open ETCS

Benchmark on SysML with Topcased and Enterprise Architect

Thomas BARDOT

2013-04-16

Modeling approach

- **Semi-formal** approach with SysML
- Modeling with **Topcased**
  - **Open source** tool
  - Based on the Eclipse platform
  - Not stable, we faced a corrupted project file
- Modeling with **Enterprise Architect** (EA)
  - **Proprietary** license
  - **Code generation** and behavior **simulation**

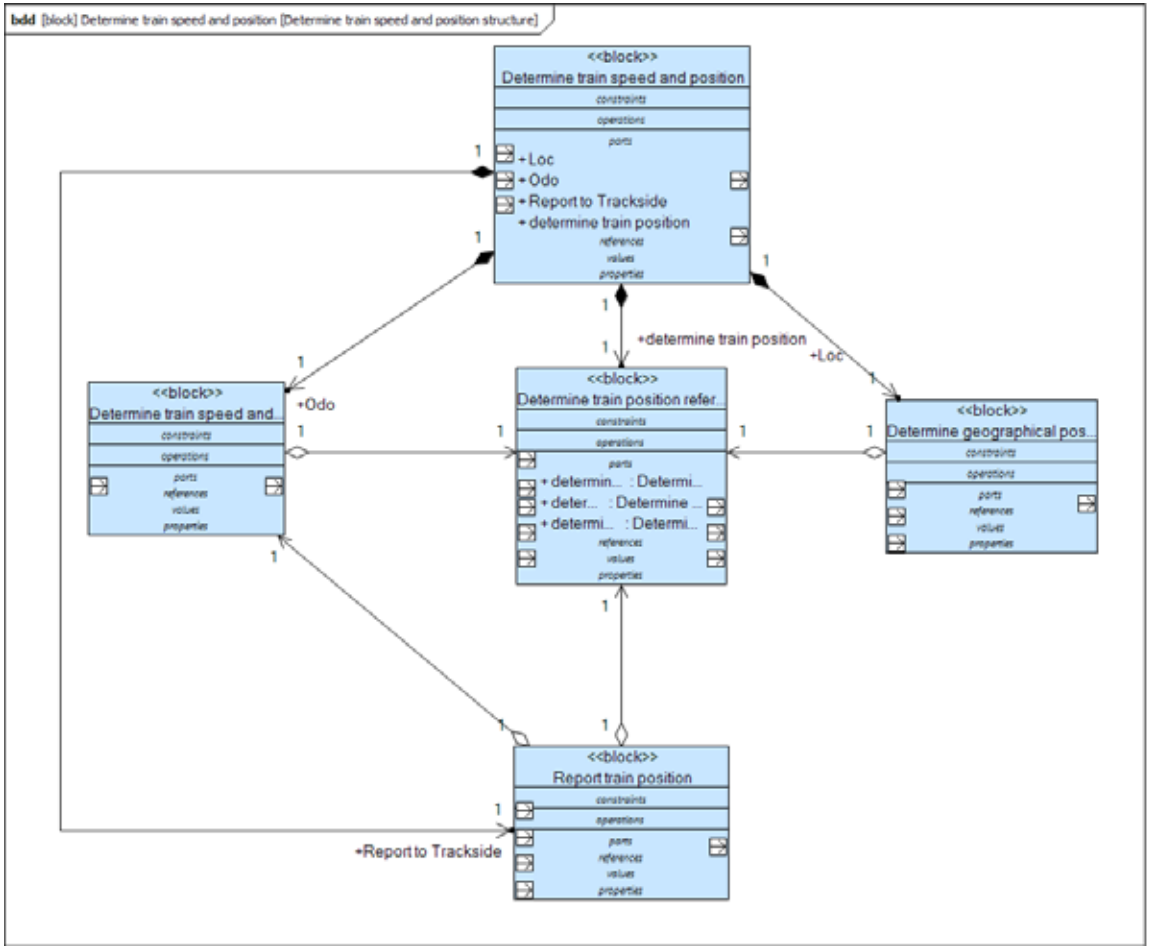
MODELING WITH TOPCASED

Model Purpose

- Model the **static structure** of the “Determine train speed and position” functions (SRS §3.6 and §4.5.2)
- Use of **block definition diagram** (bdd) and **internal block diagram** (ibd)

