ITEA 2

INFORMATION TECHNOLOGY FOR EUROPEAN ADVANCEMENT

openETCS

Verification and Validation in openETCS:
Conclusions & Discussion

supported by:

Federal Ministry of Education and Research

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE
MINISTÈRE DE L'ENSEIGNEMENT SUPÉRIEUR ET DE LA RECHERCHE

INVESTISSEMENTS D'AVENIR

Région de Bruxelles-Capitale

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA E INNOVACIÓN

Halfterm Project Review

Marc Behrens, Hardi Hungar

Munich, 14.01.2014

WP 4 Review Schedule

- 17:00 - 17:20 Introduction and Overview of the first VnV Level (Marc Behrens und Hardi Hungar, DLR)
- 17:20 - 17:50 Results Model V&V (Ana Cavalli, Institute Telecom)

  [Video contribution]
  - 17:50 - 18:00 Coffee Break
- 18:00 - 18:10 Results Implementation / Code V&V (Jens Gerlach, Fraunhofer FOKUS)
- 18:10 - 18:30 Process and Safety (Jan Welte, TU BS)
- 18:30 - 18:40 Internal Assessment and Preparation of Workshop in Nuernberg (Hardi Hungar, DLR)
- **18:40 - 19:15 Overall Conclusions & Discussion of Upcomming V&V activities (Marc Behrens & Hardi Hungar, DLR)**

