The projects CONNECTA-2 and Safe4RAIL-2 have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 826098 (CONNECTA-2) and No. 826073 (Safe4RAIL-2) respectively. The information and views set out in this document are those of the author(s) and do not necessarily reflect the official opinion of Shift2Rail Joint Undertaking. The JU does not guarantee the accuracy of the data included in this article. Neither the JU nor any person acting on the JU's behalf may be held responsible for the use which may be made of the information contained therein.

CONtributing to Shift2Rail's NExt generation of high Capable and safe TCMS. Phase 2

SAFE architecture for Robust distributed Application Integration in roLling Stock 2

Mid-Term Conference – Demonstrator

Christoph Müller, christoph.mueller7@de.bosch.com

21/01/2020

Agenda

1. Introduction demonstrator
2. Demonstrator: Time Synchronization
3. Application Profile, TCMS-HVAC
4. Modeling and Implementation
5. Demonstrator: AUTOSAR Adaptive App via TRDP
6. Demonstrator: AUTOSAR Adaptive App via OPC UA
7. Conclusion & Next Steps

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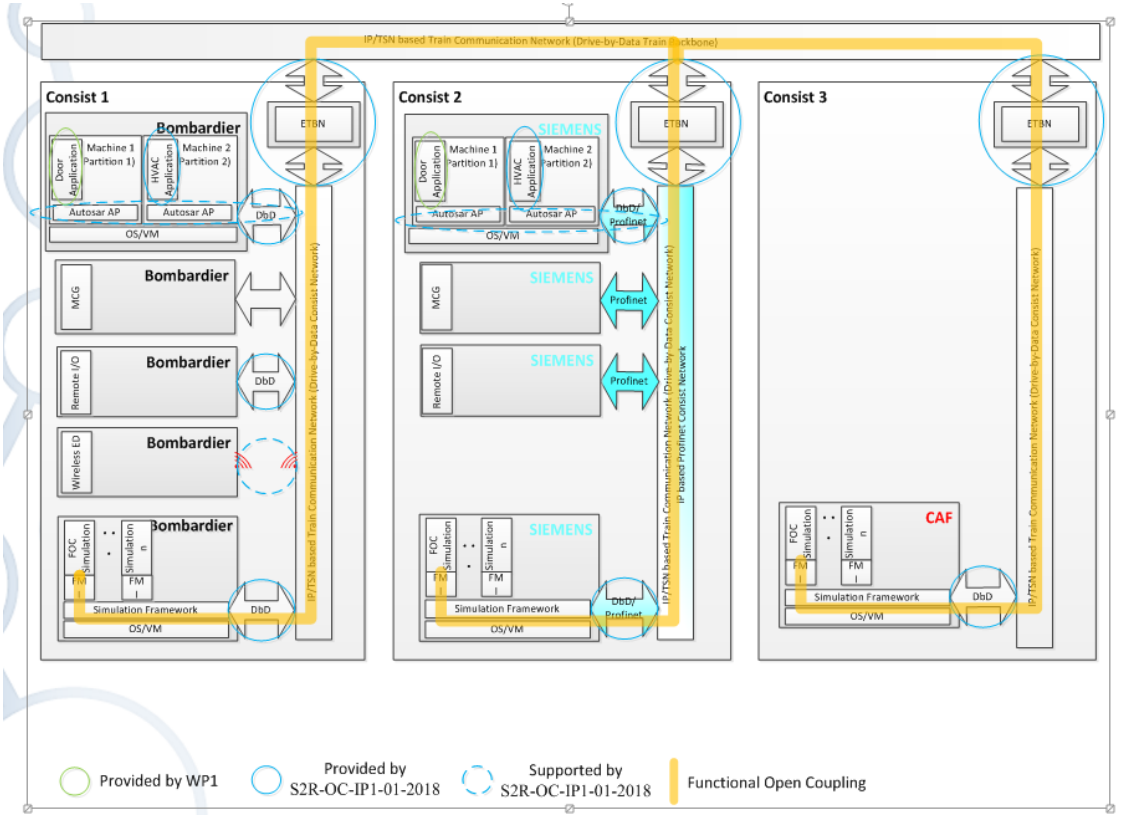
1. Introduction demonstrator



Schematics for Demonstrator

- Compatibility between consist of different manufacturer
- TSN Network[1] for Realtime
- One Development for Application Software
- Support of TRDP[2] and OPC UA[3]

[1] Time Sensitive Network
[2] Train Realtime Data Protocol
[3] Open Platform Communication/ Unified Architecture

General Goals for Demonstrator

1. Introduction demonstrator

Main Topics

- TSN Network
- Application Profiles
- Integration Platform, Environment, Development Tools
- TRDP and OPC UA