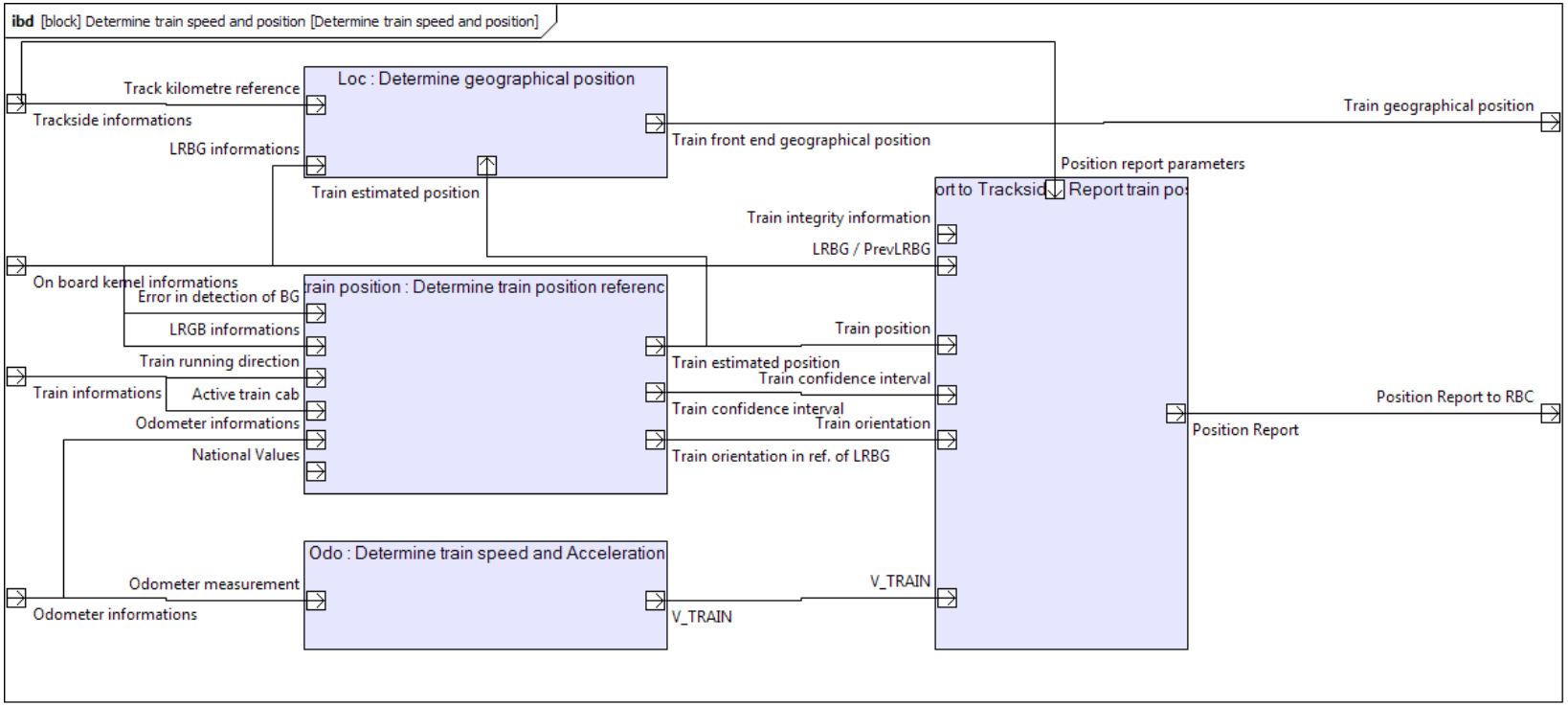
Block Definition Diagram

- Show the **dependencies** between SRS **functions and sub-functions**
- Excerpt