Structure

Challenges

Formalization of

- Test Model
- Test Architecture
- Interface Definition

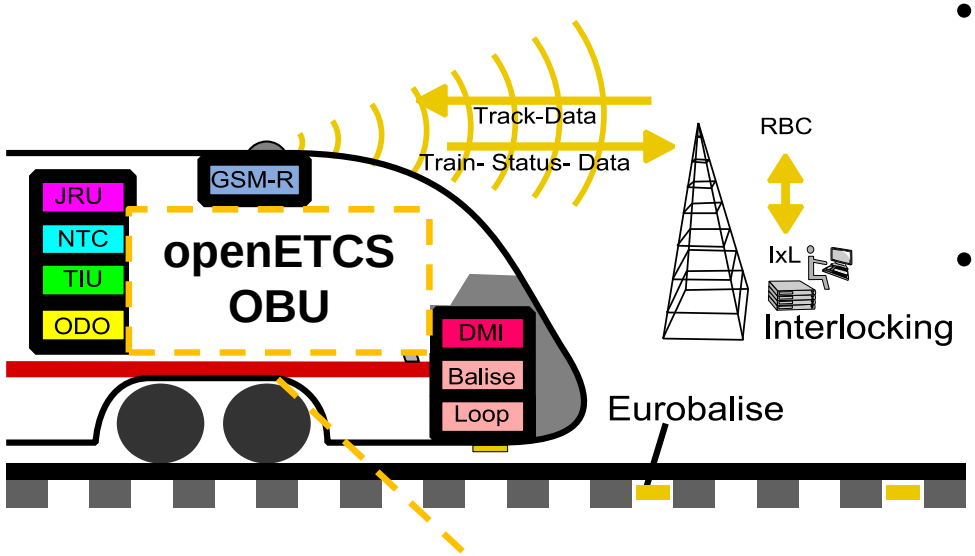
Collaboration within the WP4

Outlook

2nd level VnV

- Steps in Verification
- Steps in Validation
- Executing tests

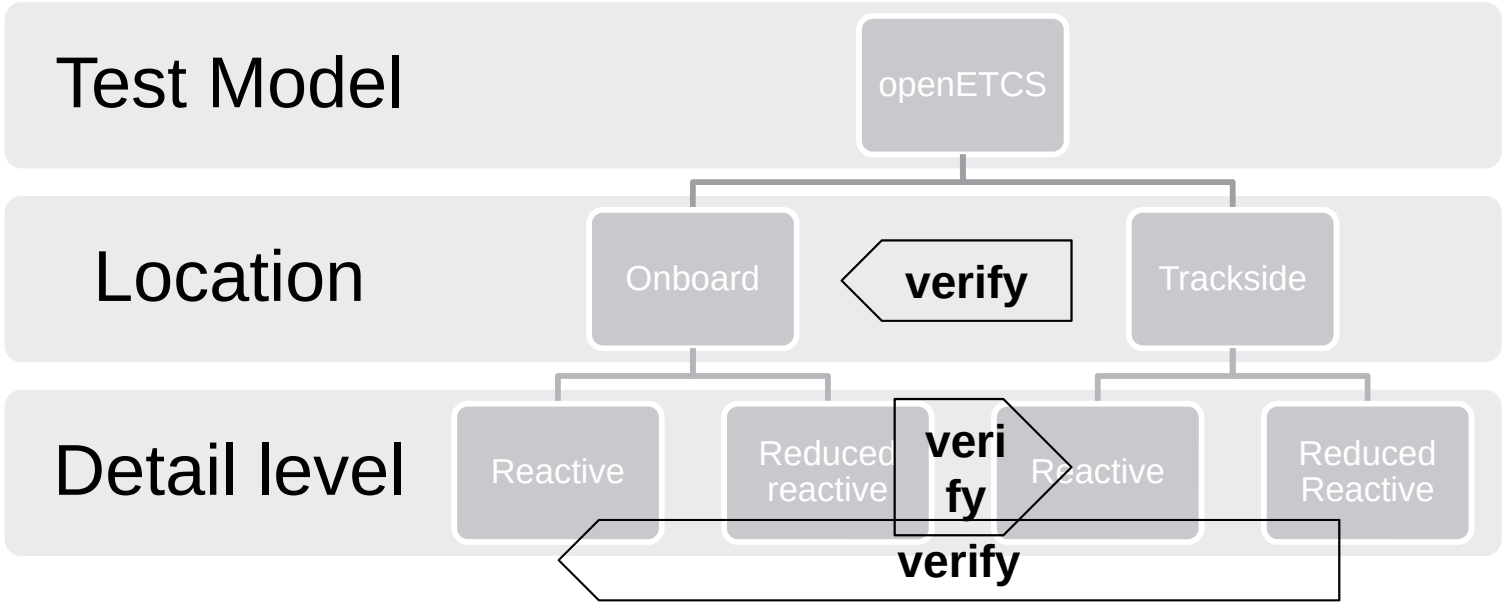
Challenges within complete system:



- **Creating a formal specification of the ETCS OBU functionality → Subset 026**
- **Software generated from the formal specification for purpose:**
  - **laboratory test**
  - **simulation**
  - **reference purposes**

System under Test (SuT)

