



# ***openETCS:***

## ***Modellbasiert, Agil und Open Source***

supported by:



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openETCS@ITEA2 Project

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Klaus-Rüdiger Hase, DB Netz AG, u.a.

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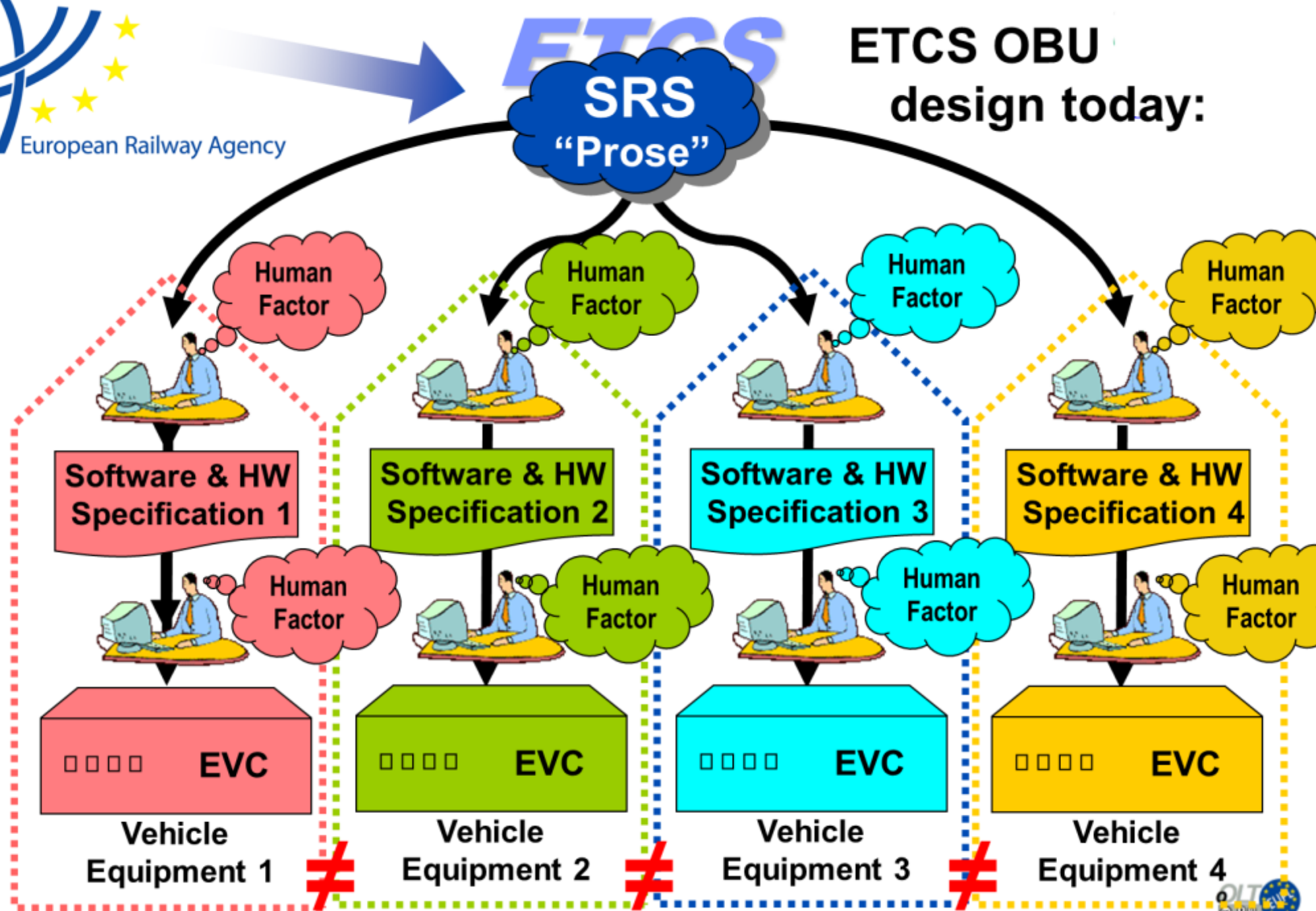
Graz, 06.04.2016

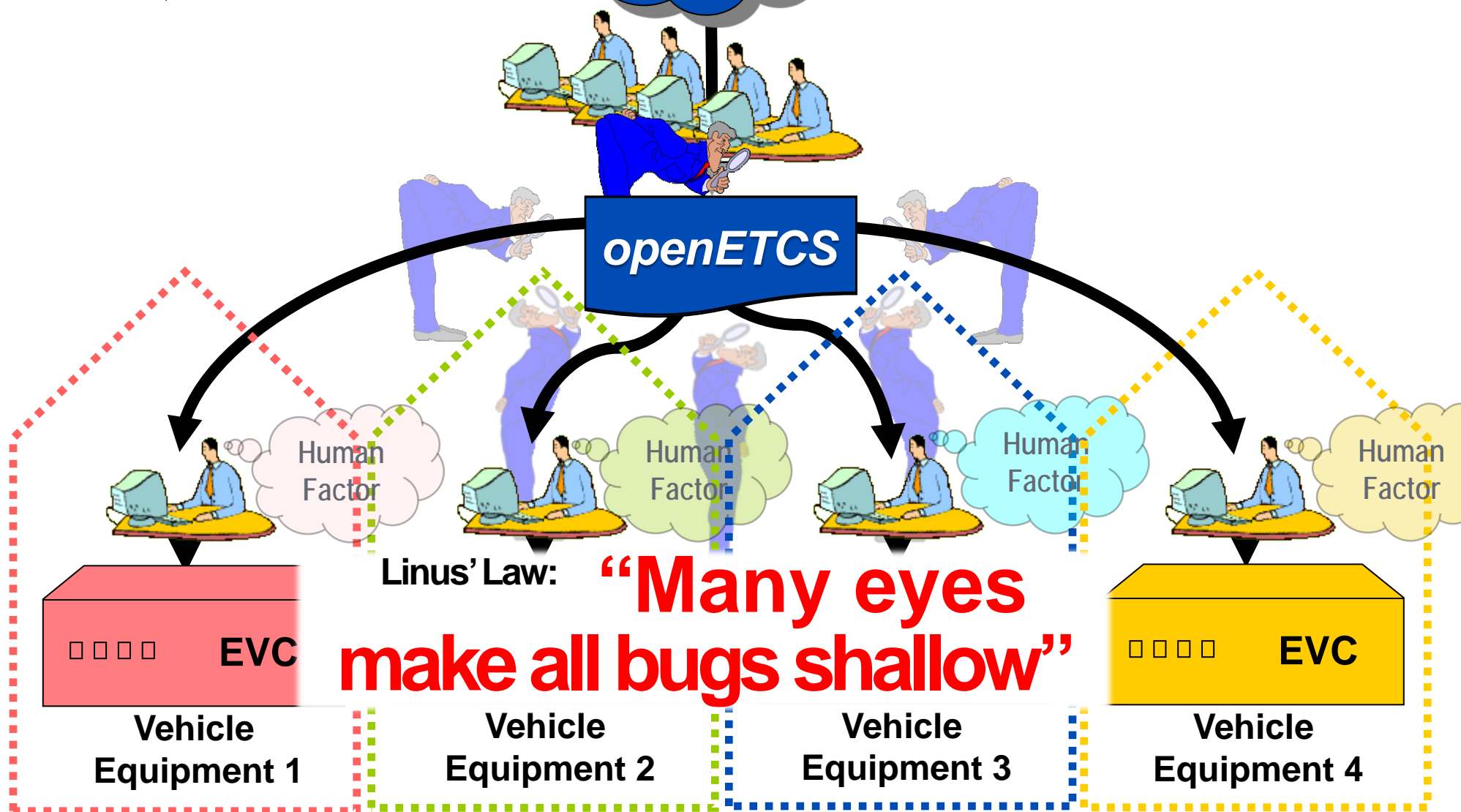
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# Ziele von *openETCS*:

