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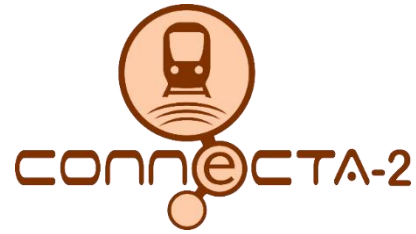

CONtributing to Shift2Rail's NExt generation of high Capable and safe TCMS. Phase 2

SAFE architecture for Robust distributed Application Integration in roLling Stock 2

Urban Demonstrator & SF

Imanol de Arriba, CAF

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Technical Seminar on Advanced Architectures and Components for Next-Generation TCMS

January 21st 2020, Brussels

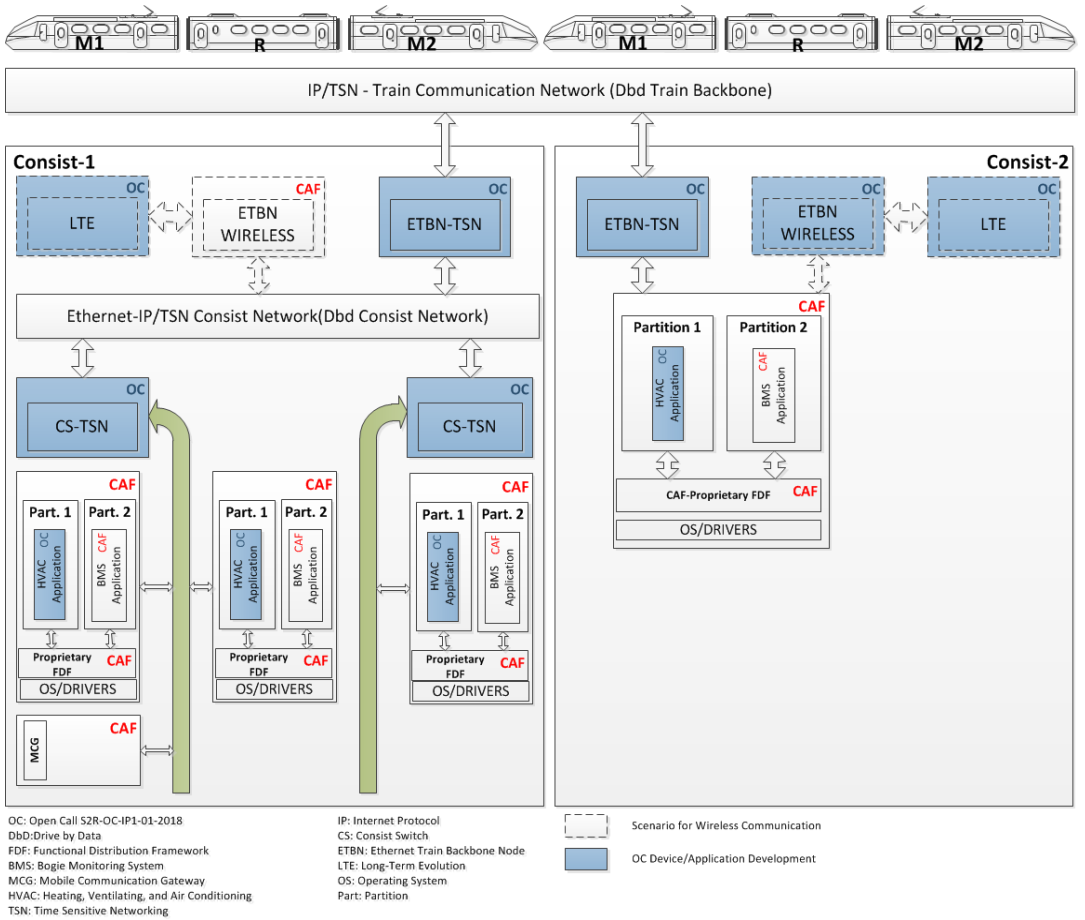
Outline

- **Introduction**
- **Urban Train General Description**
- **Urban Demonstrator Functional Architecture**
- **TSN Communication Network**
- **Simulation Framework Architecture**

Introduction

Urban Demonstrator (overview)

- Laboratory demonstrator for the **proof-of-concept demonstration of innovative technologies:**
  - Wireless TCMS (WLTB and T2G)
  - Drive-by-Data
  - Application Profiles & Functional Distribution Framework
  - Simulation Framework
- Composed of two coupled consists