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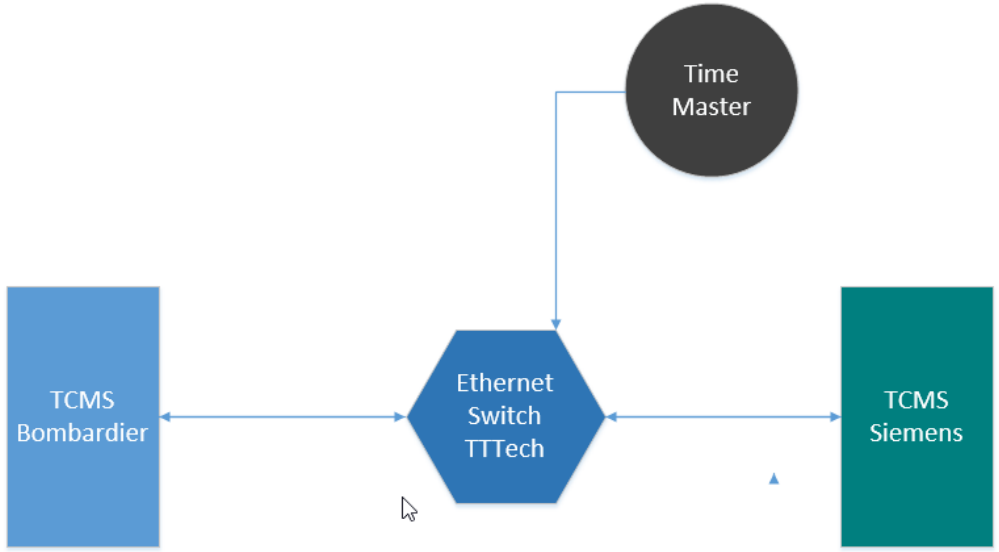
2. Demonstrator: Time Synchronization

Overview



Description

- Sync over Ethernet as Basis
- PTP according to IEEE 1588/802.1AS_rev
- At least one Time Master
- TSN capable Hardware