## Kostensenkung durch :

- **Standardisierung von**
  - ***Software und***
  - ***Schnittstellen (SW & HW)***
- **„State-of-the-Art“ IT-Methoden**
  - ***Formaler Ansatz (SRS)***
  - ***Alternative Lizenzen → Open Source***
  - ***Agiles Arbeiten mit SCRUM***



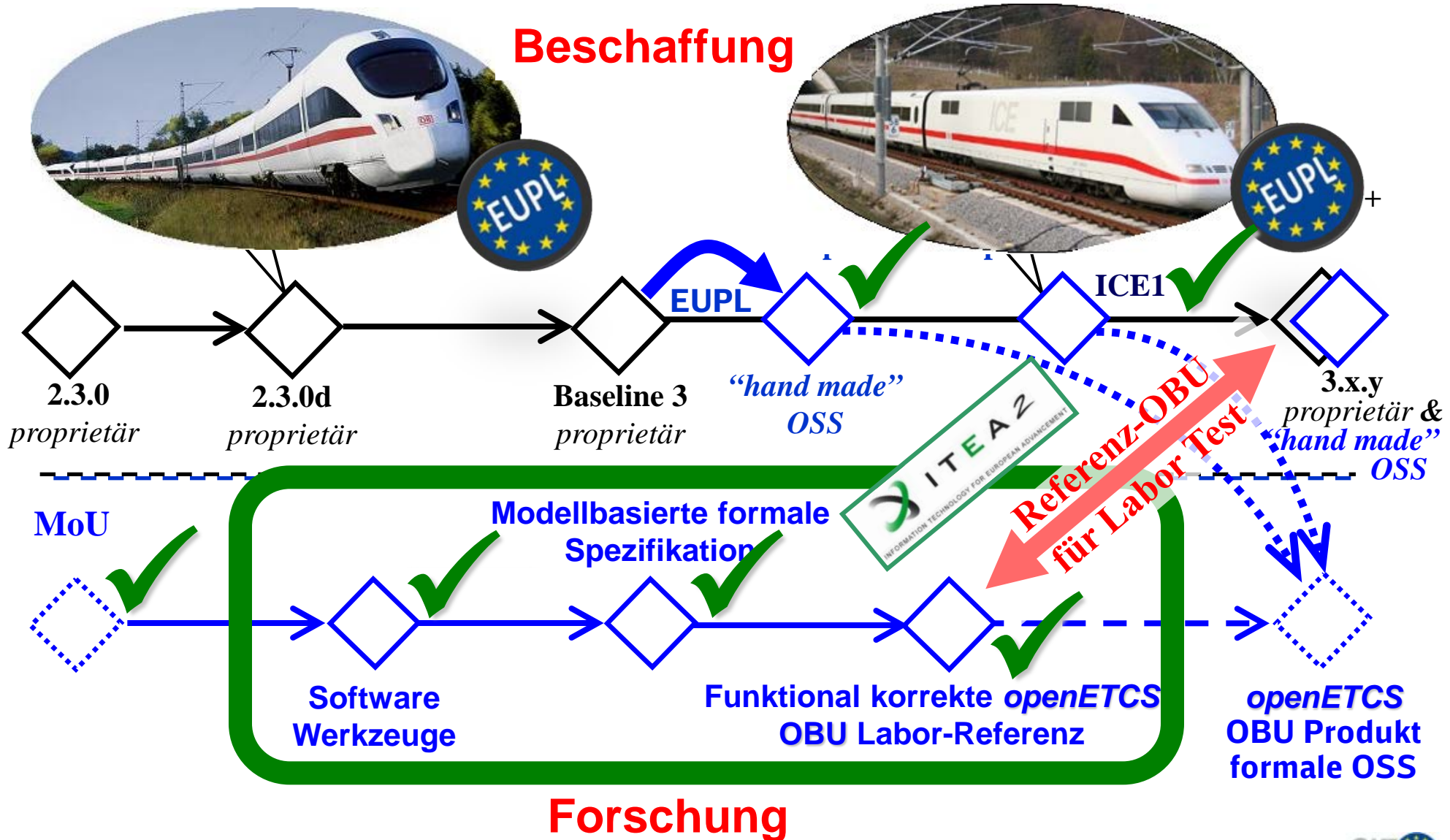


# Strategie



# openETCS Einführungsstrategie

## Beschaffung



# openETCS @ ITEA2 Projekt



Gefördert durch:



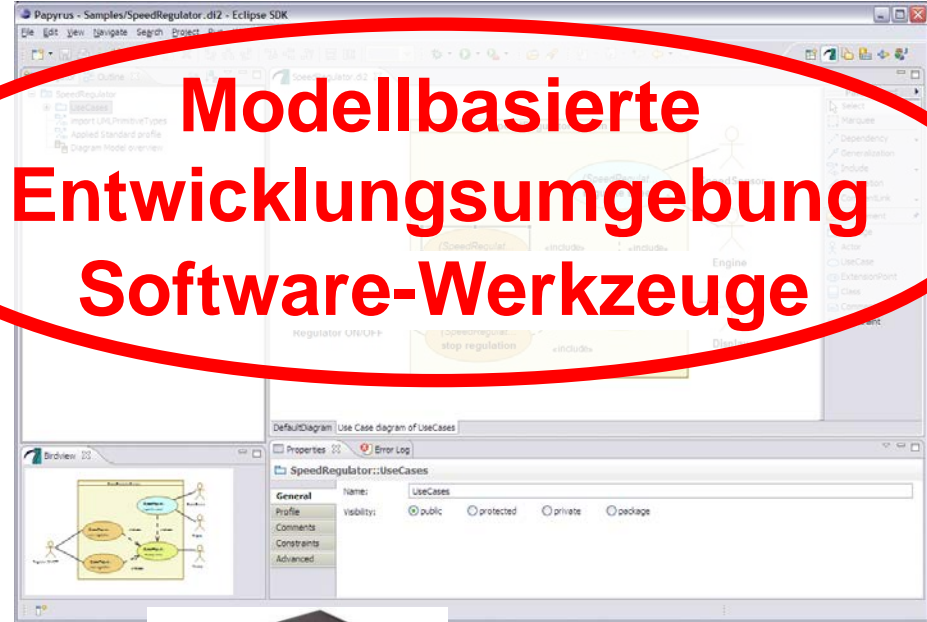
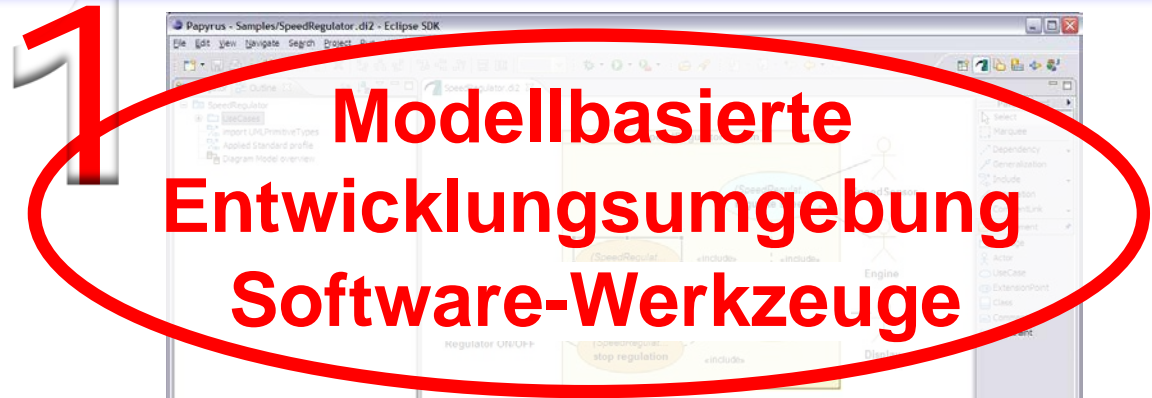
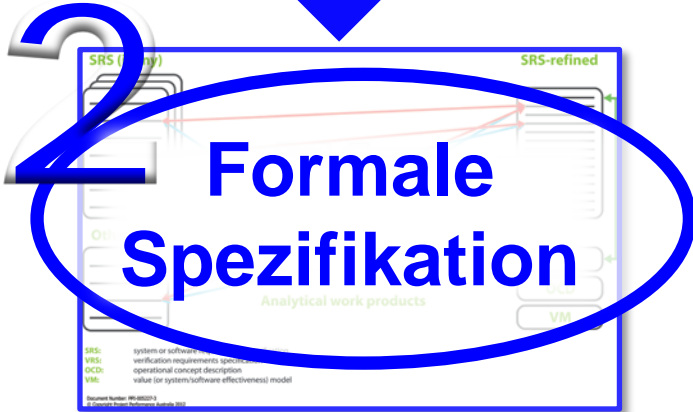
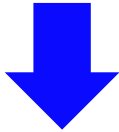
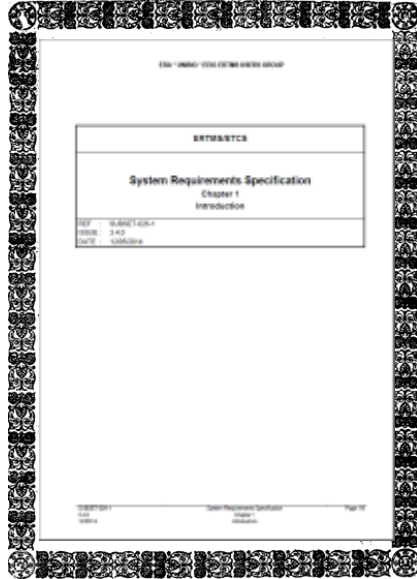
MINISTÈRE DE  
L'ENSEIGNEMENT  
SUPÉRIEUR ET DE  
LA RECHERCHE