Urban Train General Description

Urban Train General Description

TECHNOLOGIES SPECIFICATION

LABORATORY DEMONSTRATION

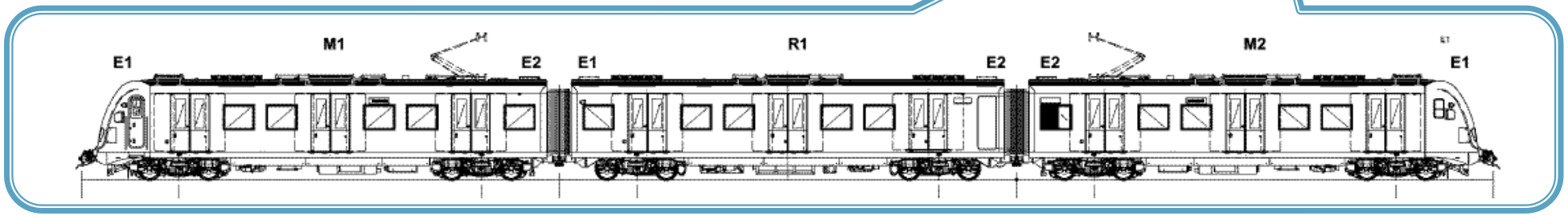
CONNECTA-1

CONNECTA-2

CONNECTA-3

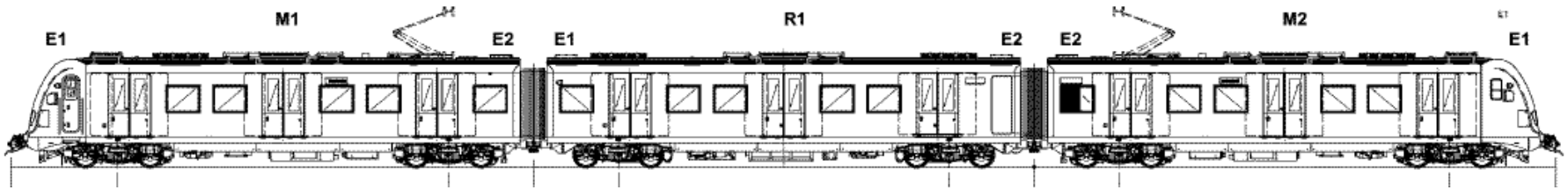
Sept 2016 — Sept 2018 — Oct 2018 — NOW — Mar 2021 — Dec 2020 — Dec 2022

Near future



Urban Train General Description

- The **urban laboratory demonstrator (not real train)** is based on:
  - EMU of 3 cars: 2 motor cars (M1 & M2) and a trailer car (R1)



- Each motor car has its own traction equipment: Traction Control Unit (TCU)
- Each car rests on two bogies: Bogie Monitoring System (BMS)
- 3 sliding passenger access doors per side on each car: Doors Control Unit (DCU)
- A Brake Control Unit (BCU) per car
- 5 Heating, Ventilation and Air Conditioning (HVAC) units
- A Central Control Unit (CCU) in each cabin (redundant TCMS control)

