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A TEST FRAMEWORK FOR AN ADAPTIVE PROTECTION SCHEME USING A HARDWARE-IN-THE-LOOP SETUP

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2023 EUROPEAN RTDS TECHNOLOGIES INC. USER'S GROUP MEETING 2023

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RTDS Technologies
AMETEK

MOTIVATION

Schleswig-Holstein Netz AG
in 2023

Infeed:	9.000 MW
Peak Load:	2.000 MW

+21.000 MW

+ 15.000 MW PV
+ 5.000 MW Wind
+ 3.000 MV/LV Transformer
+ 40 HV/MV Transformer

Schleswig-Holstein Netz AG
in 2030

Infeed:	30.000 MW
Peak Load:	5.000 MW

Manpower?

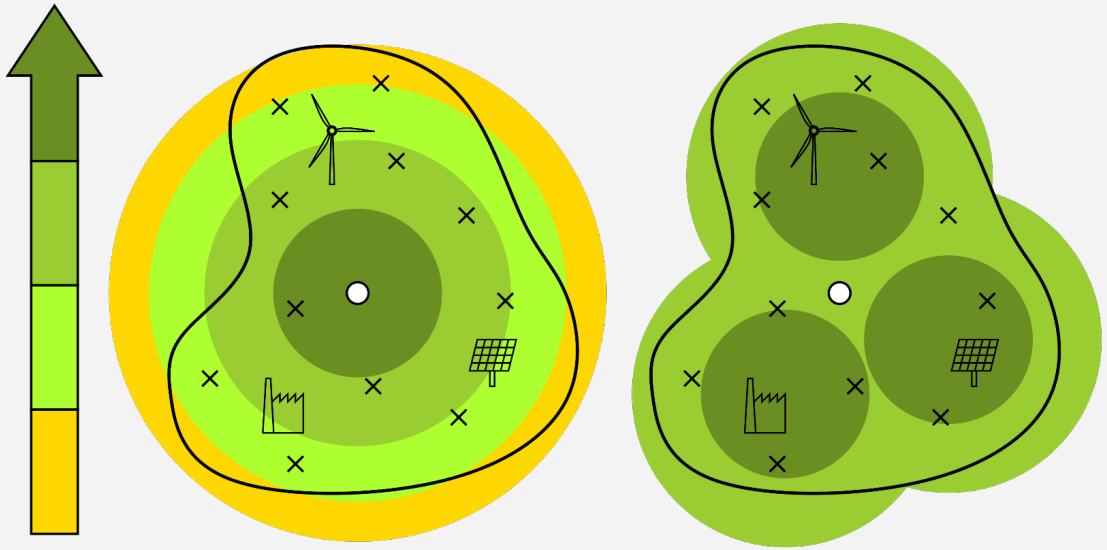
One persistant topology change PER DAY for the next 8 years

Protection Performance?

MOTIVATION

Challenge and Framework

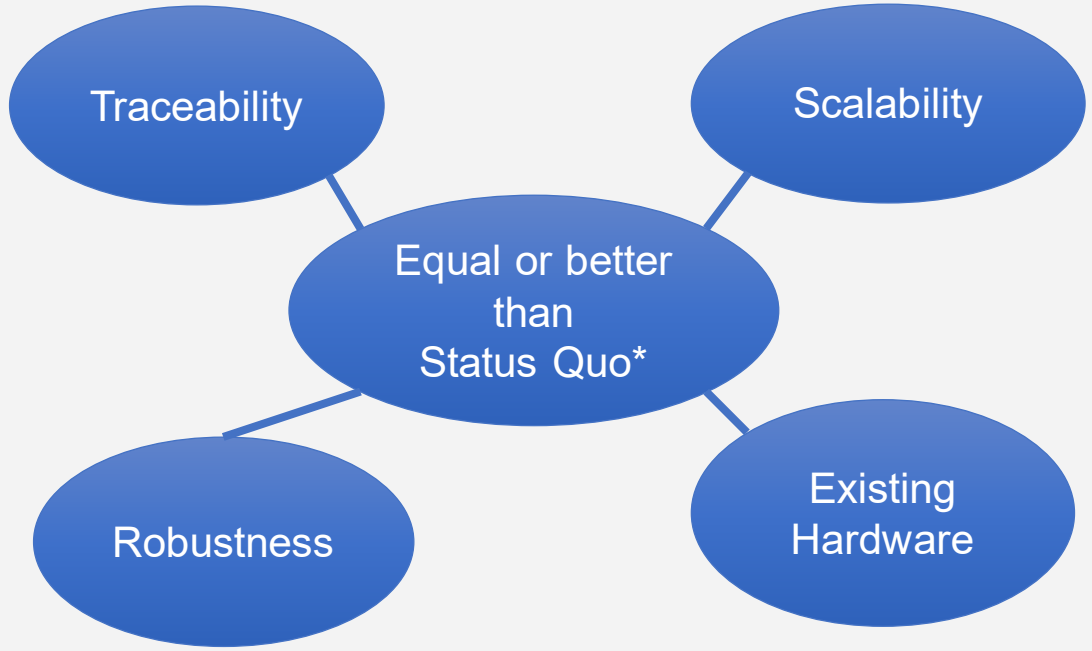
Protection Performance:



Classic Protection
Constant Setting

Adaptive Protection
Multiple Settings

Framework:



* in correct fault detection

Implementation by **automated process**

MOTIVATION

Project Goals

Key features of *VeN²uS* - Interconnected Network Protection Systems:

- Creating a prototype
- Testing in Real-world grid
- Integration in substation

VeN²uS
Vernetzte Netzschutzsysteme

Supported by:

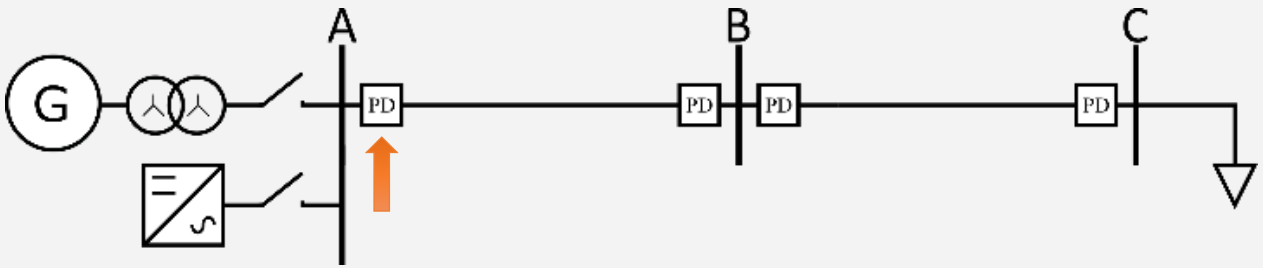
Federal Ministry
for Economic Affairs
and Climate Action

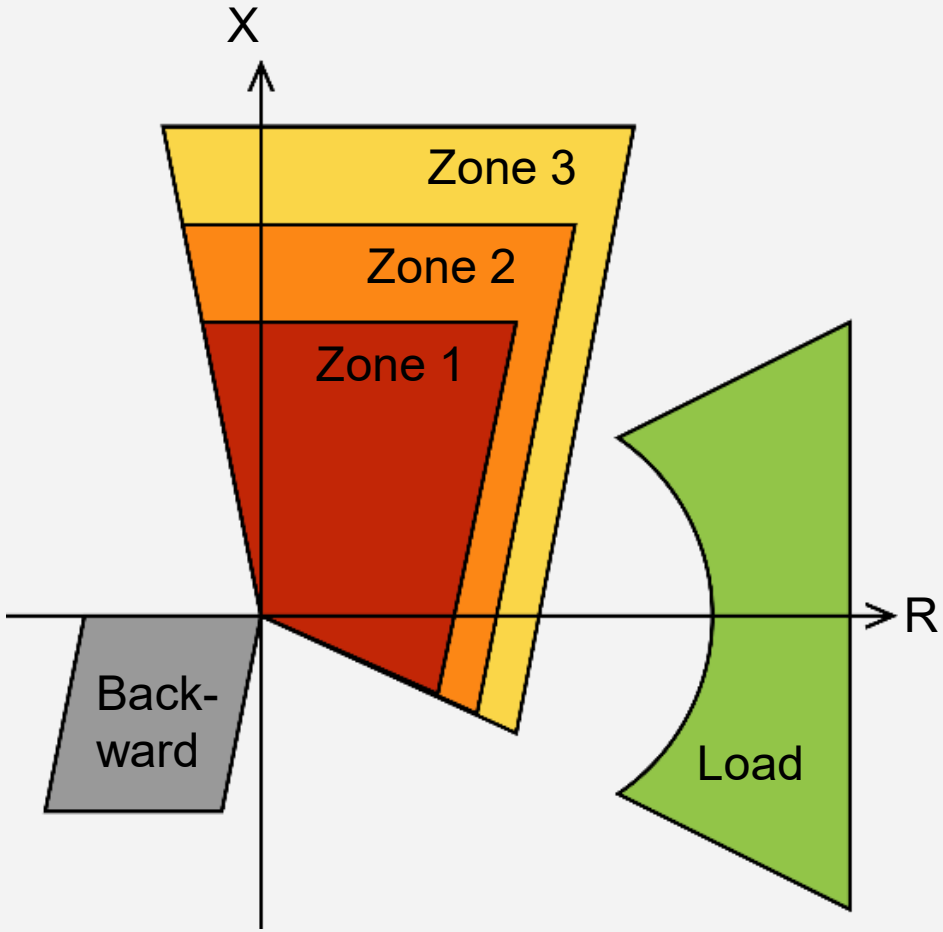
on the basis of a decision
by the German Bundestag

