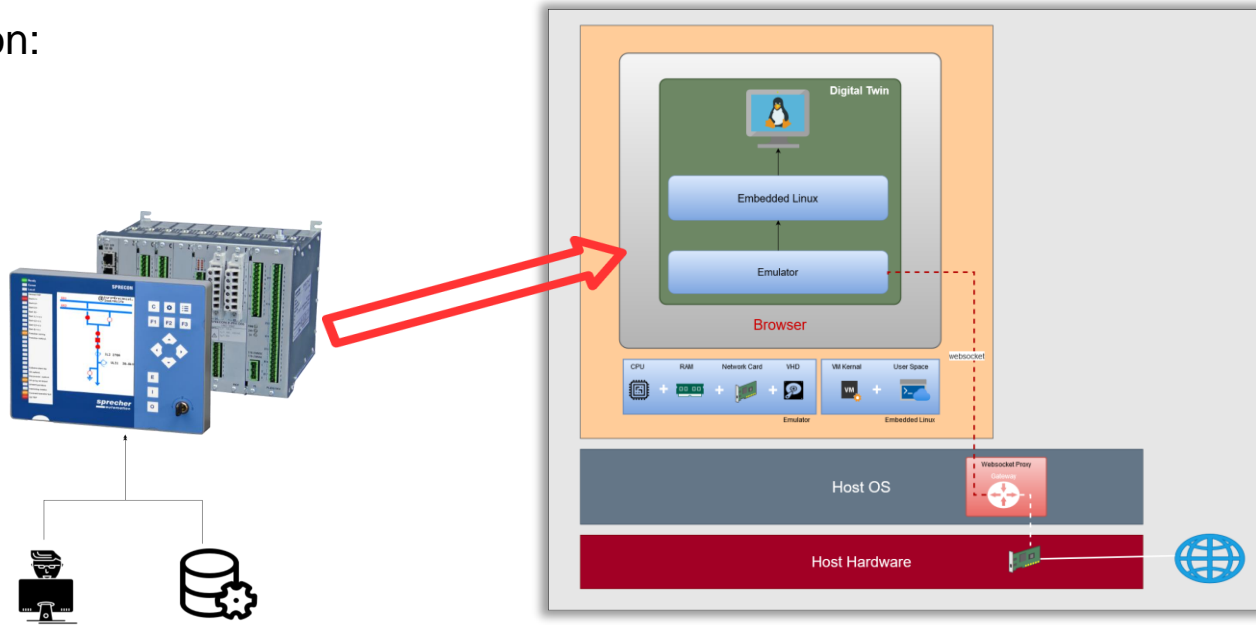Current:
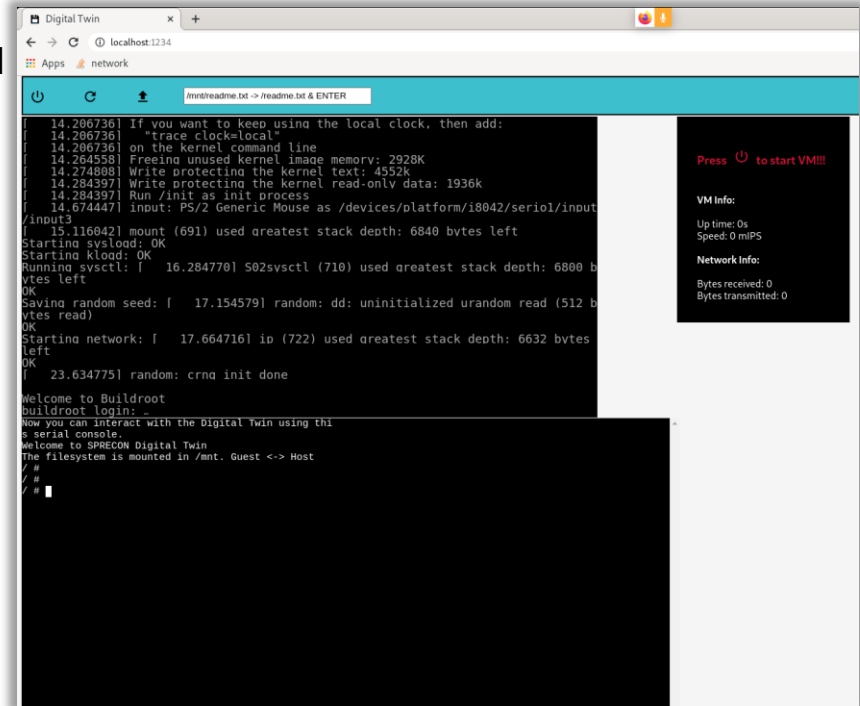
Architecture