Urban Demonstrator Functional Architecture

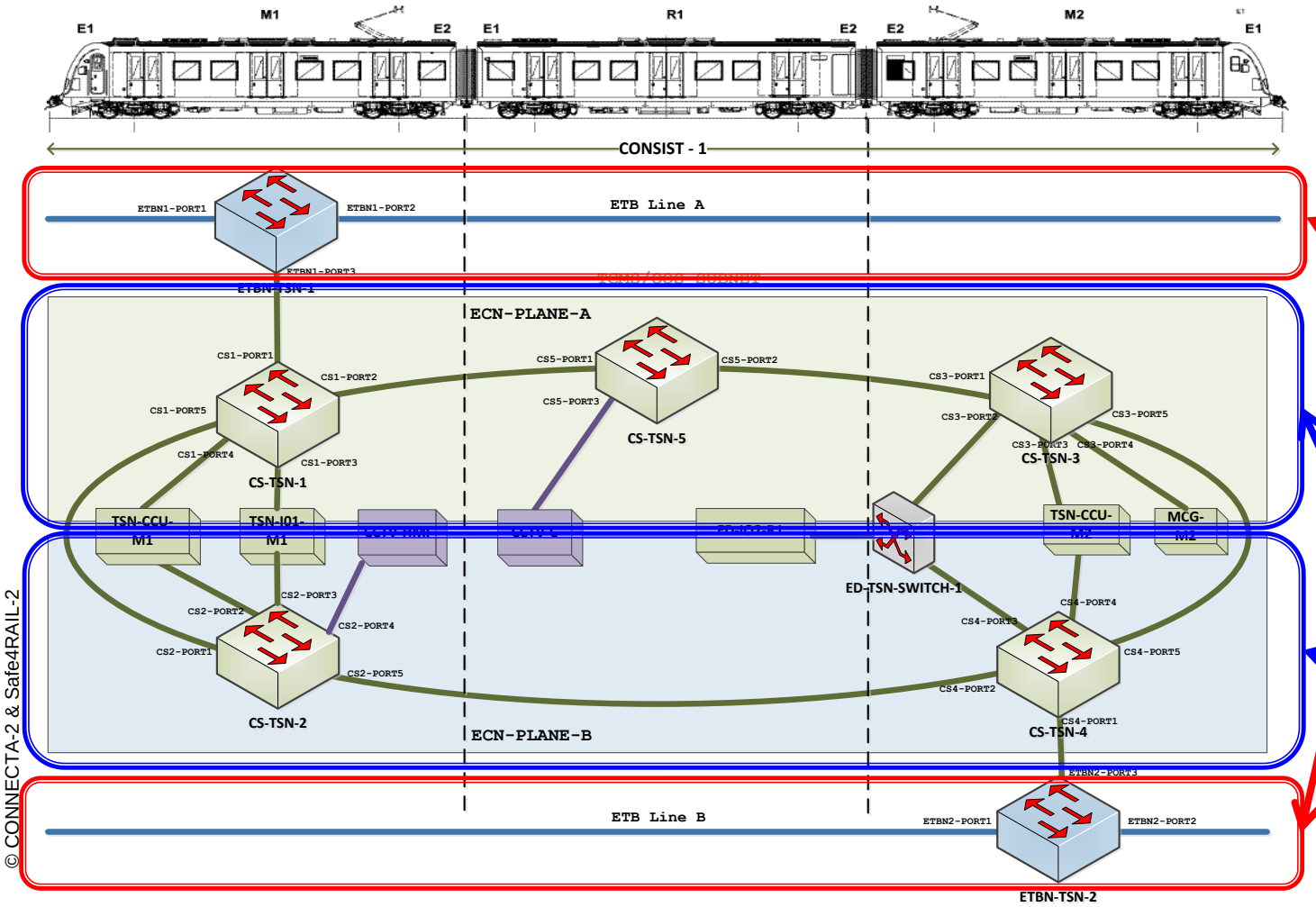
Urban Demonstrator Functional Architecture

- **Physical architecture:**
  - Only the functional architecture related to **HVAC and BMS functionalities** shall run on top of **CAF-FDF**:
    - Including TCMS logic and HVAC/BMS subsystem control logic
    - Functional interfaces between TCMS and HVAC/BMS subsystem: **Application Profiles**
  - This logical architecture will be allocated to physical end devices at consist level

- **Simulated architecture:**
  - The train control logic corresponding to the remaining subsystems will be simulated in the **Simulation Host**