BASICS

Protection Relay

- Voltage and Current Measurements
- Calculation of Impedance to Fault Location
- Less Impedance
  → Close Fault
  → Fast Reaction necessary

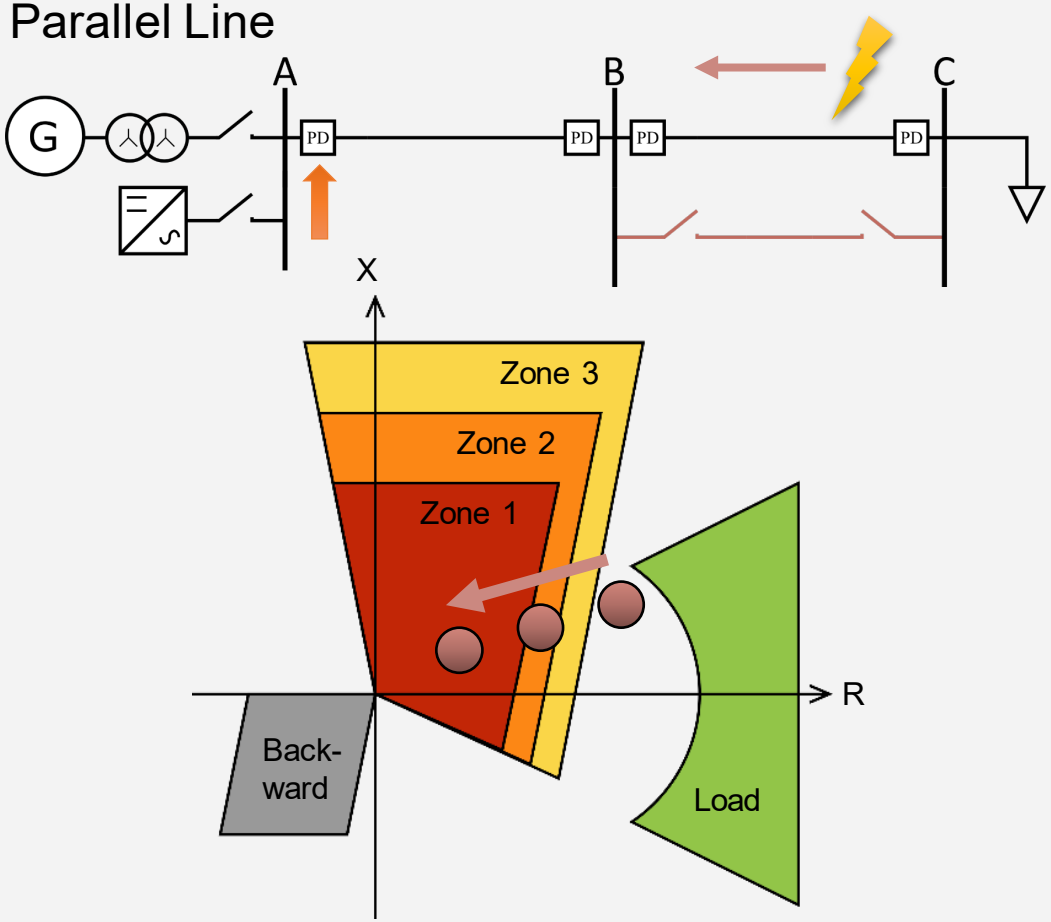




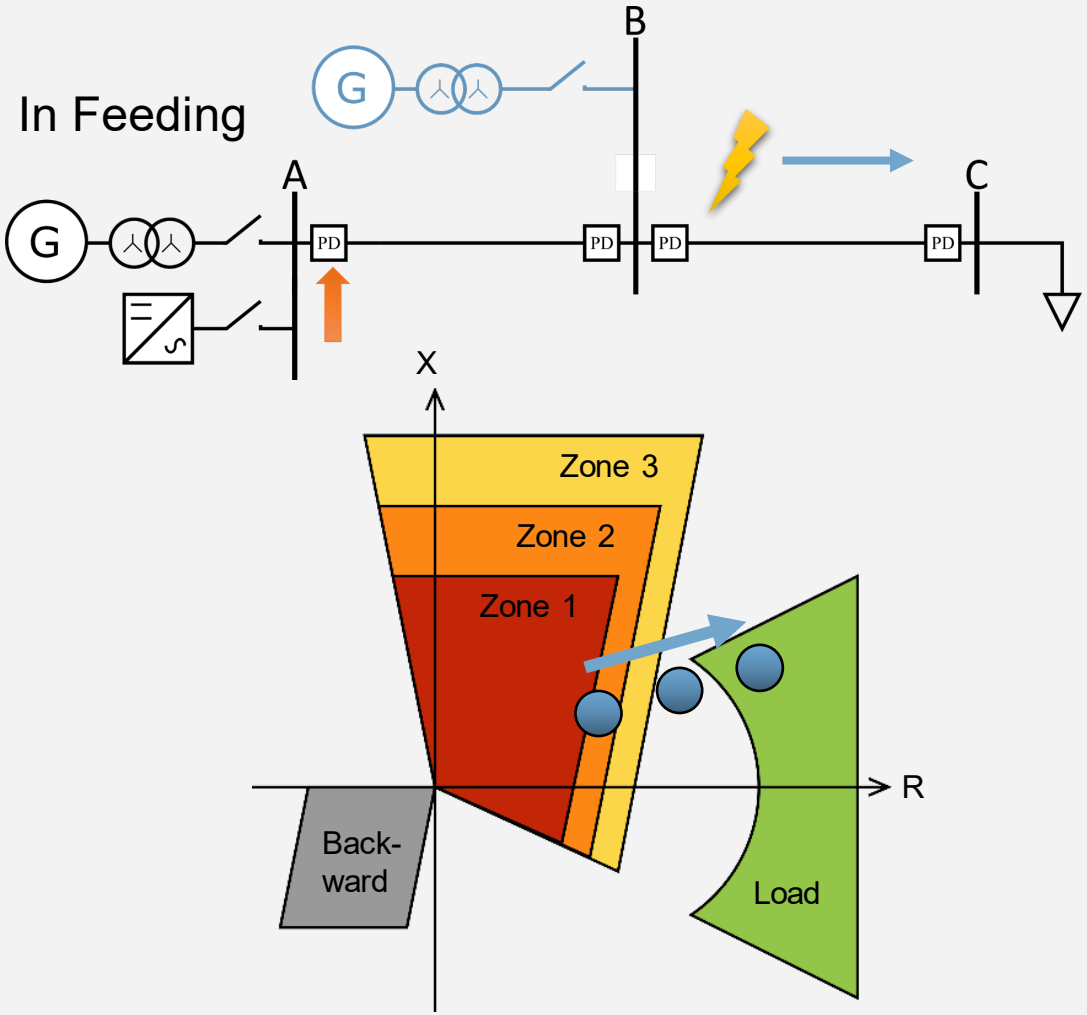
BASICS

Protection Relay

Parallel Line



In Feeding

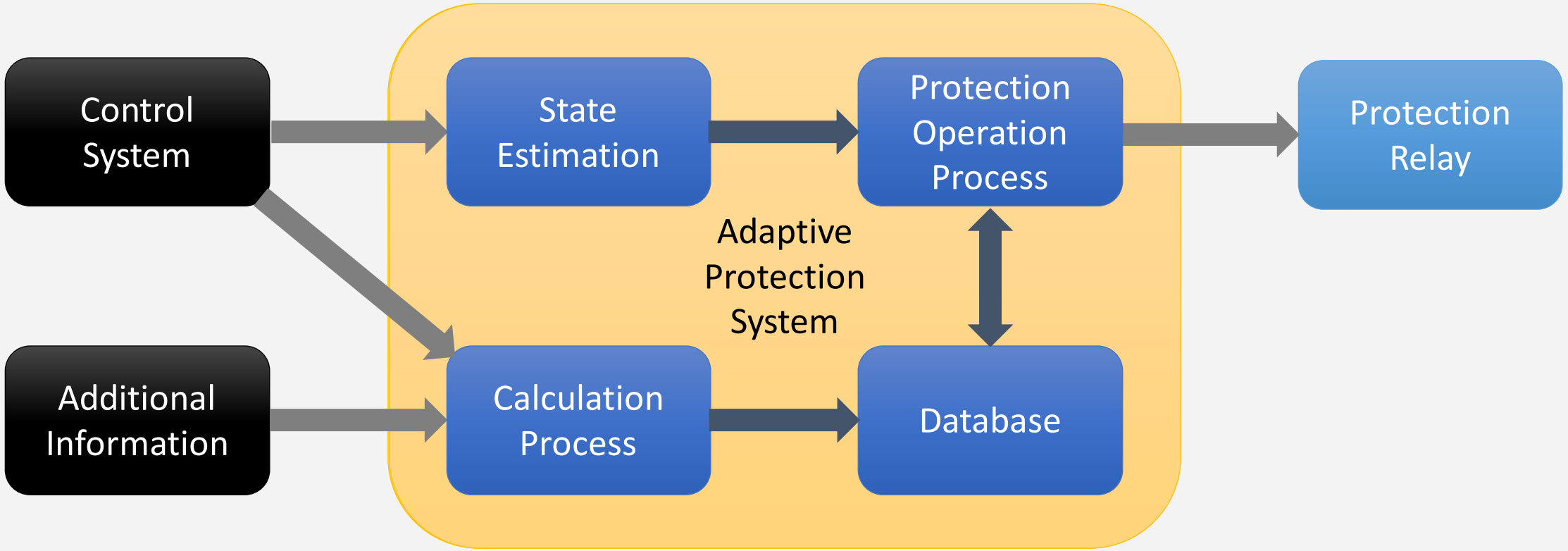


DESIGN OF THE SYSTEM