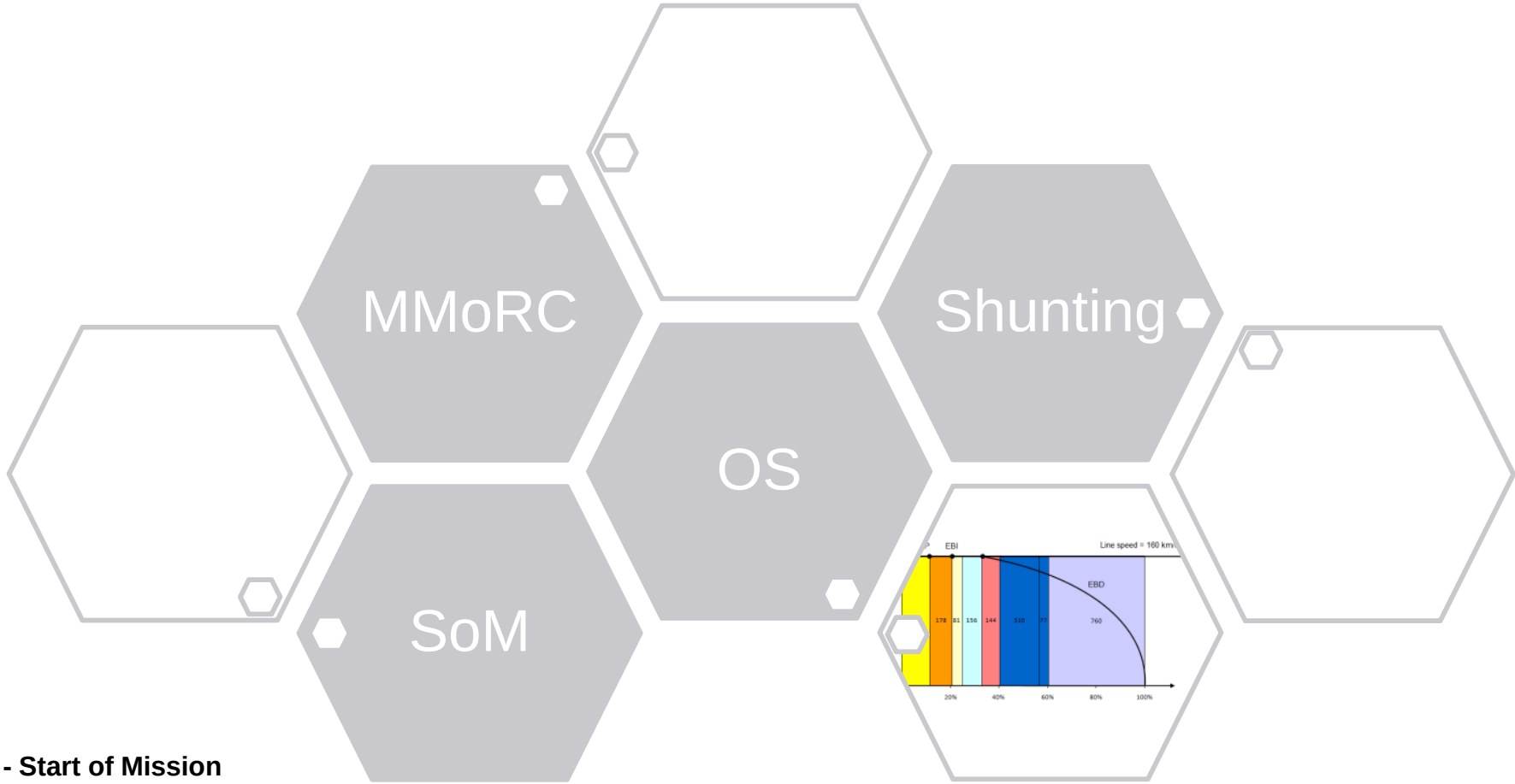
Challenges within complete system:
Reduced Reactive Testmodel



Reduced Reactive Testmodel used to verify the testmodel

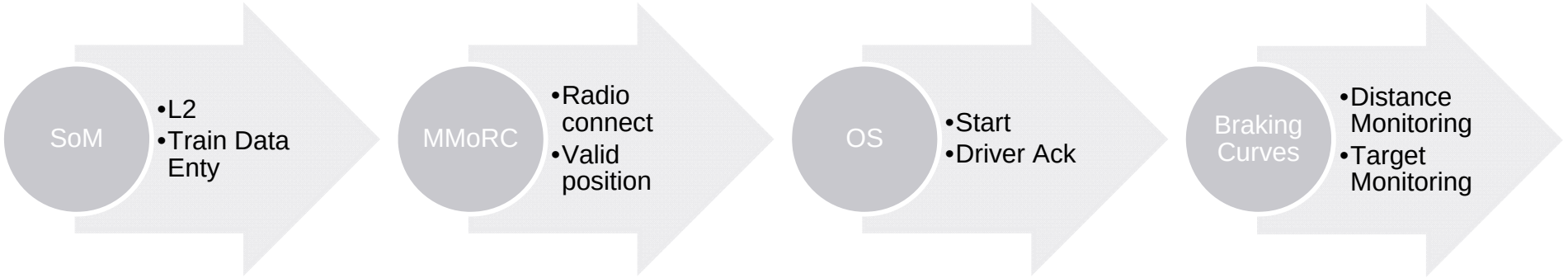
HiL structure is applied to apply reduced reactive test model