TSN Communication Network

TSN Communication Network



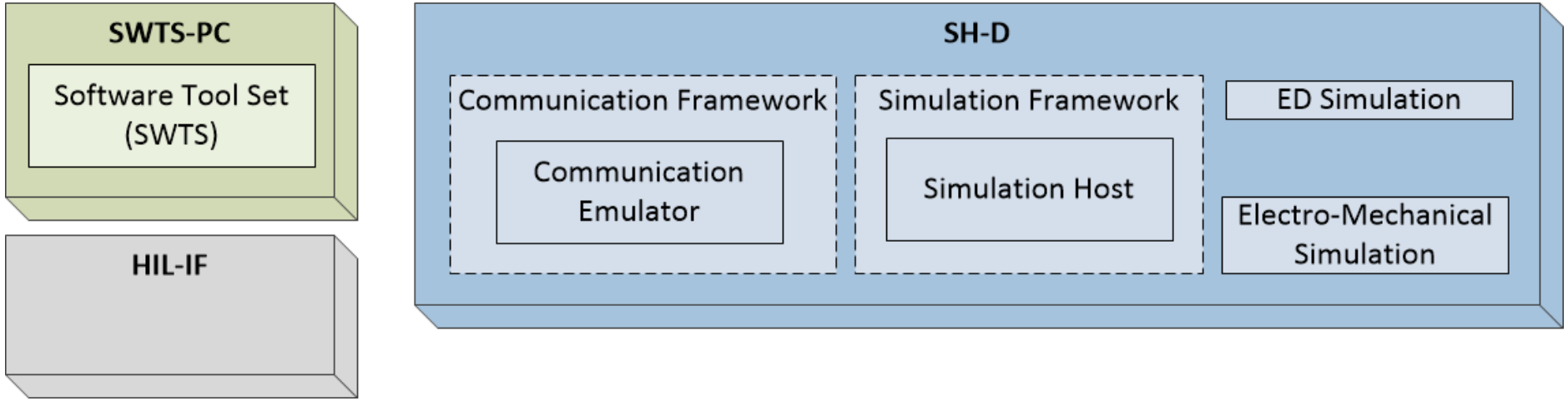
ETB network:
- 2 separated ETB lines, 2 ETBNs per consist
- Critical traffic: transmitted on both ETB lines (redundancy scheme)
- Non-critical traffic: transmitted on the 'active' line

ECN network (ring topology):
- 2 separated logical planes (each one connected to each ETB line)
- Critical traffic: transmitted on both planes (redundancy scheme)
- Non-critical traffic: only transmitted on the plane of the 'active' ETBN

Simulation Framework Architecture

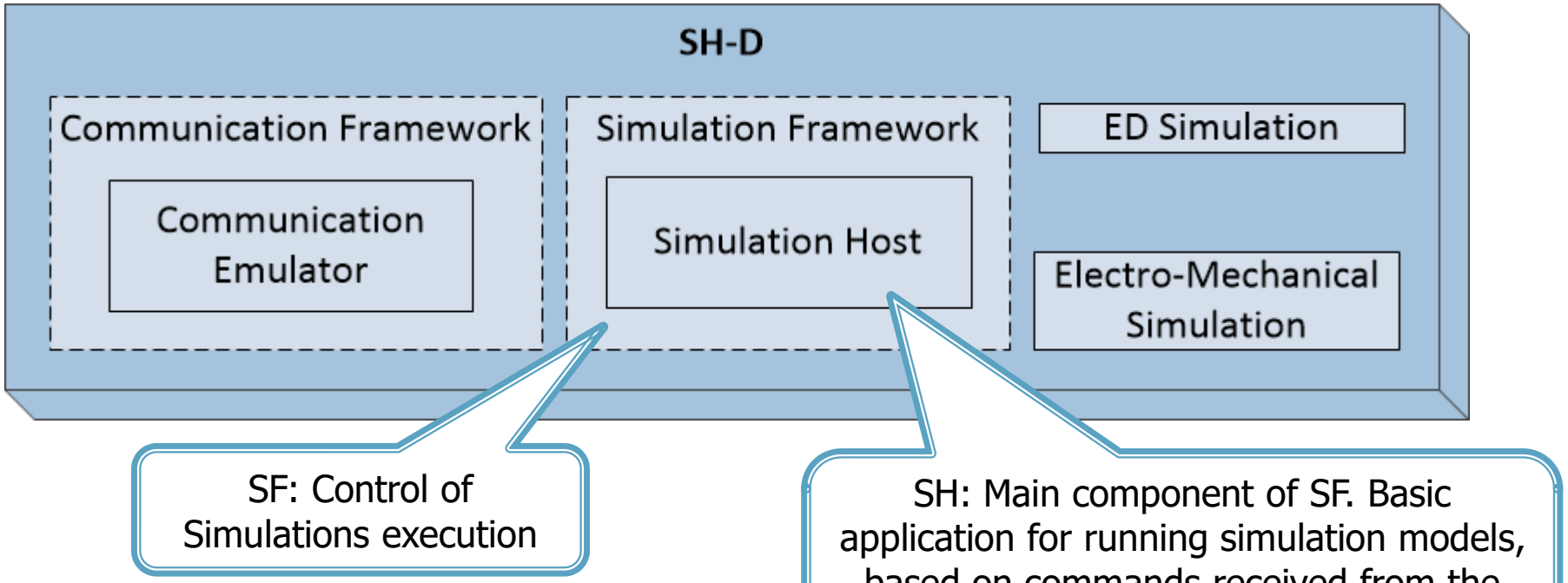
Simulation Framework Architecture

- **Simulation and Virtualisation Framework (SVF):**
  - Set of tools used for Train Virtualisation, Simulation and Communications Emulation
  - Ability to test TCMS in a virtualised environment
  - All train subsystems can be simulated
  - Allows remote testing, including **Hardware in-the-Loop**