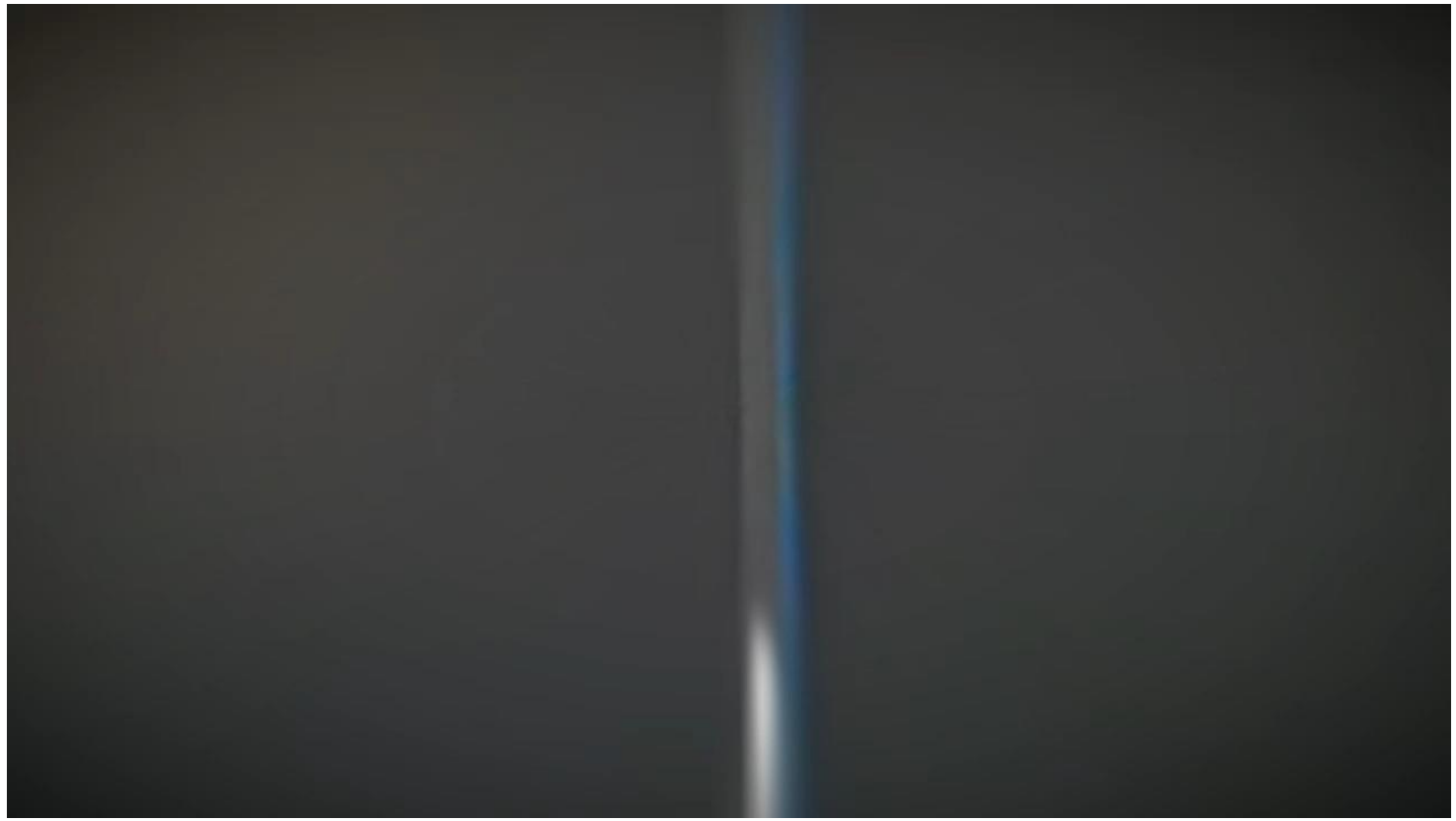
Schematics Demonstrator

Contents

2. Demonstrator: Time Synchronization

Part I: Time Synchronization

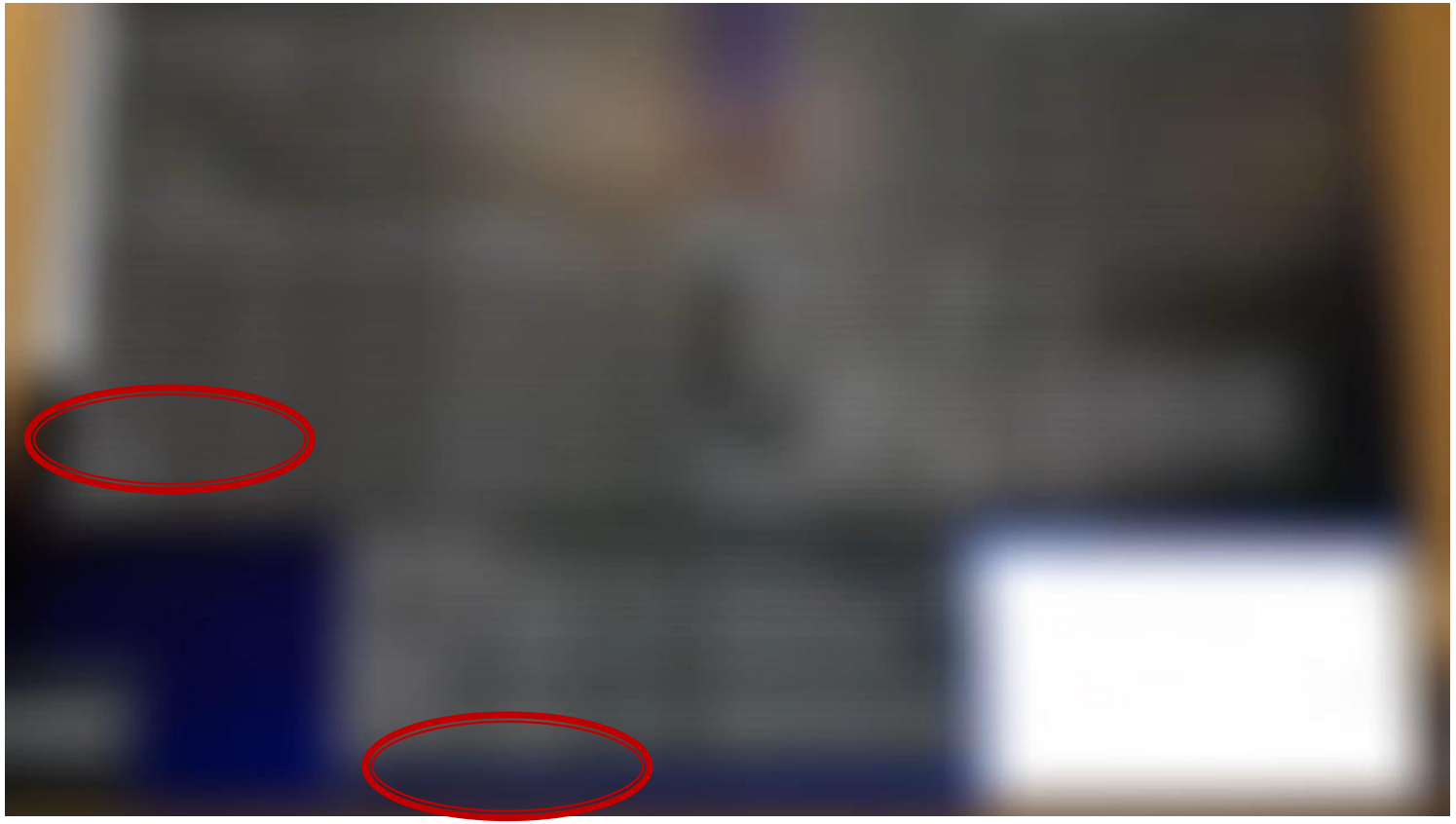
- Unsychronized Time Slave
- Detecting foreign Time Master
- Unsychronized
- Initialization
- Synchronized (Time changed)



2. Demonstrator: Time Synchronization

Part II: Time in App

- SOME/IP[1] communication
- Service Provider sending Data
- Subsriber receiving Data
- Both are synchronized
- Time information can be used