Test Model Decomposition: 1st level VnV

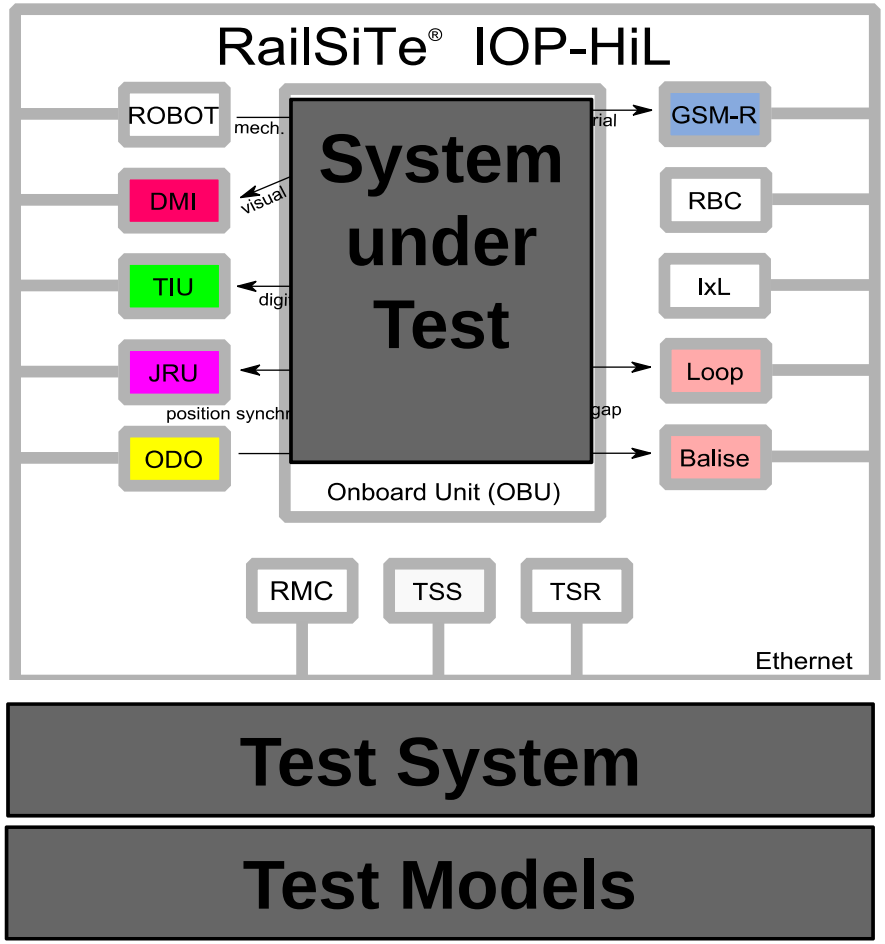


SoM - Start of Mission
MMoRC - Managment of Radio Communication
OS - Procedure OnSight

First scenario merging the current testmodel



Test Architecture Integration



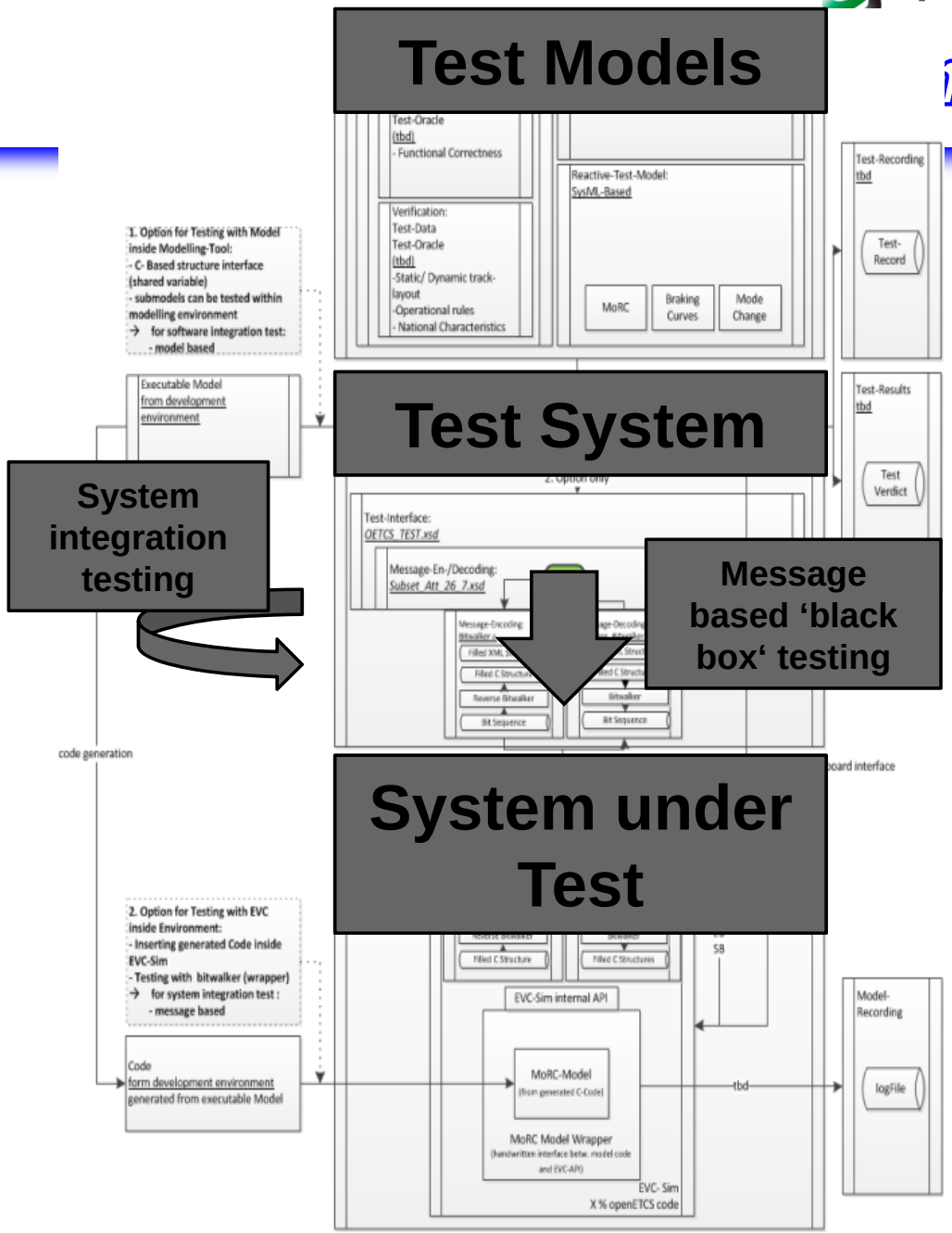
- **Model Based - Extension of our Railway Simulation and Testing Environment (RailSiTe®)**
- **Develop generic tests enabling testing for operational scenarios and harmonizing validation through model verification**