MINISTERIO  
DE INDUSTRIA, ENERGÍA  
Y TURISMO

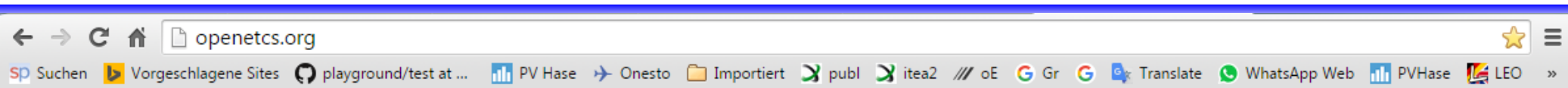
## openETCS

|             |   |
|-------------|---|
| Programcall | ITEA 2 Call 6 11025   |
| Title       | Open Proofs Methodology for the European Train Control Onboard System |
| Period      | Jul 2012 · <b>verlängert: Dez. 2015</b>                               |
| Status      | Labelled  |
| Domain      | Services, Systems & Software Creation                                 |
| Technology  | Engineering and development   |
| Effort      | 156 man-year  |
| Costs       | 18,959,000 EURO   |





# Werkzeuge



home

principles

members

tool

community

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## European Train Control System (ETCS) Open Proofs - Open Source



The purpose of the openETCS project is to develop an integrated modeling, development, validation and testing framework for leveraging the cost-efficient and reliable implementation of ETCS. The framework will provide a holistic tool chain across the whole development process of ETCS software. The tool chain will support the formal specification and verification of the

### Upcoming Events

openETCS final ITEA review

Wanneer: Wo 16. Dec 2015  
13:00 - 18:00 CET Waar: DB  
Netz AG, Völckerstr. 5, 80939  
Munich, Germany Status van ...

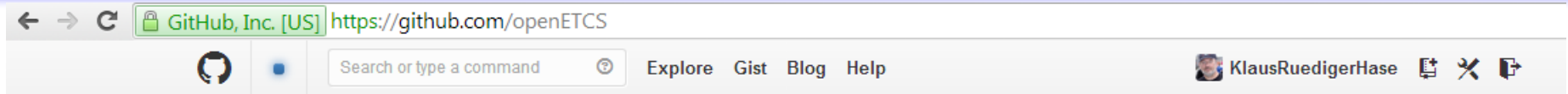
openETCS review rehearsal

Wanneer: Di 15. Dec 2015  
13:00 - 18:00 CET Wie:  
PublicEvents Status van  
afpraak: bevestigd

openETCS review  
preparation and exploitation  
workshop

Wanneer: Ma 23. Nov 2015 - Di  
24. Nov 2015 Waar: Munich,  
Germany Status van afspraak:





## openETCS Project

openETCS

📍 Europe  
✉ [github@openETCS.org](mailto:github@openETCS.org)  
🌐 <http://openetcs.org>  
🕒 Joined on Apr 09, 2012

**24** public repos  
**3** private repos  
**101** members

Repositories Members

Edit openETCS's Profile

Find a repository...

Search

All Public Private Sources Forks Mirrors

**validation** C ★ 4 🌐 7  
WP4: Validation and verification strategy  
Last updated 20 hours ago

**internal-assessment** ★ 2 🌐 3  
part of WP4: activities for internal assessor task  
Last updated 3 days ago

**ERTMSFormalSpecs** Java ★ 6 🌐 6  
ERTMSFormalSpecs provides a domain-specific language, designed to express the ERTMS specification in a concise and verifiable formal representation. It is understandable by domain specialists while retaining the ability to be translated to executable representations by fully automated means.  
Last updated 3 days ago

**toolchain** Perl ★ 13 🌐 10  
WP7: Top Level Project for the toolchain  
Last updated 3 days ago

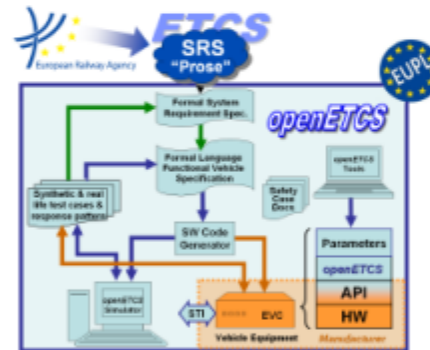
Work Package 7, Task 1: "Primary Toolchain"

## Report on the Final Choice of the Primary Toolchain

Decision on the final choice for the means of description (O7.1.4), tools (O7.1.8) and tool platform (O7.1.11)

Michael Jastram, Marielle Pottli-Doche and all participants of the decision process








September 2013



Funded by:



# openETCS Werkzeugumgebung (1)


- git auf GitHub  
  - Eclipse Modeling Framework 
  - ProR   
  - SysML mit Papyrus 
  - Eclipse Safety Framework (PolarSys)
- ➔ Artefakte ➔ "openETCS Open License Terms"