[1] Scalable Service-Oriented Middleware over IP

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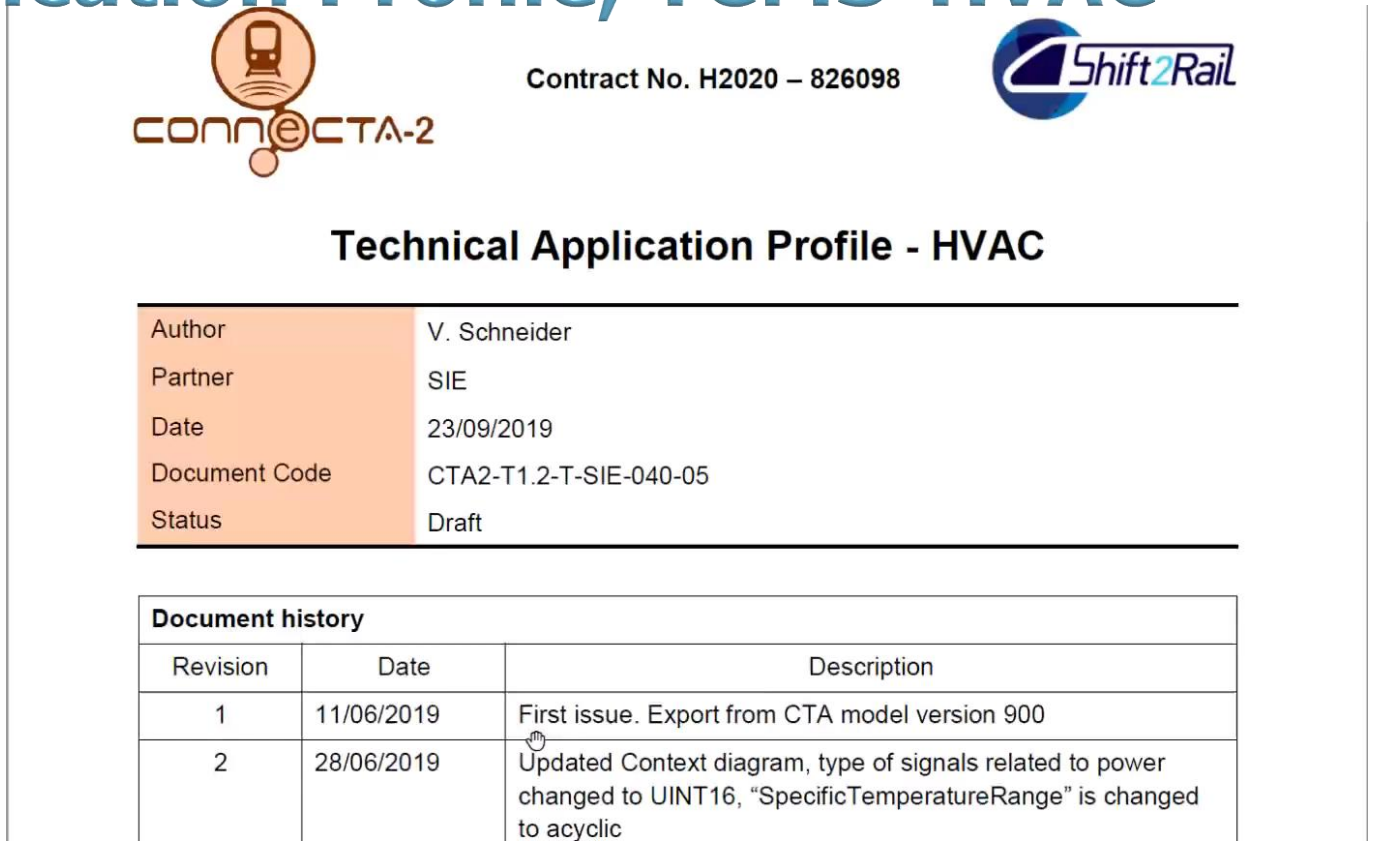
3. Introduction to Application Profile, TCMS-HVAC

- Application Profile for HVAC[1]
- SysML[2] Model for TCMS[3] and HVAC (in general)
- Interface Block Overview

[1] Heating, Ventilation, Air-conditioning Control
[2] System Modelling Language
[3] Train Control and Monitoring System



Contract No. H2020 – 826098

Technical Application Profile - HVAC

Author	V. Schneider
Partner	SIE
Date	23/09/2019
Document Code	CTA2-T1.2-T-SIE-040-05
Status	Draft

Document history

Revision	Date	Description
1	11/06/2019	First issue. Export from CTA model version 900
2	28/06/2019	Updated Context diagram, type of signals related to power changed to UINT16, "SpecificTemperatureRange" is changed to acyclic

Overview

Application Profile

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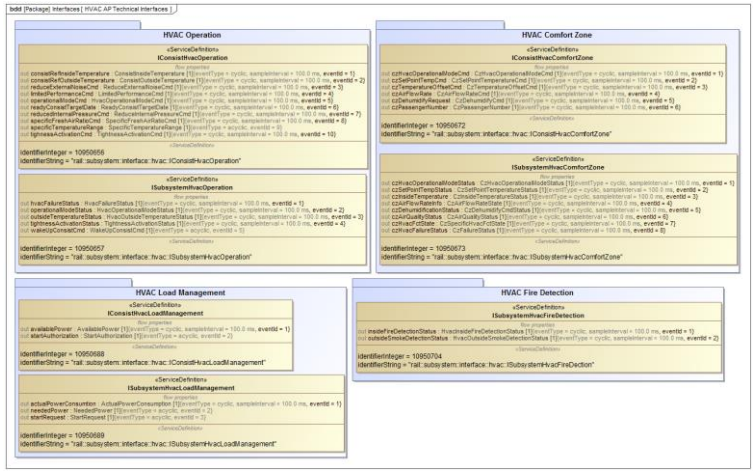
4. Modeling and Implementation