Transformation:

Implementation

A web framework achieved using JavaScript and WebAssembly.

Emulator

Bootable Embedded Linux image

COMM-3 protection device settings

COMTRADE(Common format for Transient Data Exchange for power systems)

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Evaluation

Data

Embedded bootable Linux image, Protection device settings, Comtrade file, testing procedure and results.

Testing

Three use-cases of different Comtrade play with amount of data.

Evaluation

Machine performance/day and comparison of CPU, memory and network usages with physical and VM.

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Current status of the work

Status:
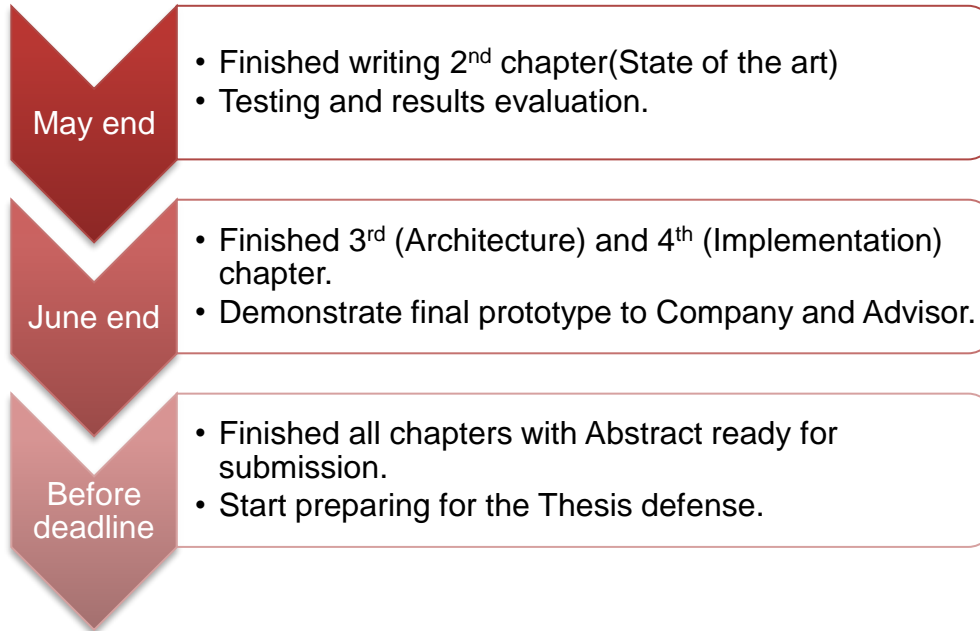- A web framework is in place.
- WebSocket proxy for out-bound traffic (bit tricky).
- Writing the second and third chapter.
- Currently integrating protection system image into Digital twin.
- Next finding best use-case, test, evaluate and get results.

Open issues:
Find an approach to make in-bound traffic using network stack or serial communication.

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Cont..

Timeline

May end
- Finished writing 2nd chapter(State of the art)
- Testing and results evaluation.

June end
- Finished 3rd (Architecture) and 4th (Implementation) chapter.
- Demonstrate final prototype to Company and Advisor.

Before deadline
- Finished all chapters with Abstract ready for submission.
- Start preparing for the Thesis defense.

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Q & A

Thank you for listening!!!

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