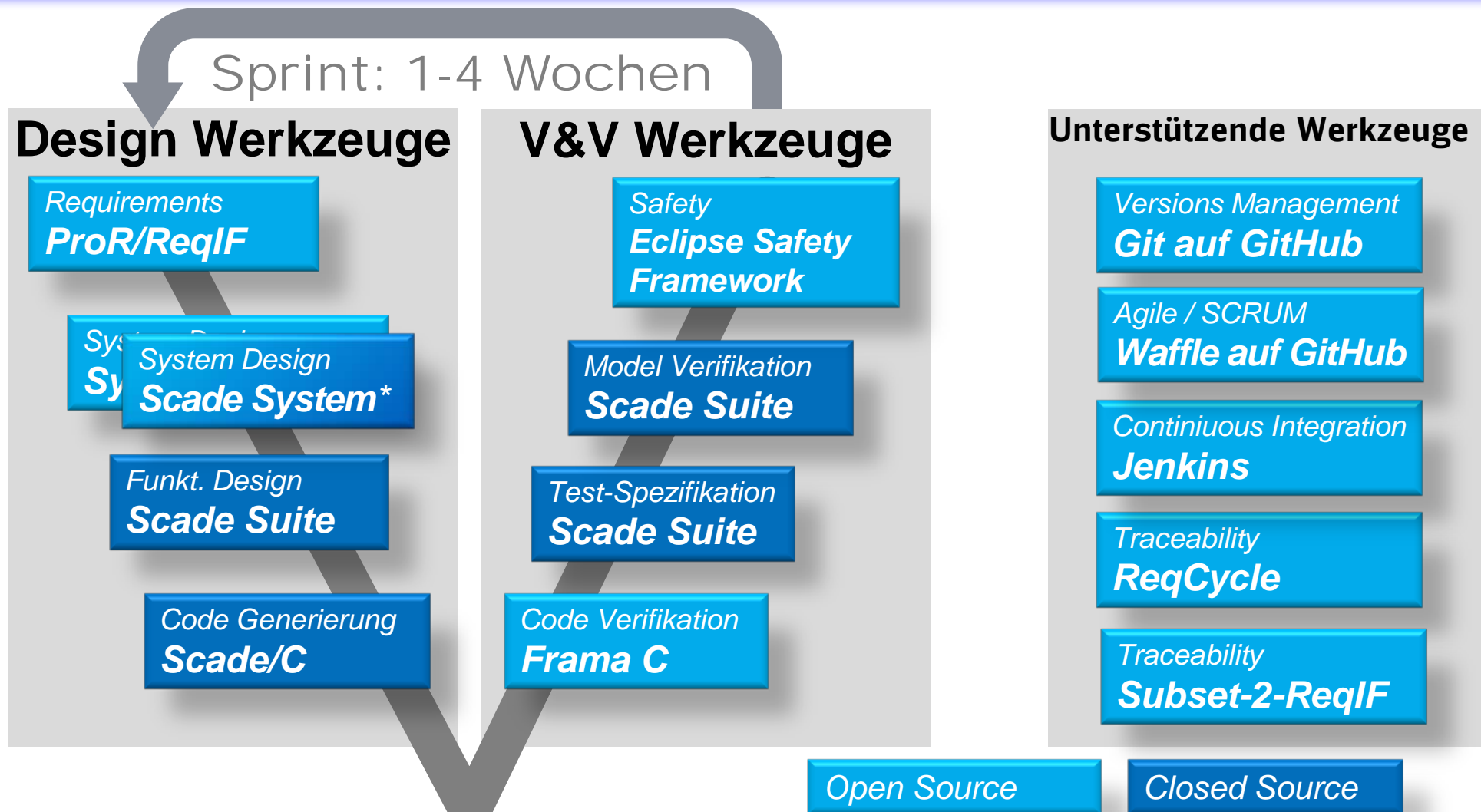
Ergebnis aus OSS Tools “Marktrecherche”:

**→ Formale OSS-Werkzeuge noch nicht verfügbar**

**WP3: “Formal Spec.” & “Ref. OBU SW” cannot wait !**

- Start mit  für formale Funktionfestlegung aus Papyrus/SysML Moduldesign**
- *“Lustre”*: Synchronous data flow programming language
  - Zertifiziert für CENELEC EN50128 SIL 4 Entwicklung
  - Großes Einsatzspektrum (Flugzeugbau, Nuklear, Bahn, ...)

# openETCS Werkzeugumgebung unterstützt agile Projektbearbeitung



\*) basiert auf Papyrus (open Source)

Scade® ist eine Marke der ANSYS Corporation, USA

# Subset-2-ReqIF Anforderungsmanagement

The screenshot displays two software windows. The top window, Papyrus, shows a ReqIF model structure with a tree view on the right containing requirements like 3.1, 3.1[2], 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.8.1, 3.8.2, 3.8.3, 3.8.3.1, 3.8.3.2, 3.8.3.3, 3.8.3.3.a, 3.8.3.3.b, 3.8.3.3.c, 3.8.3.3[2], 3.8.3.4, 3.8.3.5, 3.8.3.6, and 3.8.3.7. The bottom window, Formalmind Studio, shows a RichText editor for requirement 3.8.3.3.c, titled 'Structure of a Movement Authority (MA)'. The text describes the MA structure, including section timer stop locations, overlap timer start locations, end section timer start locations, and distance to danger point. A diagram below the text illustrates a 'Single Balise Group schematic representation' with 'Section(1)' and 'Section(2) = End Section', showing 'Section timer stop location', 'Overlap timer start location', 'End Section timer start location', and 'Distance to Danger Point Length of Overlap'. A red arrow points from the text 'Konvertiert Spezifikation in MS Word doc-Format in ReqIF-Format' to the ReqIF model tree in Papyrus.

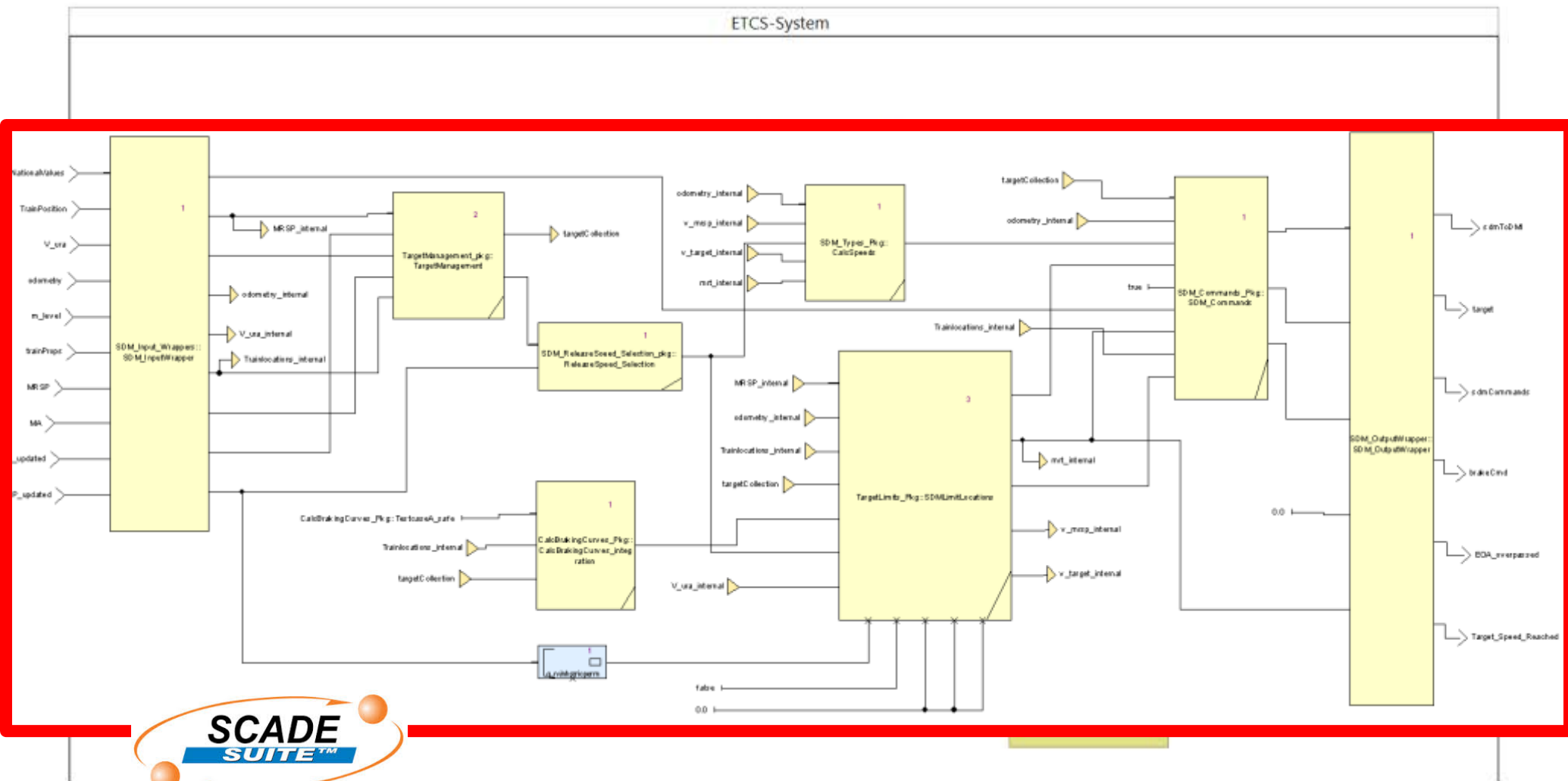
Konvertiert Spezifikation  
in **MS Word** doc-Format  
in **ReqIF-Format**