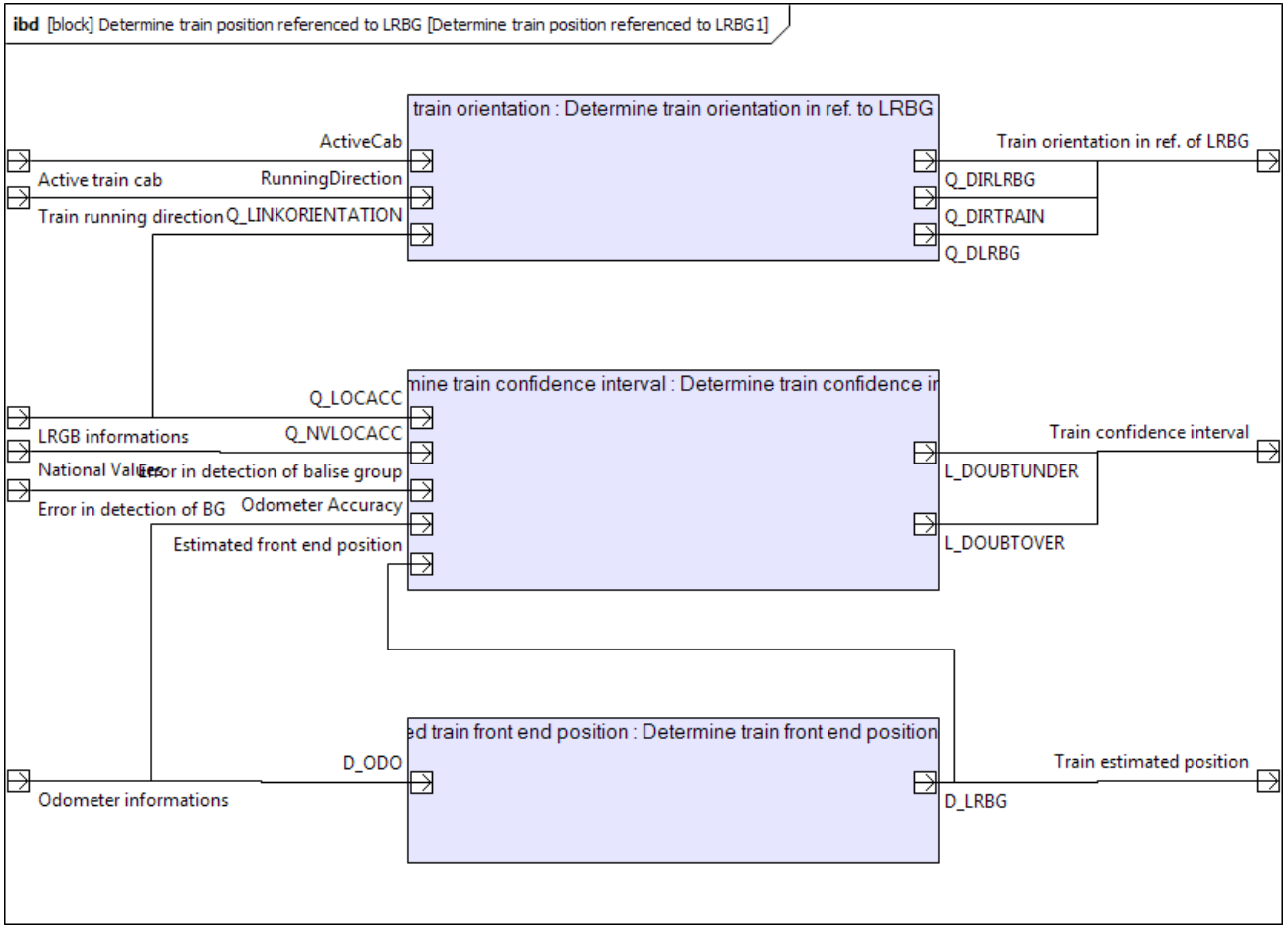
Internal Block Diagram

- **Block parts** represents ETCS functions and sub-functions
- **Information** exchanged between parts and block **is detailed**
- Excerpt