From SysML model to Interface Implementation



Application Profile for HVAC

AUTOSAR Adaptive Platform-based DataTypes Generator

CAF Proprietary Tool based on Integrity

Implementations for AUTOSAR based FDF - APIs: Skeletons & Proxies

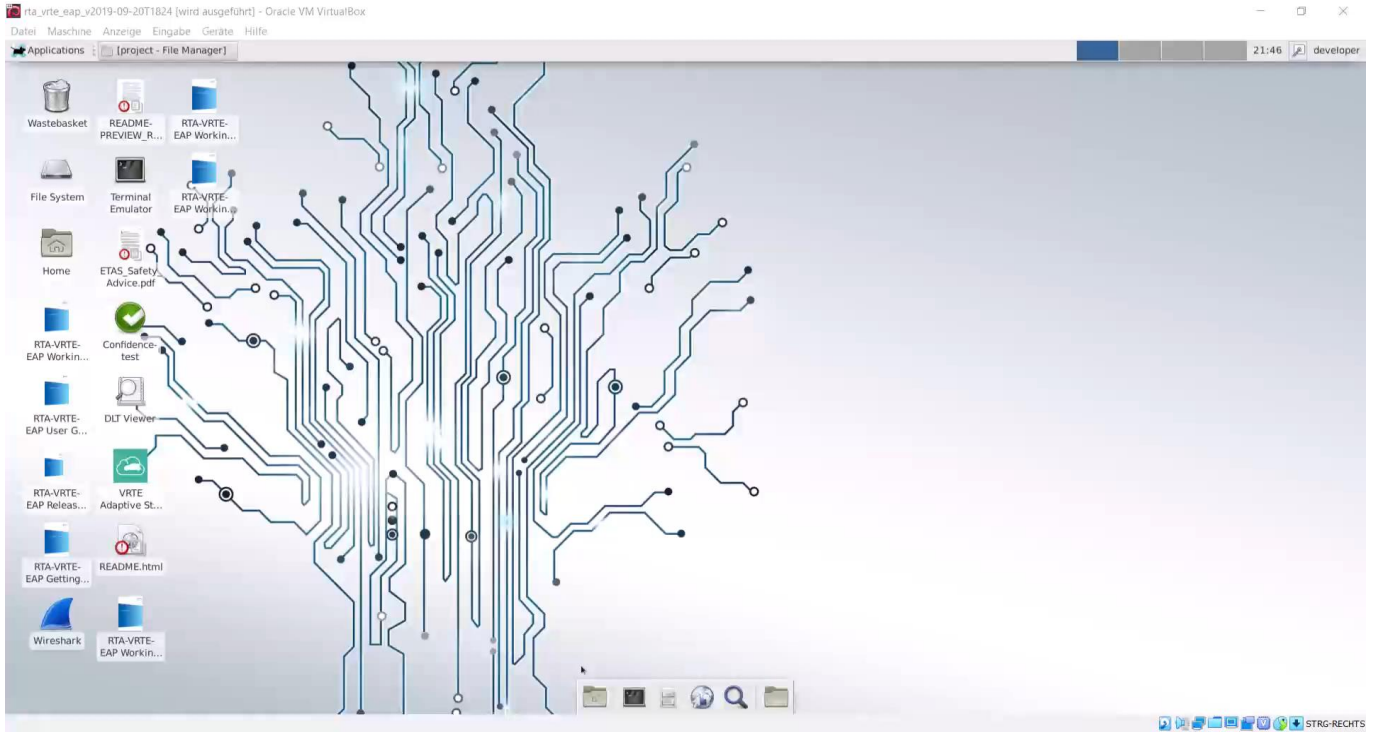
Data Structures for Application Profile DataTypes

- impl_type_adjustmenttemperature.h
- impl_type_airflowratecmd.h
- impl_type_comfortzonefailure.h
- impl_type_consistinsidetemperature.h
- impl_type_czdehumidifycmd.h
- impl_type_czdehumidifycmdstatus.h
- impl_type_czhvacoperationalmodestatus.h
- impl_type_czinsidetemperature.h
- impl_type_czsetpointtemperature.h
- impl_type_datetime.h
- impl_type_hvacfailurekind.h
- impl_type_hvacfiredetection.h
- impl_type_hvacoperationalmodestatus.h
- impl_type_hvacoutsidesmokedetection.h
- impl_type_limitedperformancecmd.h
- impl_type_neededpower.h
- impl_type_reduceinternalpressurecmd.h
- impl_type_specificfreshairratio.h
- impl_type_startauthorization.h
- impl_type_startrequest.h
- impl_type_targettemperaturecheck.h
- impl_type_tightnessactivationcmd.h