Location Reference  
1<sup>st</sup>

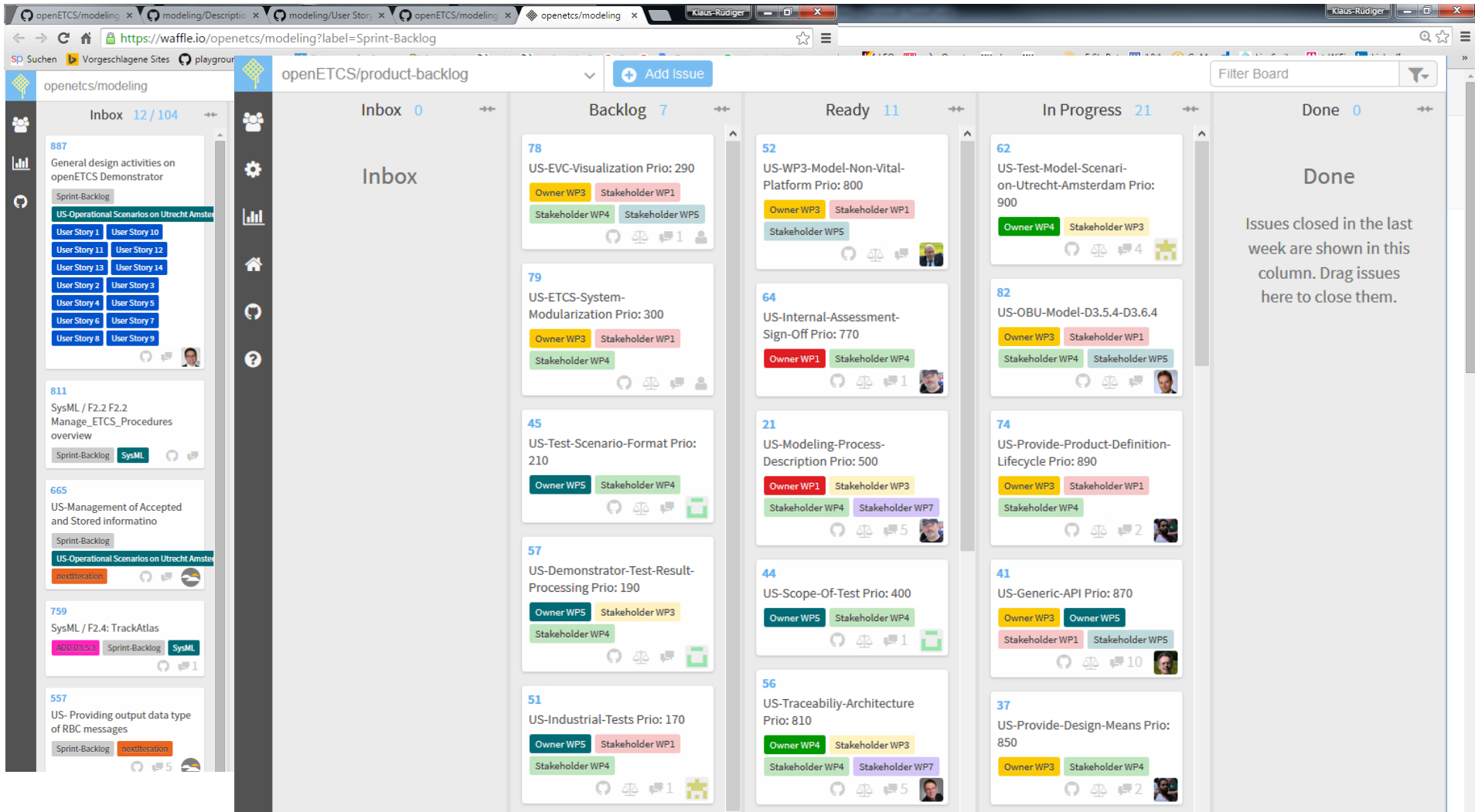
Single Balise Group  
schematic representation

# Modulare Strukturierung → SysML mit Papyrus

## Funktionale Festlegung → Lustre mit SCADE



# SCRUM: „BackLog Grooming“ auf GitHub



The screenshot displays a GitHub project board for 'openETCS/product-backlog'. The board is organized into five columns: 'Inbox' (0 items), 'Backlog' (7 items), 'Ready' (11 items), 'In Progress' (21 items), and 'Done' (0 items). Each card represents an issue with a title, priority, owner, and stakeholders. The 'Backlog' column contains issues like 'US-EVC-Visualization' (Priority: 290) and 'US-ETCS-System-Modularization' (Priority: 300). The 'Ready' column includes 'US-WP3-Model-Non-Vital-Platform' (Priority: 800) and 'US-Internal-Assessment-Sign-Off' (Priority: 770). The 'In Progress' column shows 'US-Test-Model-Scenario-Utrecht-Amsterdam' (Priority: 900) and 'US-OBU-Model-D3.5.4-D3.6.4' (Priority: 82). The 'Done' column contains a note: 'Issues closed in the last week are shown in this column. Drag issues here to close them.'