Test Architecture

Model based definition of interfaces according to e.g. SUBSET-094

Human readable formats: SysML, XMI, XML, …

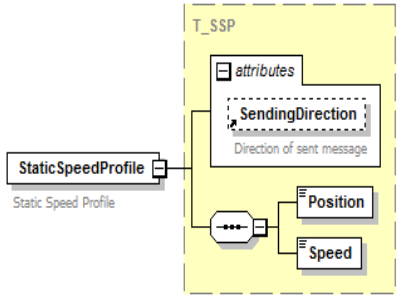
Synchronized Datadictionary modularized system integration test



Model based interface definition

Formalizing testing relevant Subsets of the TSI in

- Type definition
- Variable definition
- Human readable source




```
<xs:complexType name="T_SSP">
 <xs:annotation>
  <xs:documentation>Set of Static Speed Profile Parameters</xs:documentation>
 </xs:annotation>
 <xs:sequence>
  <xs:element name="Position" type="xs:int"/>
  <xs:element name="Speed" type="xs:int"/>
 </xs:sequence>
 <xs:attributeGroup ref="DirectionParaToTrackTe"/>
</xs:complexType>
```

Documentation can be found on github:
https://github.com/openETCS/validation/tree/master/VnVUserStories/VnVUserStoryDLR/05-Work/InterfaceSchema/Documentation

First findings

Verification results to the design model

Specificational questions:

- **Where is the Subset-026 not clear enough to be consistently formalized comparing design-model to test-model?**

- **Specificational questions to be synchronized with operational rules of validation scenarios**

Organization of the VnV Process: 2nd level VnV

Process:

- Weekly Wednesday meeting from 11h00 to 12h30
- Sprints last 4 weeks
- Contribution outside of the deliverables are collected inside user stories which then become part of the next deliverable.