Implementation of data structures required by Integrity based FDF

4. Modeling and Implementation

- AUTOSAR Adaptive IDE (RTA-VRTE by ETAS)
- AUTOSAR Adaptive Apps
  - HVAC
  - TCMS
- Service Oriented Communication

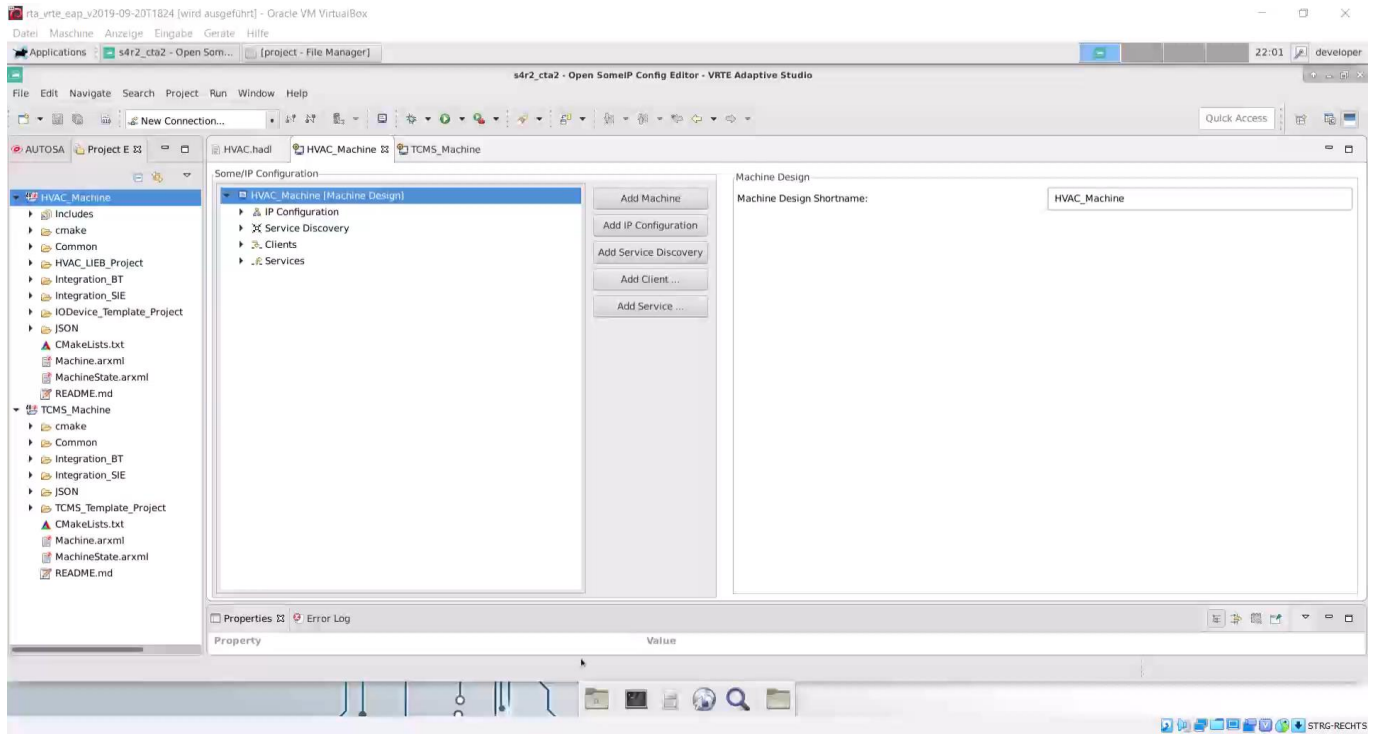


Overview

Modeling AR Adaptive Applications

4. Modeling and Implementation

- HVAC deployed to run on an AUTOSAR Adaptive Machine
- TCMS deployed to run on an AUTOSAR Adaptive Machine
- TCMS offers service `IConsistHvacLoadManagement` and HVAC subscribes to service



Overview

Deployment in Machines

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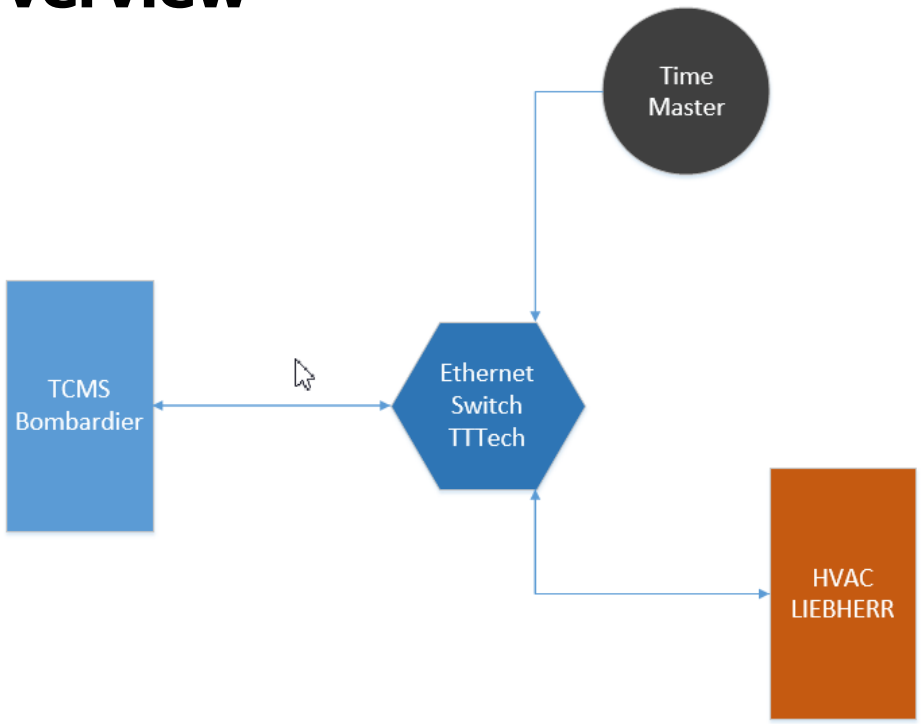
5. Demonstrator: AUTOSAR Adaptive App via TRDP