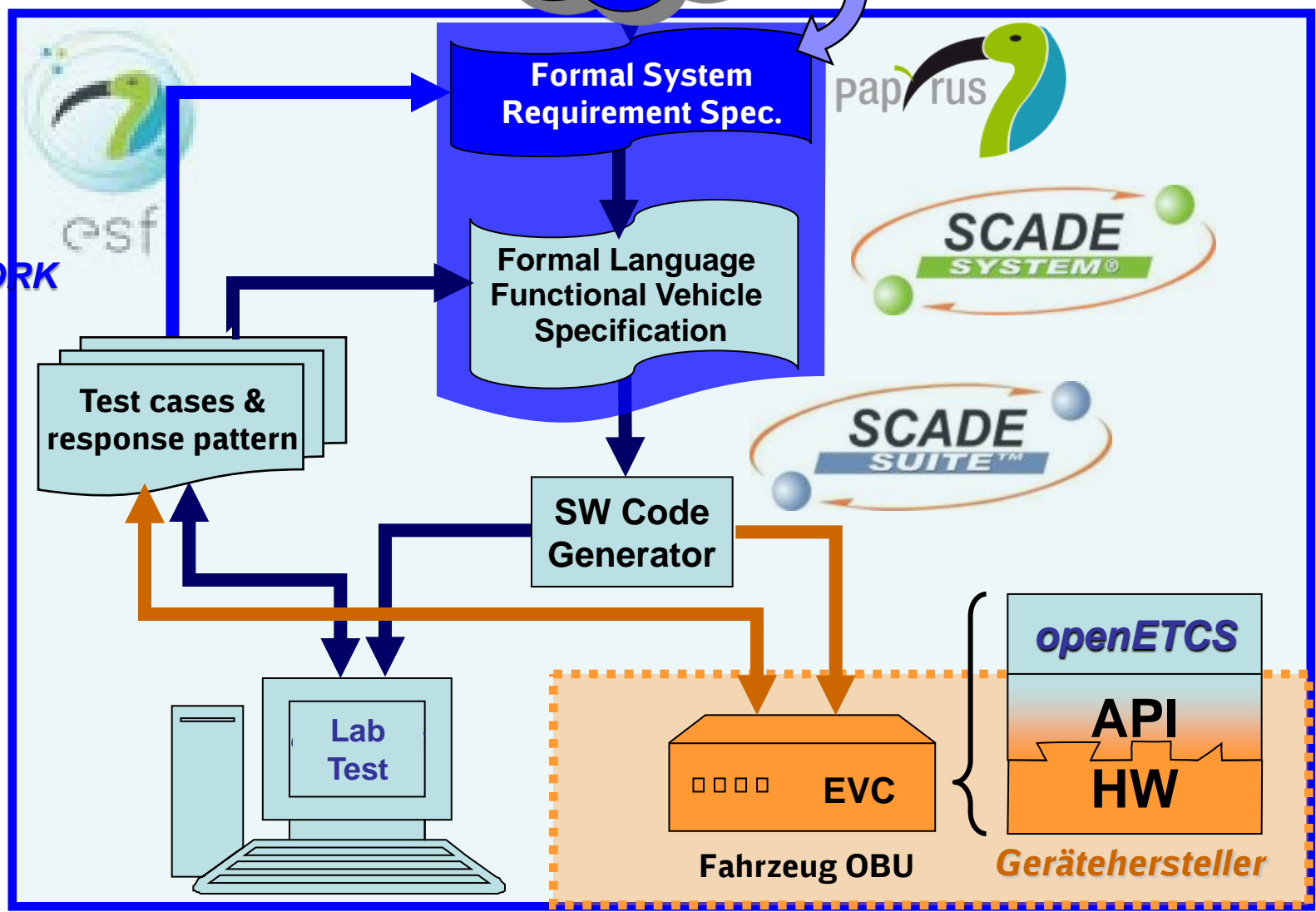
#927 opened on 19 Nov 2015 by UweSteinkeFromSiemens



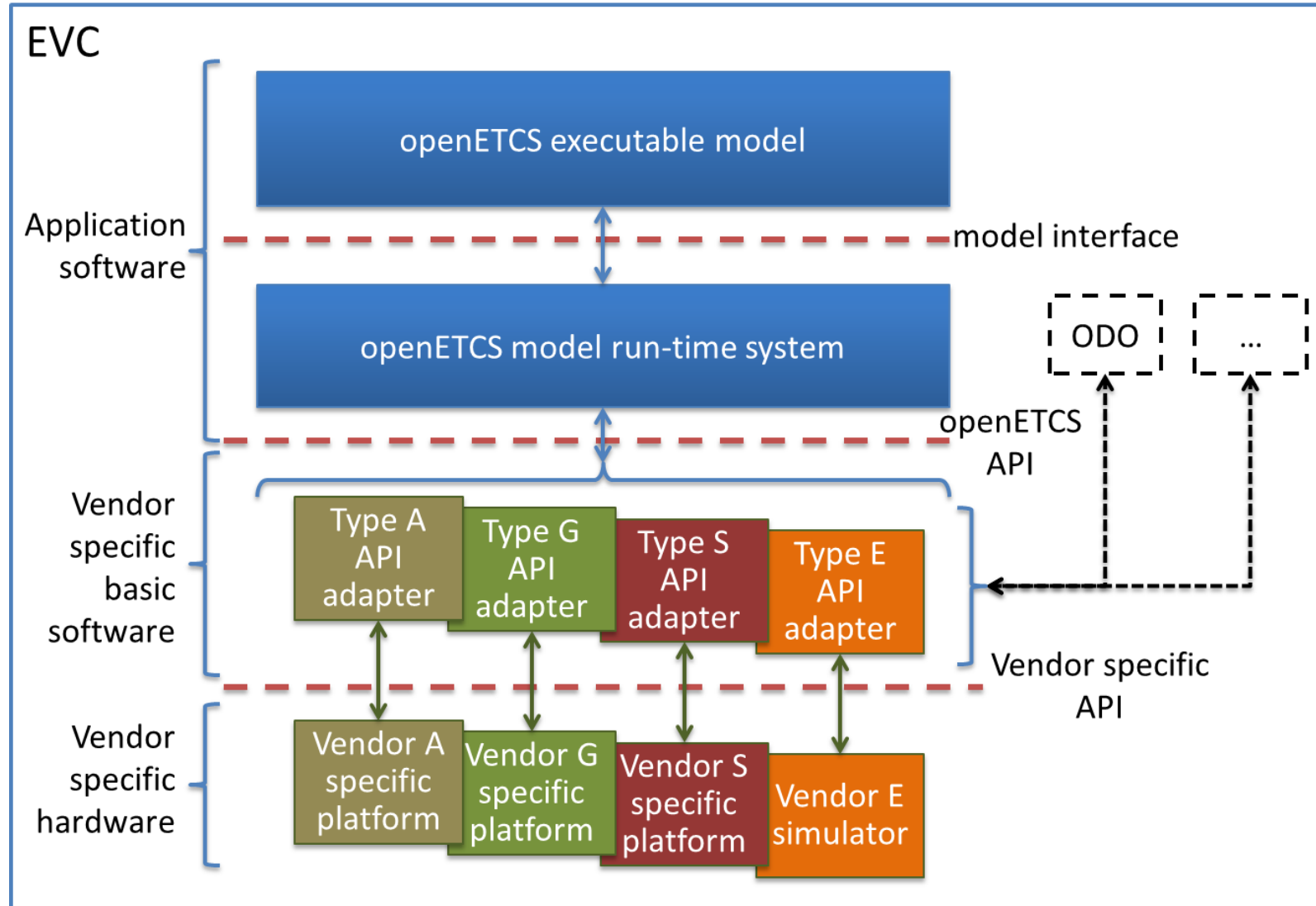
**SRS**  
"Prosa"