Basic Idea

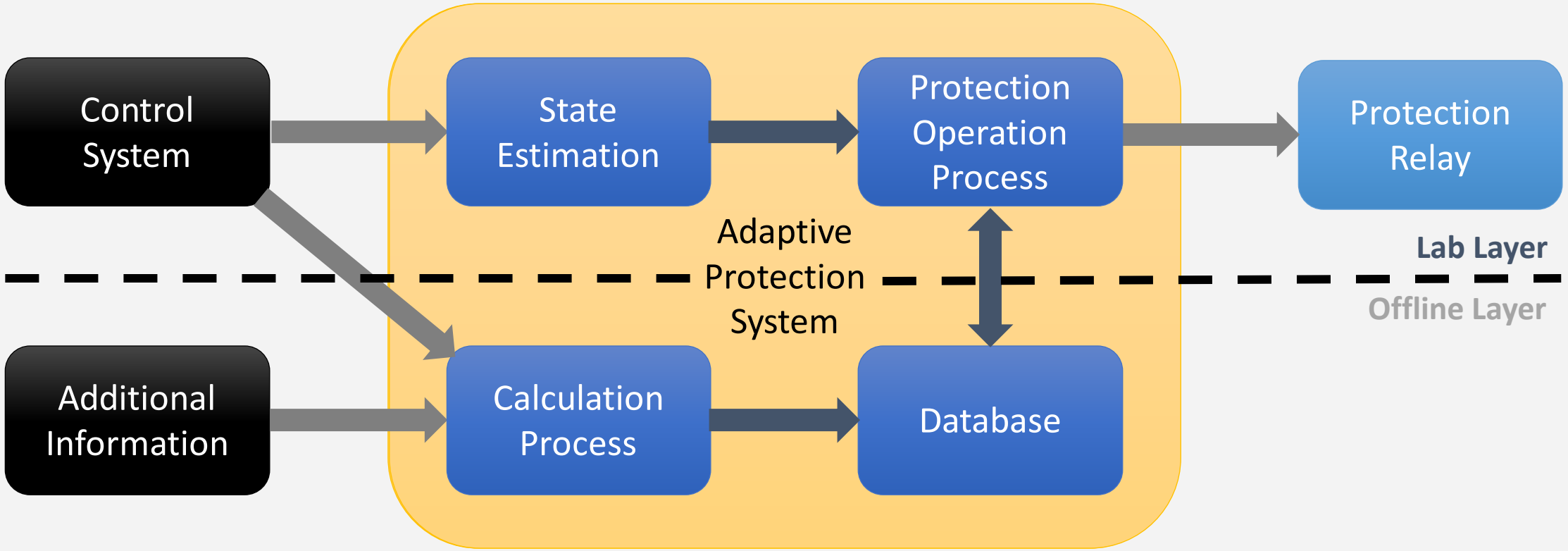
DESIGN OF THE SYSTEM

Defining the Process



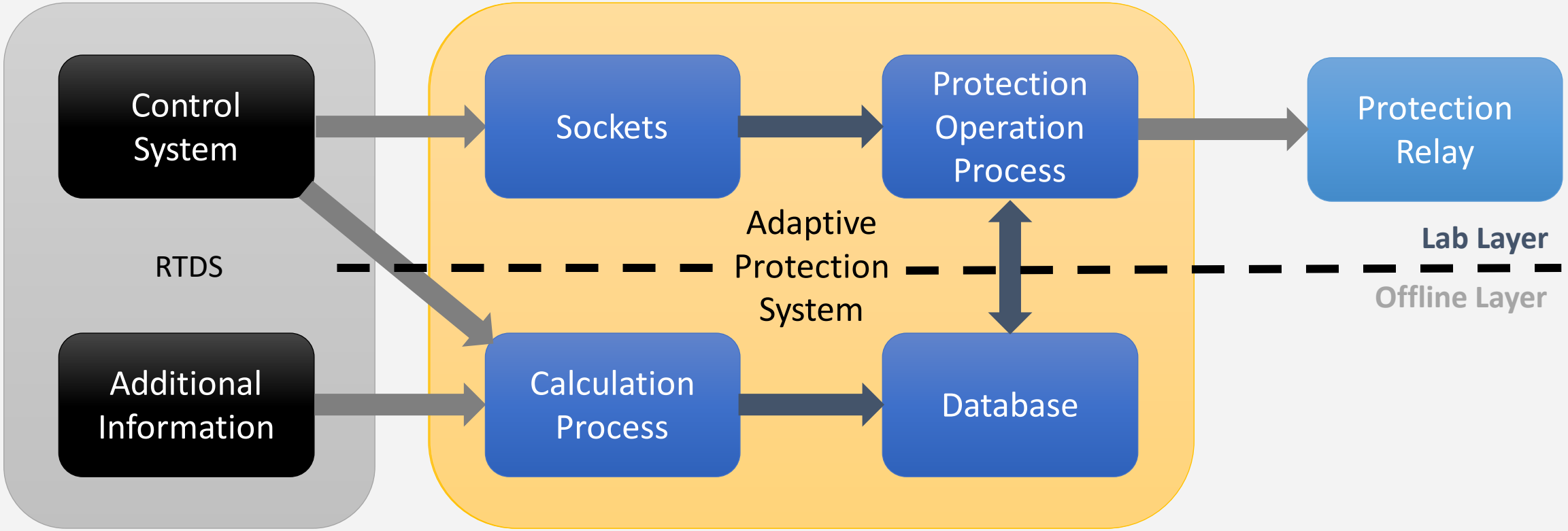
DESIGN OF THE SYSTEM

Separating the Process