Objectives of 2nd level VnV Process

Objectives:

- **Establish usable method and tool combination**
- **Perform complete verification of specification, model and code fragments**
- **Evaluate further method and tools to improve V&V**
- **Define the quality gate for artifacts?**
  - E.g. Definition of Acceptance Criteria for each type of Objects for Verification:
    - *Specification*
    - *Model*
    - *Code*

Topic: VnV Collaboration

Code Verification

Test- Modelling

- Start of Mission
- Procedure On-Sight
- Braking Curves

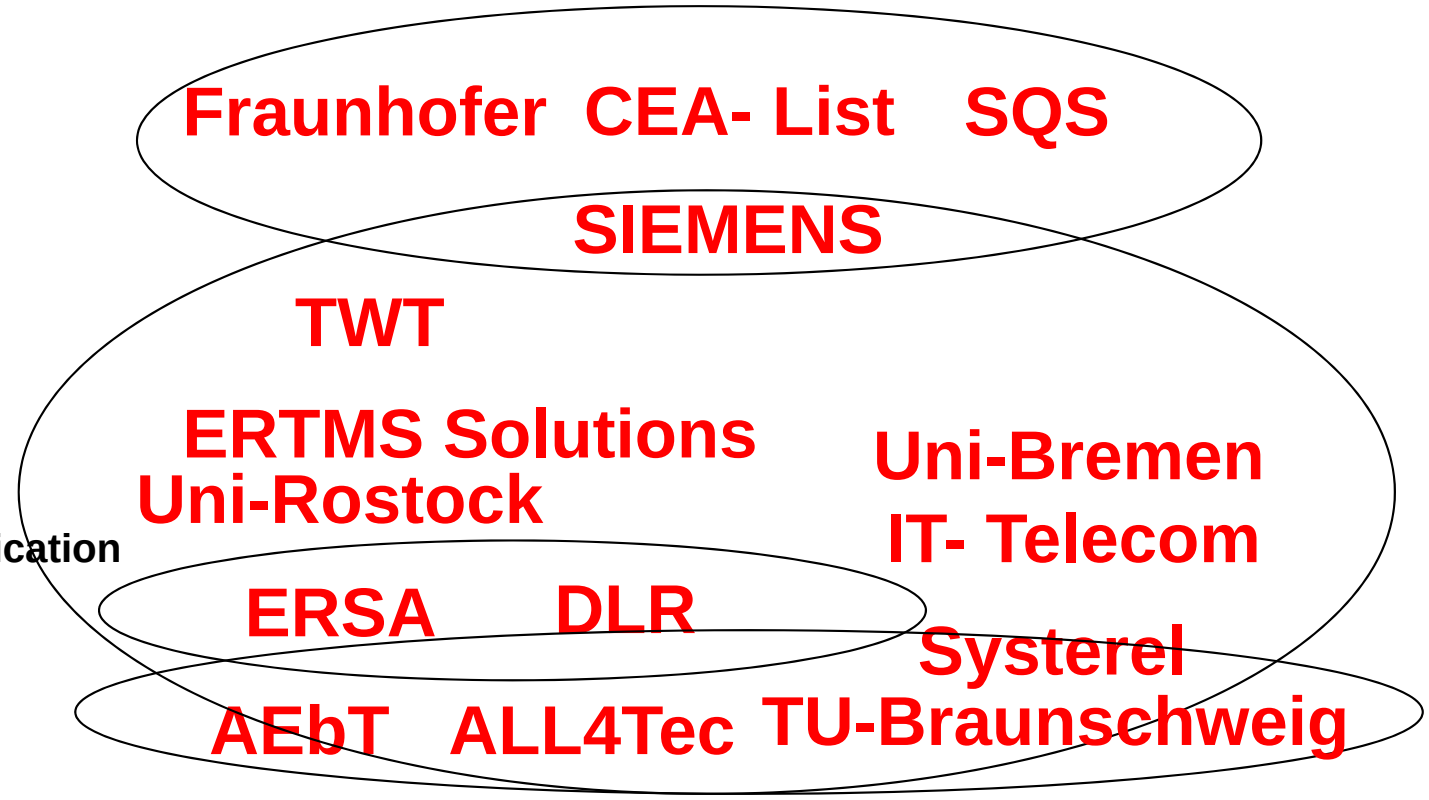
- Management of Radio Communication

Lab-Testing

Safety/ Assessment

Requirements verification ?

Validation ?



How to enhance collaboration/ extend core knowledge?