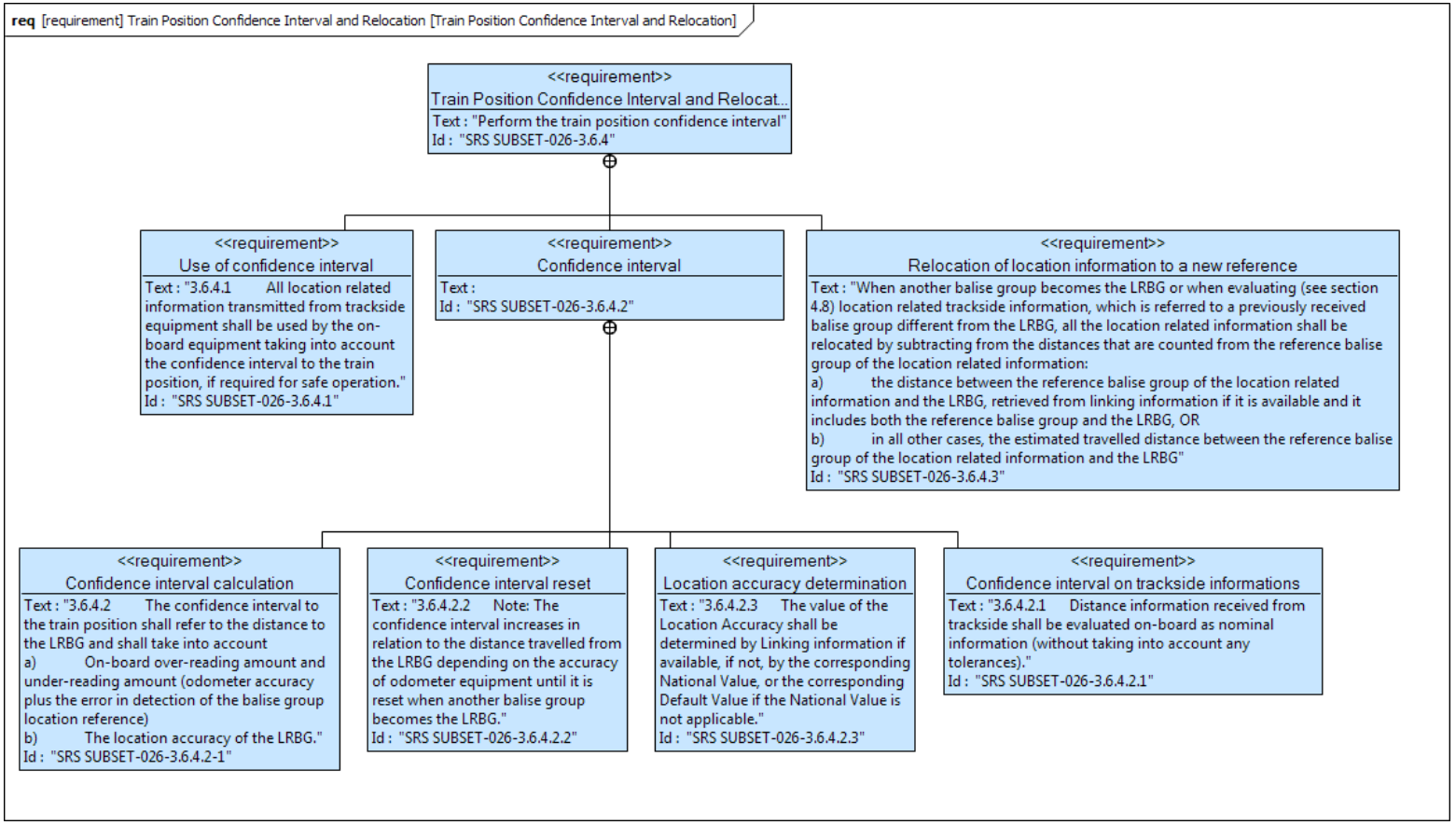
Nested diagram

- We can detail the structure with **nested diagram**



Requirements

- Requirements are text of SRS 3.6
- Creating requirements **manually**