Simulation Framework Architecture

- Physical devices / Software components:
  1. **Simulation Host Device (SH-D)**: Equipment where Simulations are executed, and where Simulation Framework and Communication Framework software components are installed



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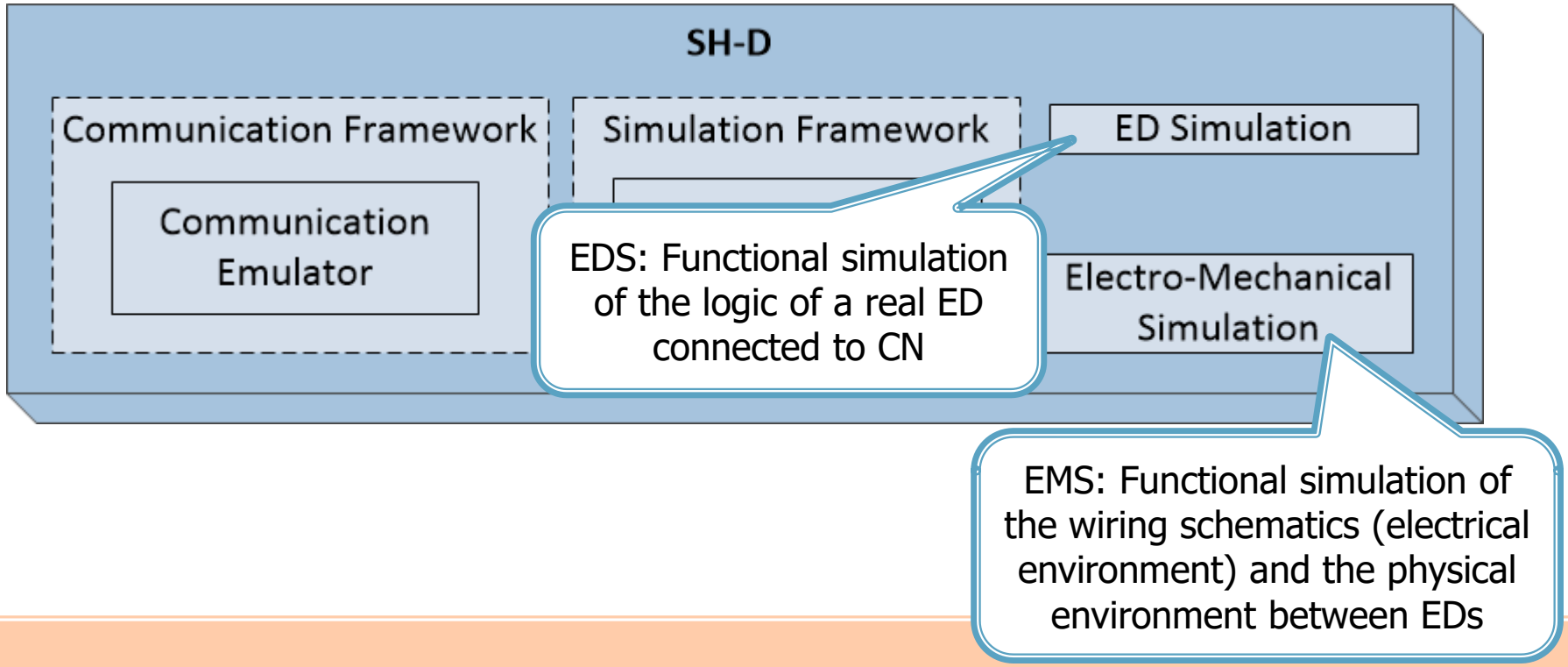