Outlook

Upcoming activities:

- Finishing the Deliverable 1st VnV Report D4.2
- Refining the VnV plan D4.1 anticipating the outcome of D4.2
- Integrating tools into testlab environment
- Starting Validation
- Setting up a common test model merging the different approaches.
- Processing the findings of the first internal assessment
- Supporting the modelling task with solid verification
- Identification of key partners for the topic
  - *Strengthen collaboration between key partners*

Outlook: Steps in verification

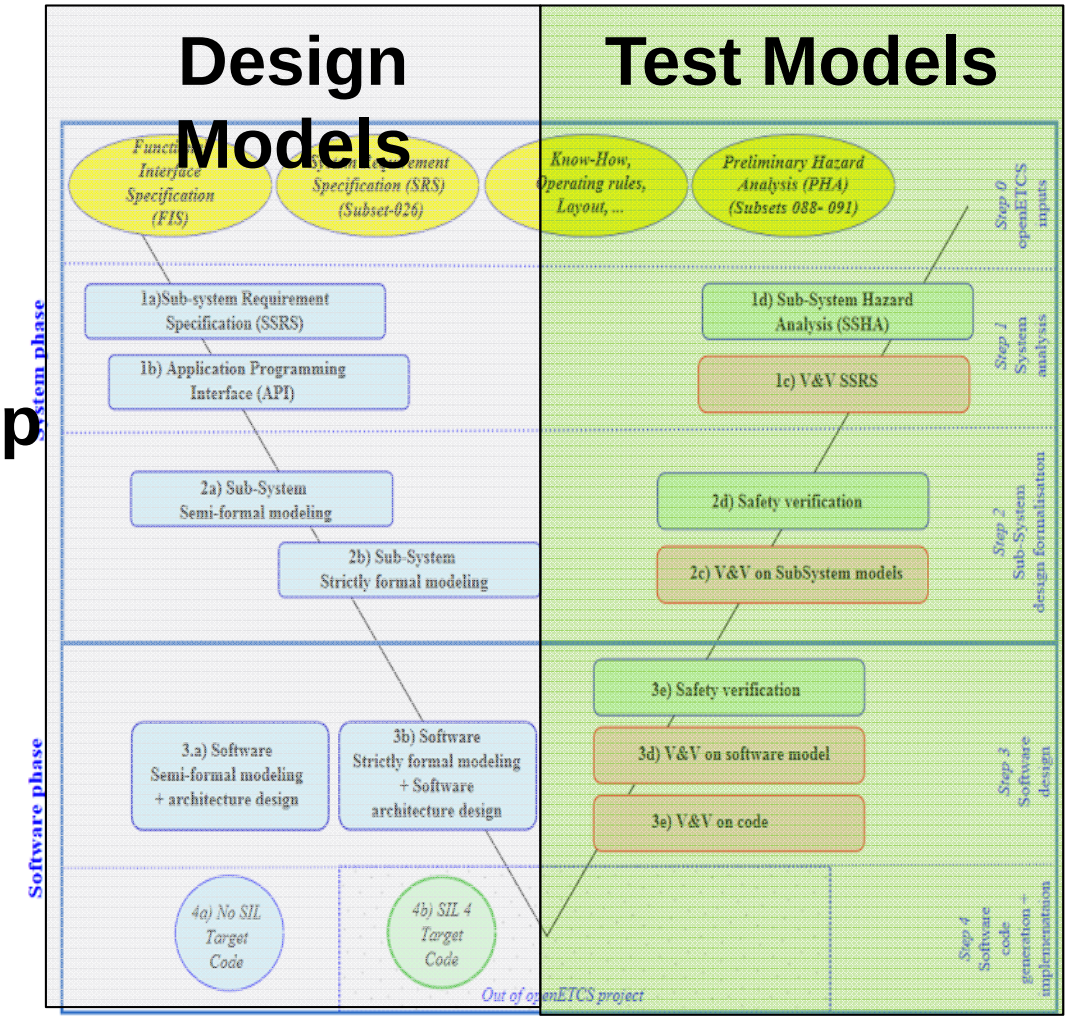
Gain certainty on test models

- Testing: Develop operational reduced reactive test- model of the trackside
- Verify operational reduced reactive test- model of the trackside
- Verify with operational reduced reactive test- model of the onboard
- Develop functional operational counterpart to the reduced reactive test- model → Test Model (WP4)