Overview



Description

- TCMS Application
- HVAC Application
- Service Publisher & Subscriber
- Communication via TRDP

Schematics Demonstrator

Contents

5. Demonstrator: AUTOSAR Adaptive App via TRDP

AUTOSAR Adaptive & TRDP

- Starting of Machines
- Deployment of Applications
- Searching & Binding of Services
- Communication via TRDP
- Trace

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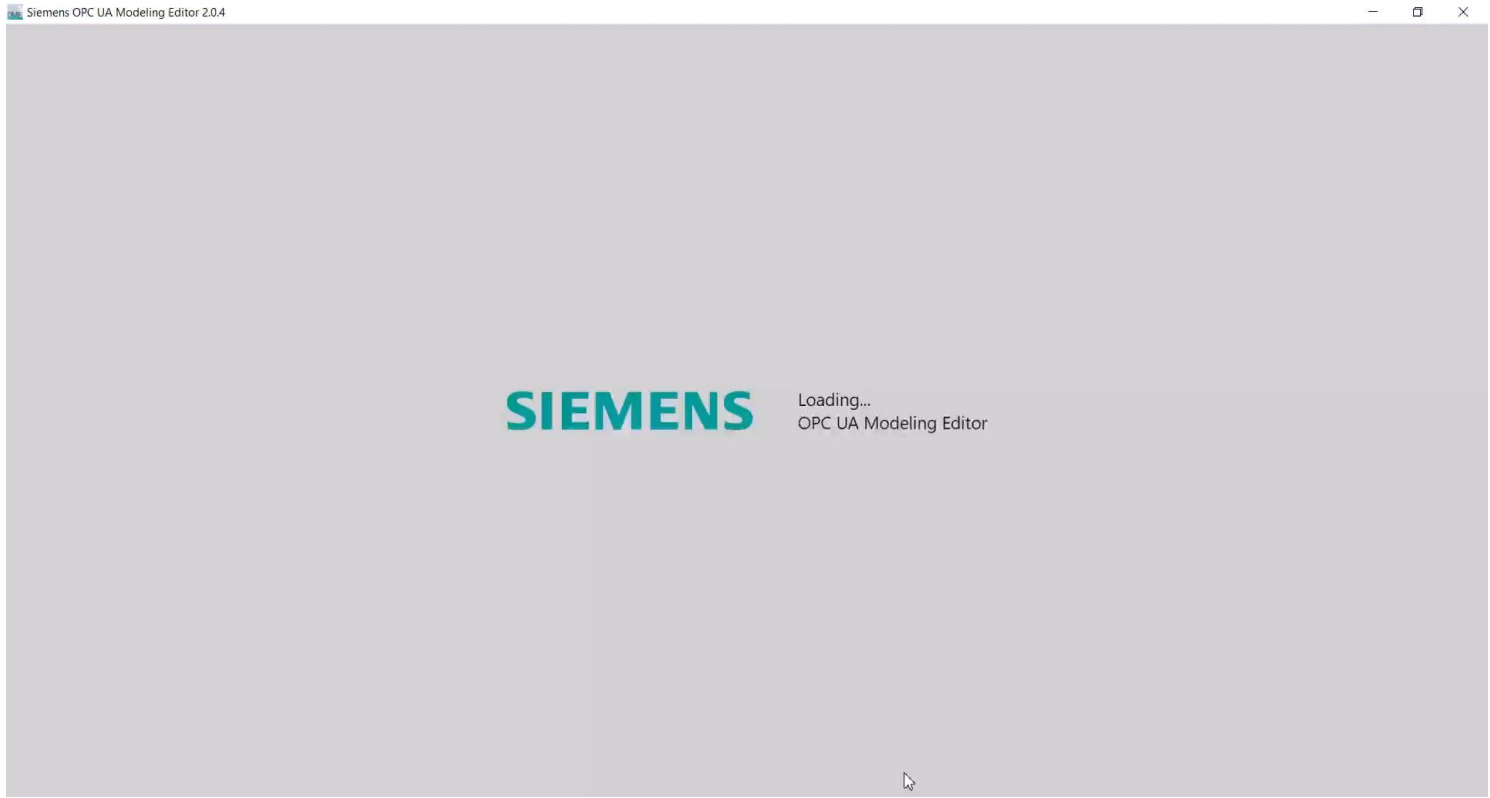
6. Demonstrator: AUTOSAR Adaptive App via OPC UA