Subset-2-ReqIF

**ECLIPSE**  
**SAFETY**  
**FRAMEWORK**



# Portierbarkeit der *openETCS*-Software



# Integration in verschiedene Plattformen

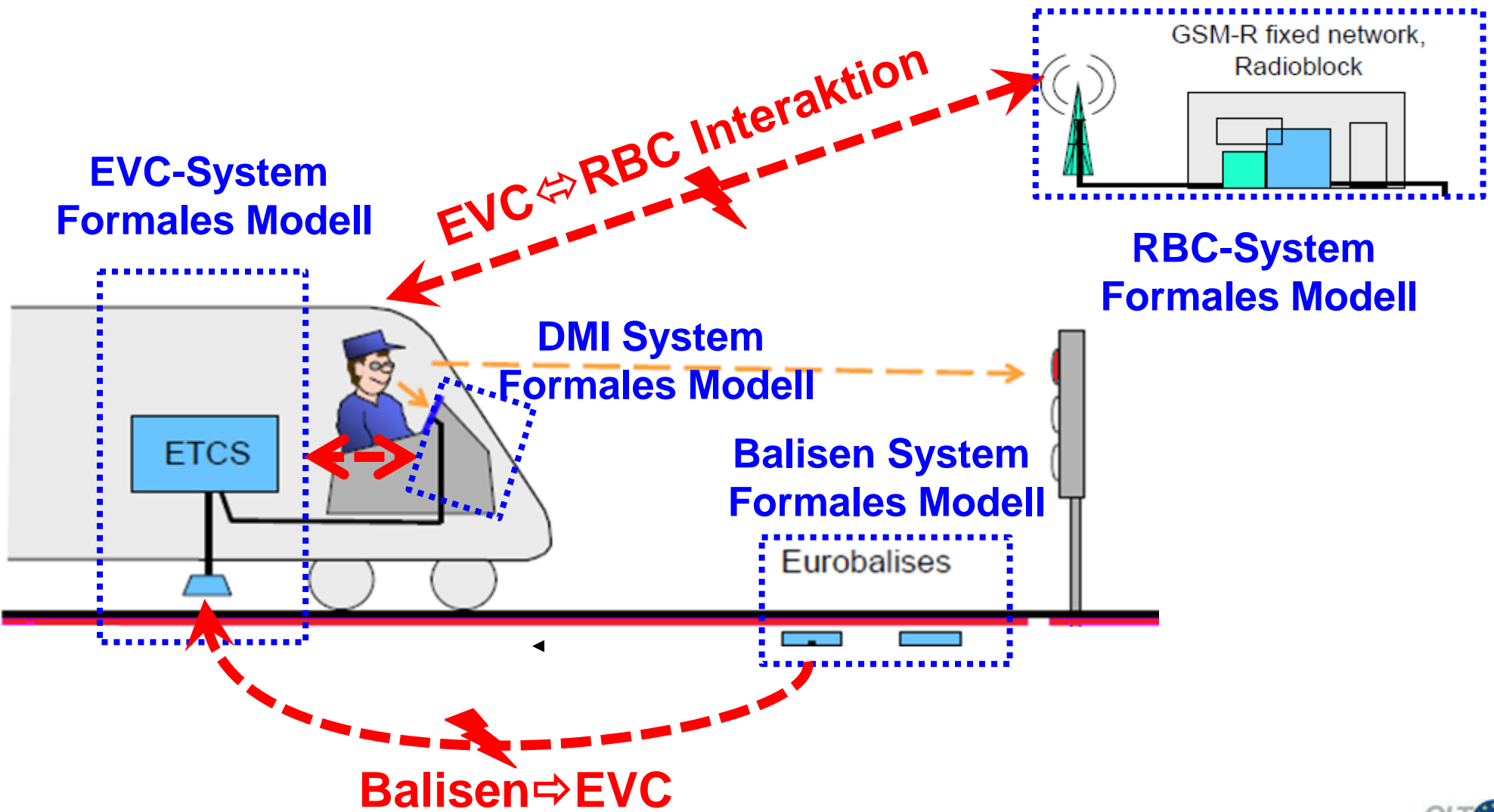


GE (heute Alstom): EVC  
Uni Rostock: *nanoETCS*  
LEA Railergy: *Simulator*  
Bachleitner&Heugel: *DMI*



# Modellierung

# openETCS-Modell mit zugseitiger (EVC, DMI) und streckenseitiger (RBC, Balisen) Simulation





# Klare Strukturierung aller Funktionen

## Funktionaler Umfang

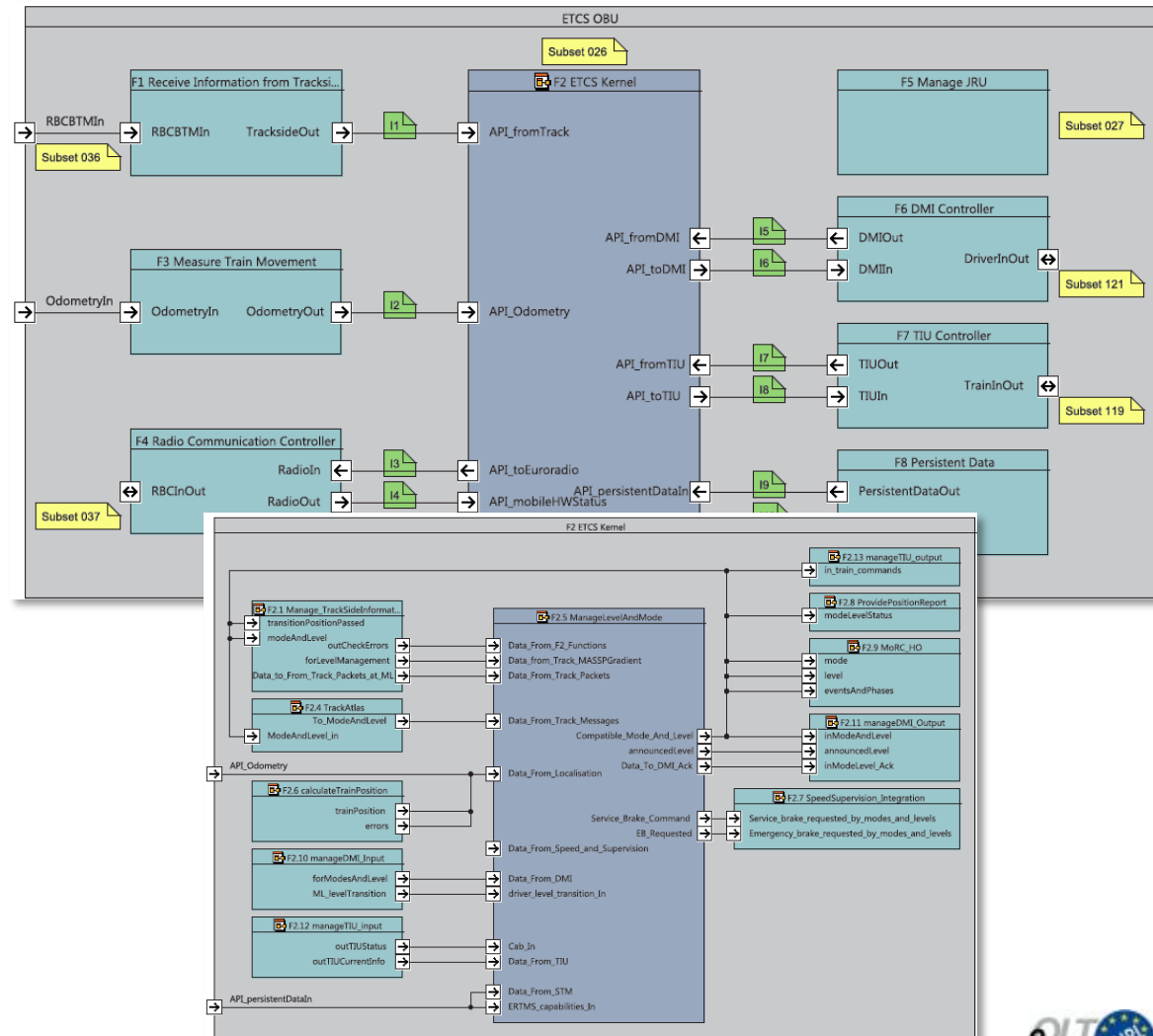
- Strecke Amsterdam-Utrecht
- Definiert über 12 „User Stories“  
(Start of Mission, Level-Wechsel, etc.)