Outlook: Early verification

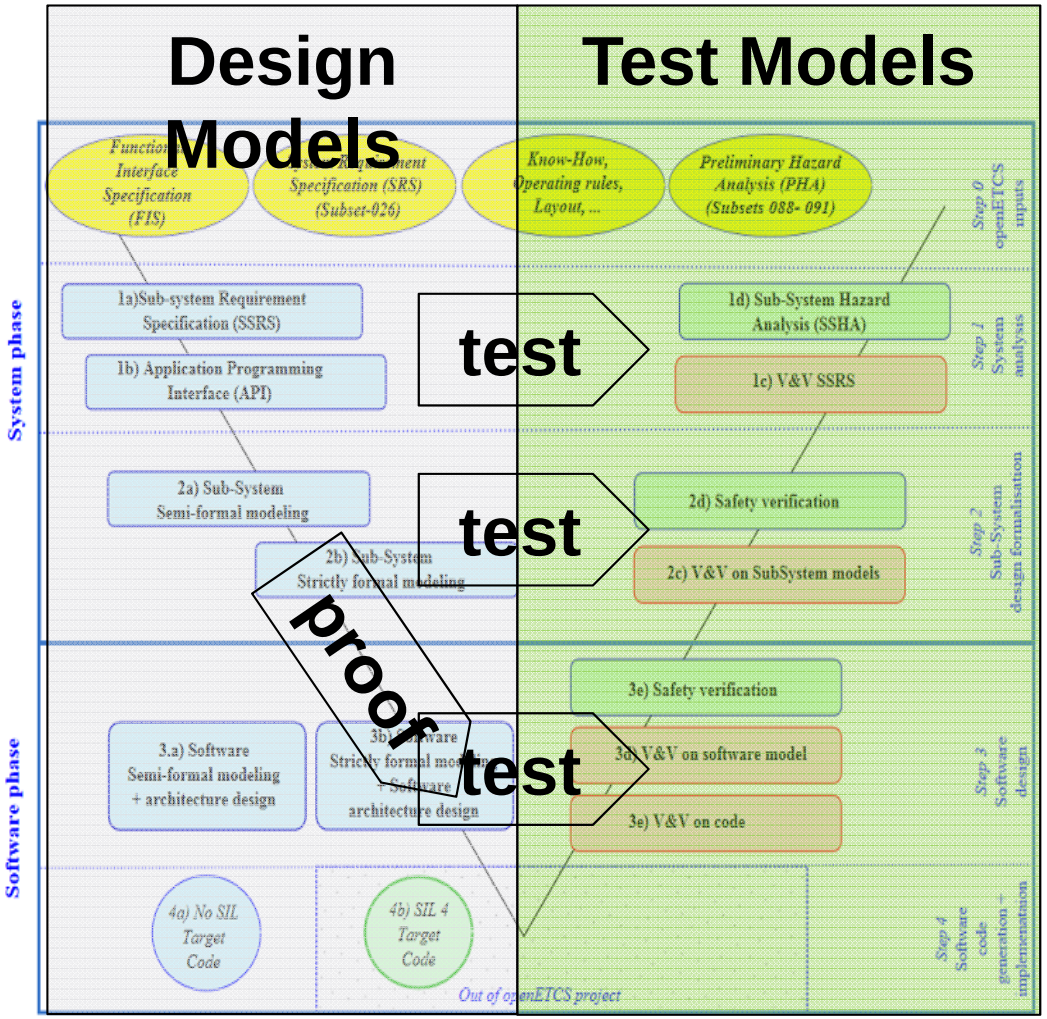
System under Test:

- **Subset-26 design model**
- **Test model is build up in parallel to the design model**
- **No hardware specification**



Outlook: Verification Concepts

- Test each level of design
- Proof of transformation can shift tests to a higher model level
- Does the V- Model become a Y – Model on which aspects?



Outlook: Steps in validation

- Define validation properties/ scenarios
- Develop scenario-data to model tranformation
- Transform scenario-data to model
- Building the first track for openETCS as input data for validation
- Validate model-based scenarios

- Who is interested to join the validation activity?

Outlook: Executing Tests

- Using tests generated from openETCS testmodel
- Verdict to be generated from testmodel
- Verifying the tests by verification of testmodel and applying reduce reactive model
- Physical testing Hardware, when baseline 3 hardware is provided (e.g. by General Electric).

Thank you for your attention!

Hardi.Hungar@DLR.de

Marc.Behrens@DLR.de