DESIGN OF THE SYSTEM

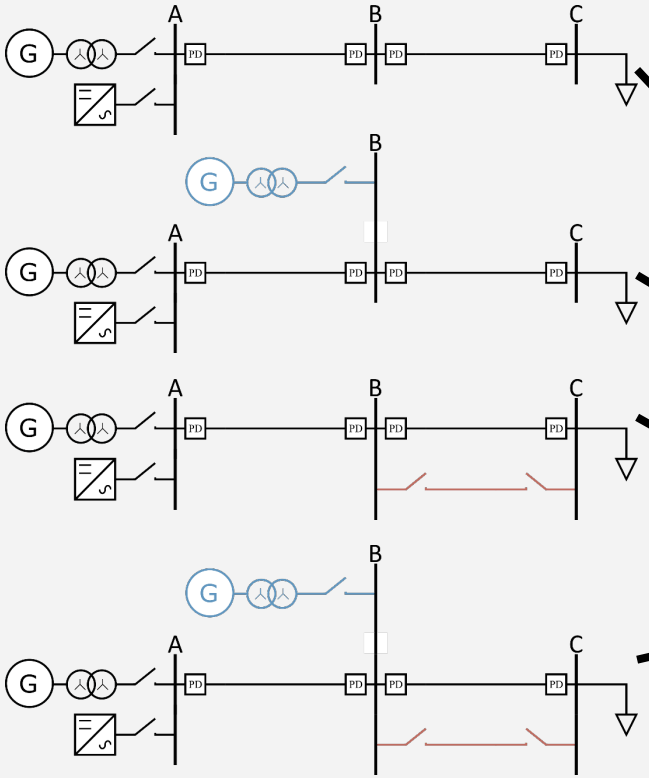
Integrating Lab Environment



IMPLEMENTATION

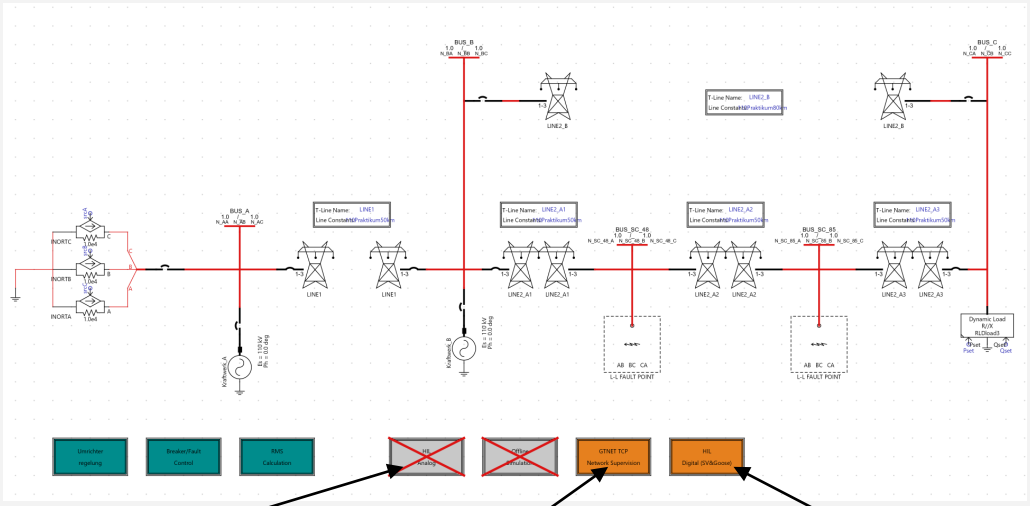
Example

Calculated Parameters:



Database

Zone 2 R	Zone 2 X
2,2 Ω	17,6 Ω
3,0 Ω	28,3 Ω
2,0 Ω	16,8 Ω
2,7 Ω	24,8 Ω



Analog CHiL

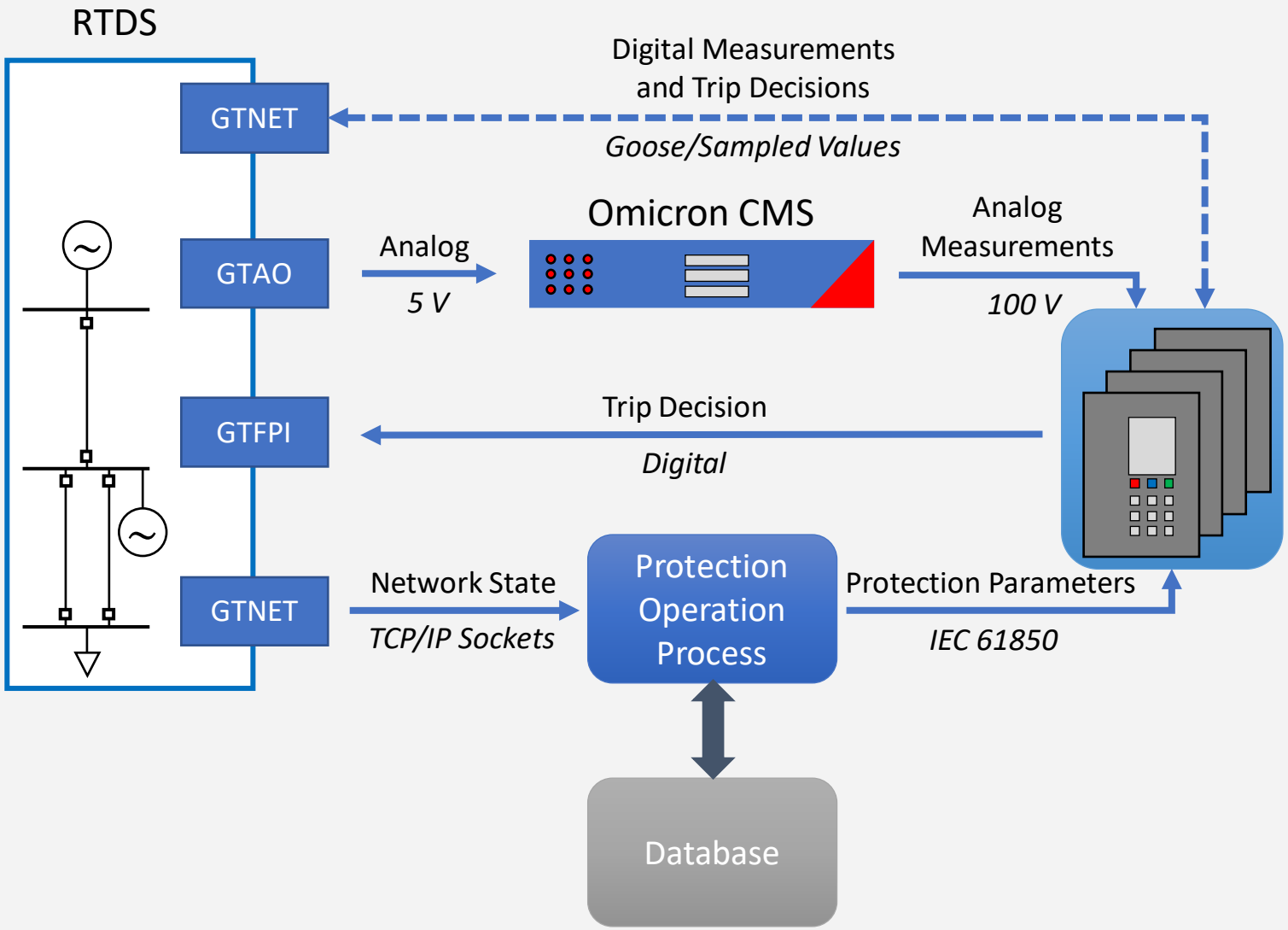
Network State Supervision

Analog CHiL

IMPLEMENTATION

Setup

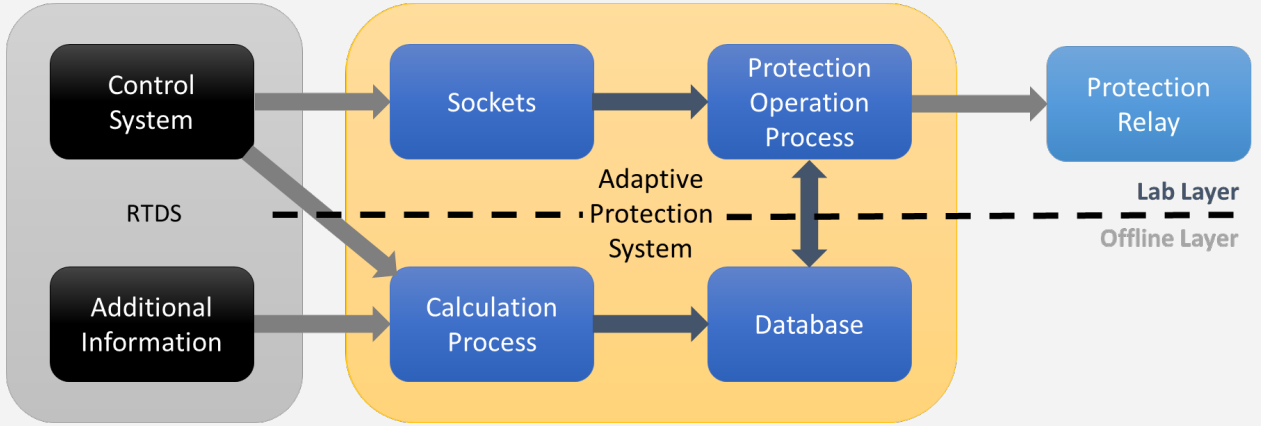
Testing with a real-time simulation as hardware-in-the-loop



CONCLUSION

Design Revisited

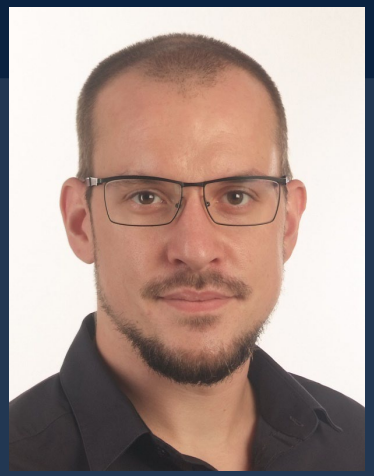
- Creating a prototype
- HIL-Tests with RTDS-Environment
- Validation of Protection Results



VeN²uS
Vernetzte Netzschutzsysteme

Integration in Substation: 3rd & 4th Quarter of 2023

VeN²uS
Vernetzte Netzschutzsysteme



VeN²uS Homepage

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