Development in OPC UA

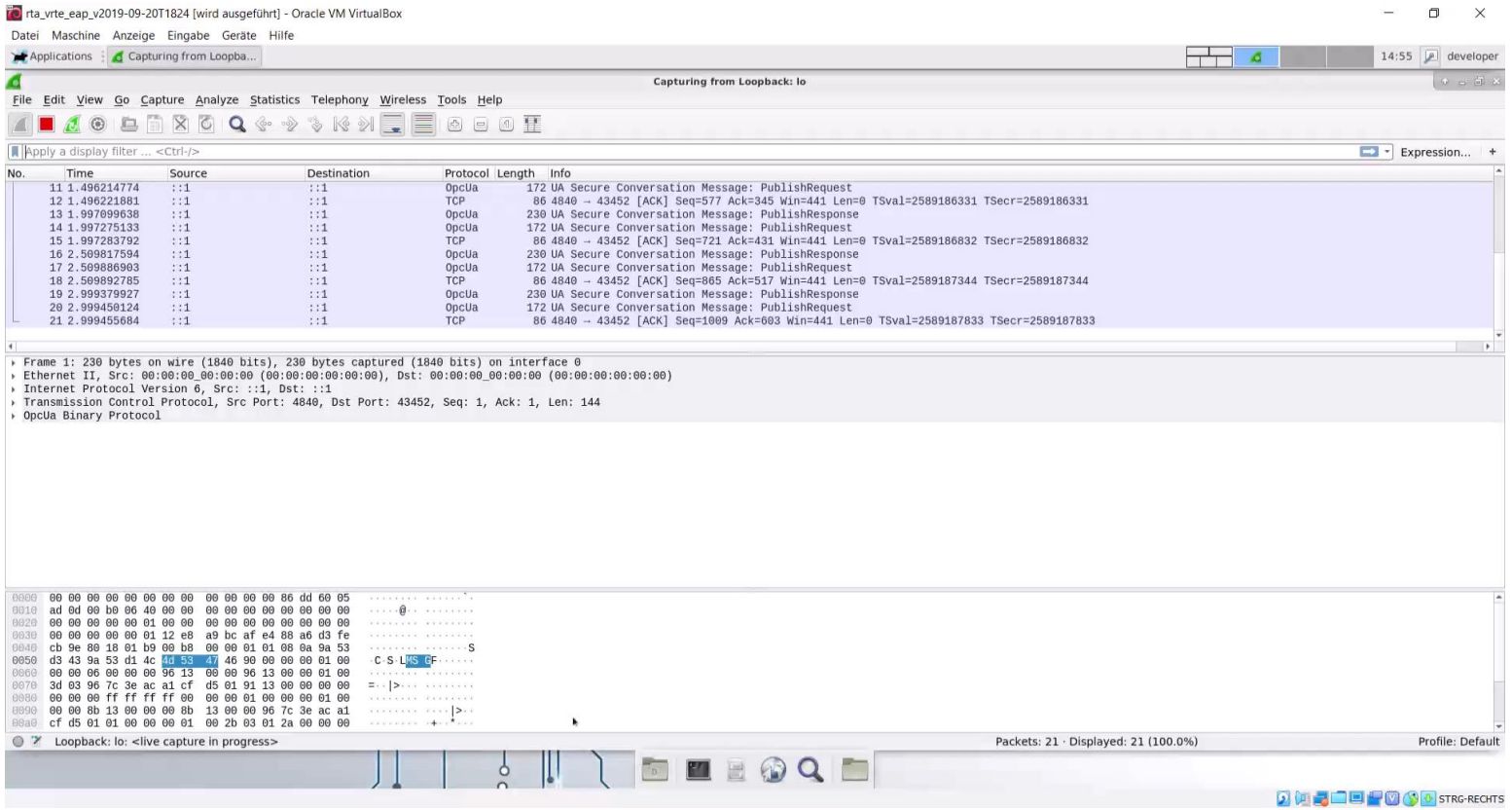
- OPC UA Modeling Editor
- AUTOSAR Adaptive & OPC UA
- Service Oriented Communication



6. Demonstrator: AUTOSAR Adaptive App via OPC UA

AUTOSAR Adaptive & OPC UA

- Publish Response
- Publish Request
- Communication via OPC UA
- Trace



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Implemented

- Hardware Setup defined and Base Functionality working ✓
- Definition of Operating System, Adaptions and first Tests ✓
- Integration of TRDP and OPC UA into AUTOSAR Adaptive ✓
- TCMS and HVAC Demo Application is running ✓

7. Conclusion & Next Steps

Next Steps

- Combine TRDP and OPC UA Communication
- Add and use further TSN features
- Common Service Registry, if needed
- Put together all Parts of the Demonstrator for the Innotrans
- …

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