## Artefakte:

- SysML Model (Papyrus)
- Funktionales Model (Scade)
- Code (C, Scade generiert)

## openETCS Kernel:

- Track Messages
- Radio Communication
- Mode & Level Management
- Calculate Train Position
- Speed & Distance Monitoring
- Track Atlas
- Etc.



# Simulation

Branch: master modeling / User Stories / Description User Story 14.pdf

Baseliyos Jacob Description and Sequence Diagram on US 13, 14, 15 and 16

0 contributors

35.5 KB

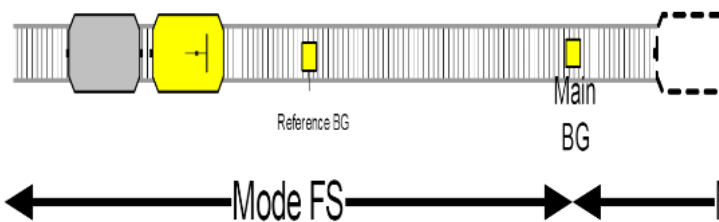
**Title:** User Story 14 – Mode Change

L2 Mode change FS – OS – FS. ERTMS track uses no TAF mechanism. Late response at mode change to OS

**Objective:**

ERTMS Level 2 track. The EVC shall change its mode from FS to OS to FS. Sp applicable for the whole train. This behavior is verified at the mode change to OS the system behavior is verified due to late driver response.

**Diagram:**



Train (T) is travelling from left to right orientation. When the RBC matches related to its interlocking the RBC sends route data, which is linked to the : The RBC sends an MA that orders OS mode. At the SMB/ signal an MA is r mode.

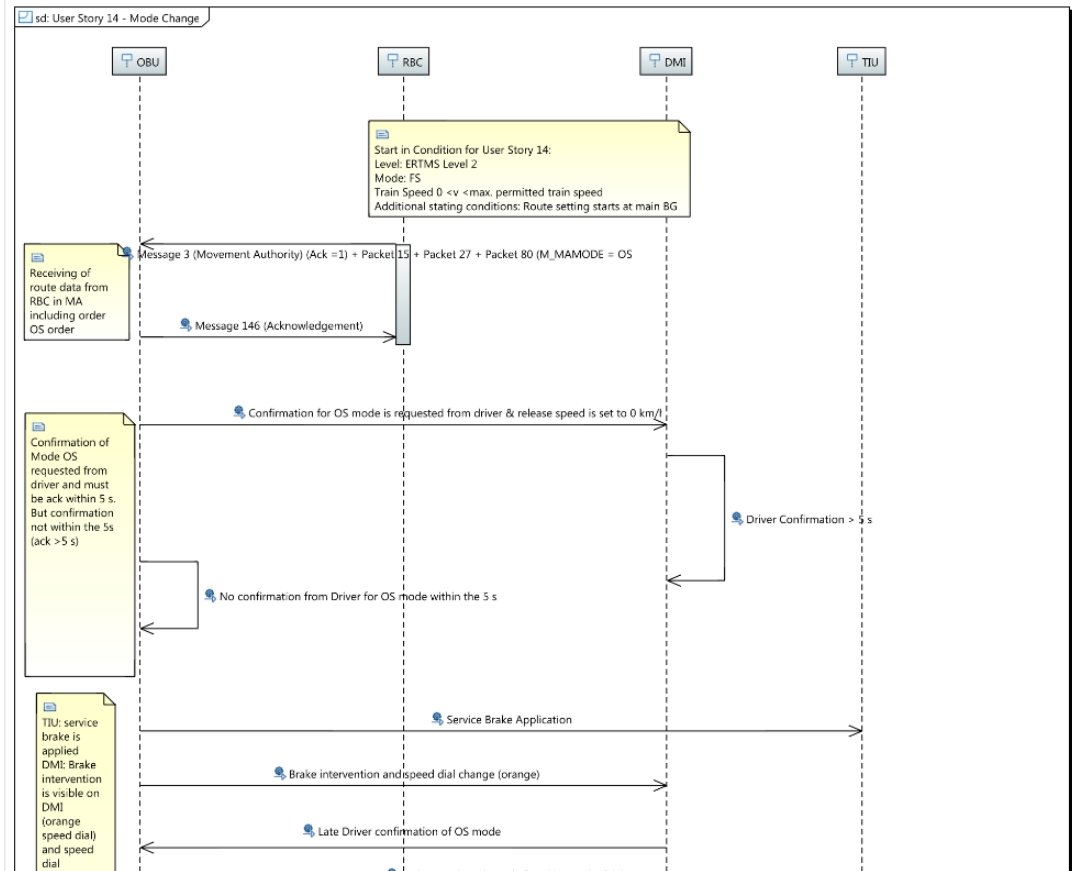
All BG in the drawing are linked balise groups. Main BG indicate that the g signal or SMB.

Branch: master modeling / User Stories / User Story 14.pdf

Baseliyos Jacob Update of US 11 - 14

0 contributors

266 KB



# Führerstands-Simulation

mark

Geschwindigkeit,  
Position & Modus

“Messages”:  
RBC & Balisen

DMI

“Bediener-  
Maus”

Diagnose

The screenshot displays the openETCS SimCtrl interface with several key components:

- DMI (Driver-Machine Interface):** Located in the bottom-left, it features a speedometer showing 35 km/h, a signal strength indicator, and a time display of 17:01:05.
- Messages Panel:** A central table listing messages and their positions. The selected message (MSG 3) is at 360.0 meters.
- Diagnostic Panel:** On the right, it shows the details for the selected packet (Level 2 Movement Authority), including variables like `nid_packet` (15), `q_dir` (1), and `q_scale` (1).
- Control Panel:** At the top, it includes status indicators for 'Open Desk', 'AFB', 'Connected', 'Emergency Brake', 'Service Brake', and 'Traction Cut Off', along with position and velocity readouts.

[https://github.com/openETCS/modeling/blob/master/demo/SchieneFahrzeugTagung\\_Graz\\_2016/openETCS\\_Graz.mp4](https://github.com/openETCS/modeling/blob/master/demo/SchieneFahrzeugTagung_Graz_2016/openETCS_Graz.mp4)

## Kommerzielles ETCS-Beschaffungsprogramm:

- ICE-Bestandsflotte mit *openETCS*-Option unter EUPL \*)
  - Software-Service-Vertrag reduziert Update-Risiken für die Betreiber
- ➔ Neue Optionen für Investition & Instandhaltung für Bahnen

## *openETCS@ITEA2* Forschungsprojekt:

- Formalisierung mit ReqIF / SysML / Lustre ... effizient und kostengünstig
- Werkzeuge EN50128 zertifiziert aber (noch) nur teilweise offen
- *openETCS*-Werkzeugkette unterstützt agiles Arbeiten (SRUM)
- Portierbarkeit der *openETCS*-Software auf 4 Plattformen
- Leistungsfähige Modellierung am Beispiel “Utrecht-Amsterdam”
- *openETCS* Foundation e.V. unterstützt das Eco-System

\*) European Union Public License, Offenlegung ab 2017





**Vielen Dank für Ihre  
Aufmerksamkeit.**