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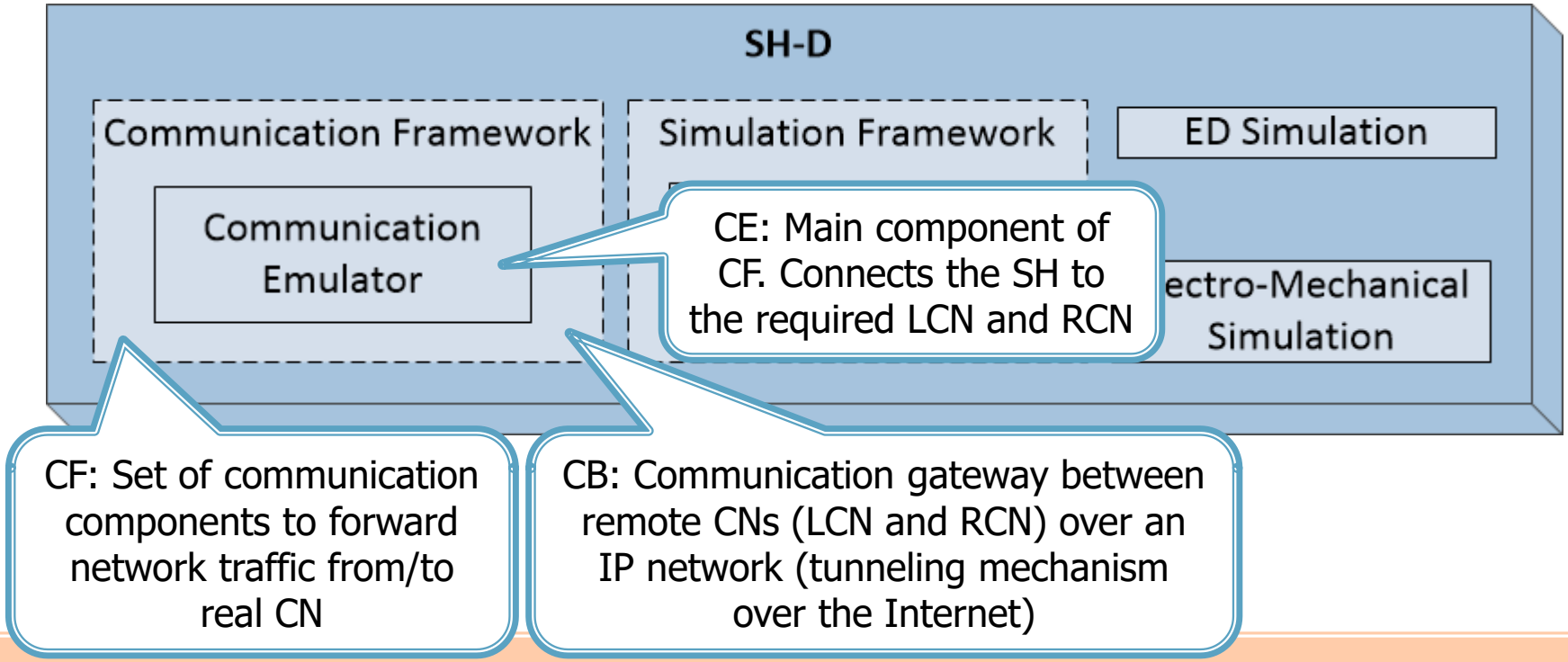
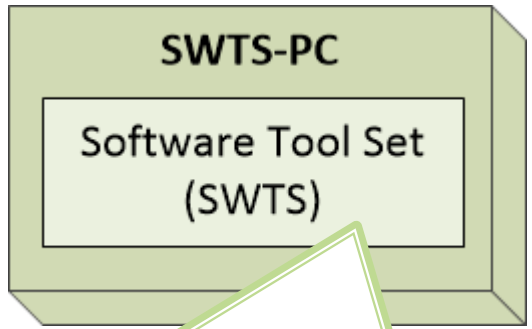


Simulation Framework Architecture

- Physical devices / Software components:
  2. **Software Tool Set-PC (SWTS-PC)**: Personal Computer which allows configuring, controlling and executing Simulations and tests
  3. **Hardware-in-the-Loop Interface (HIL-IF)**: Dedicated device providing physical (electrical, mechanical, environmental) inputs and outputs to a real ED (wired electrical interface), in replacement of the real I/O signals of EM environment



SWTS: Set of tools running on the PC of a tester or developer for configuring, controlling and monitoring the components of the Simulation and Virtualisation Framework

Provides electrical analogue inputs to I/O devices related to BMS functionality (accelerometer electrical signal and temperature sensor signals), as well as digital I/O signals

Questions?

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