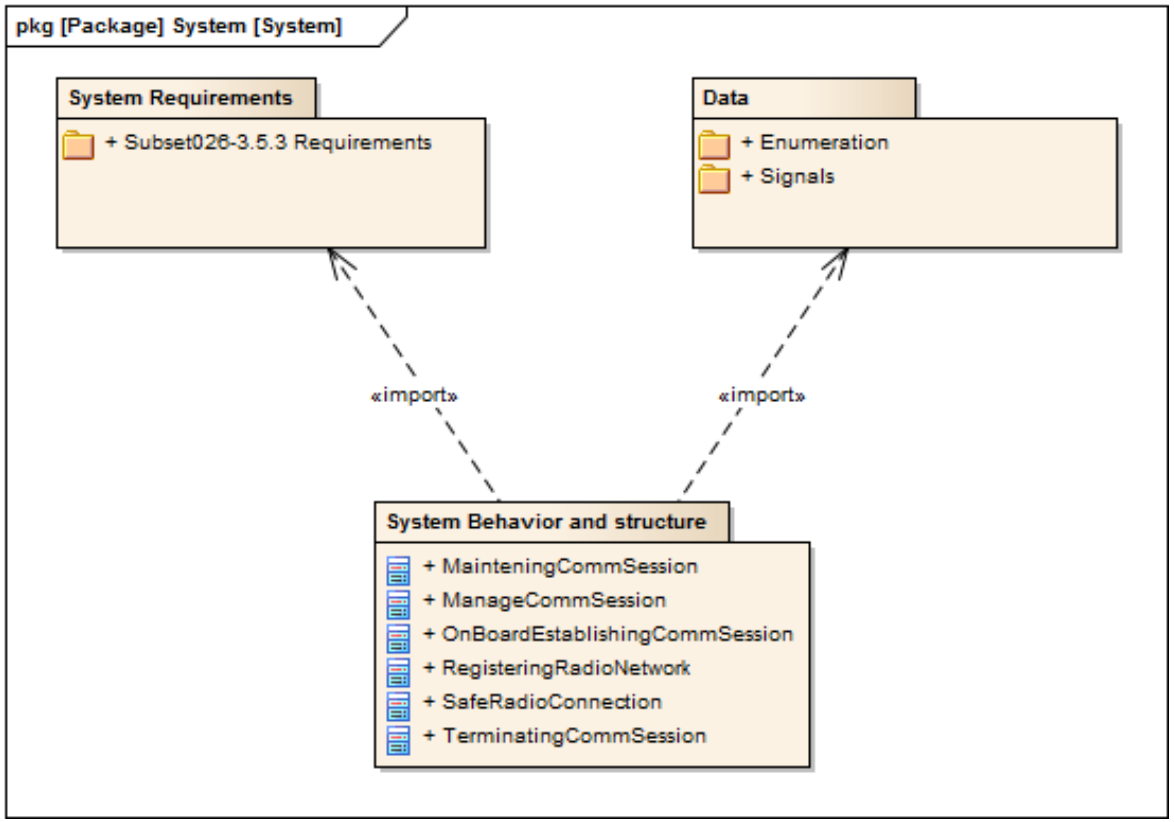
MODELING WITH ENTERPRISE ARCHITECT

Model Purpose

- Model the **behavior** of the “Establishing a communication session” function (SRS §3.5.3)
- Use of **activity diagram**

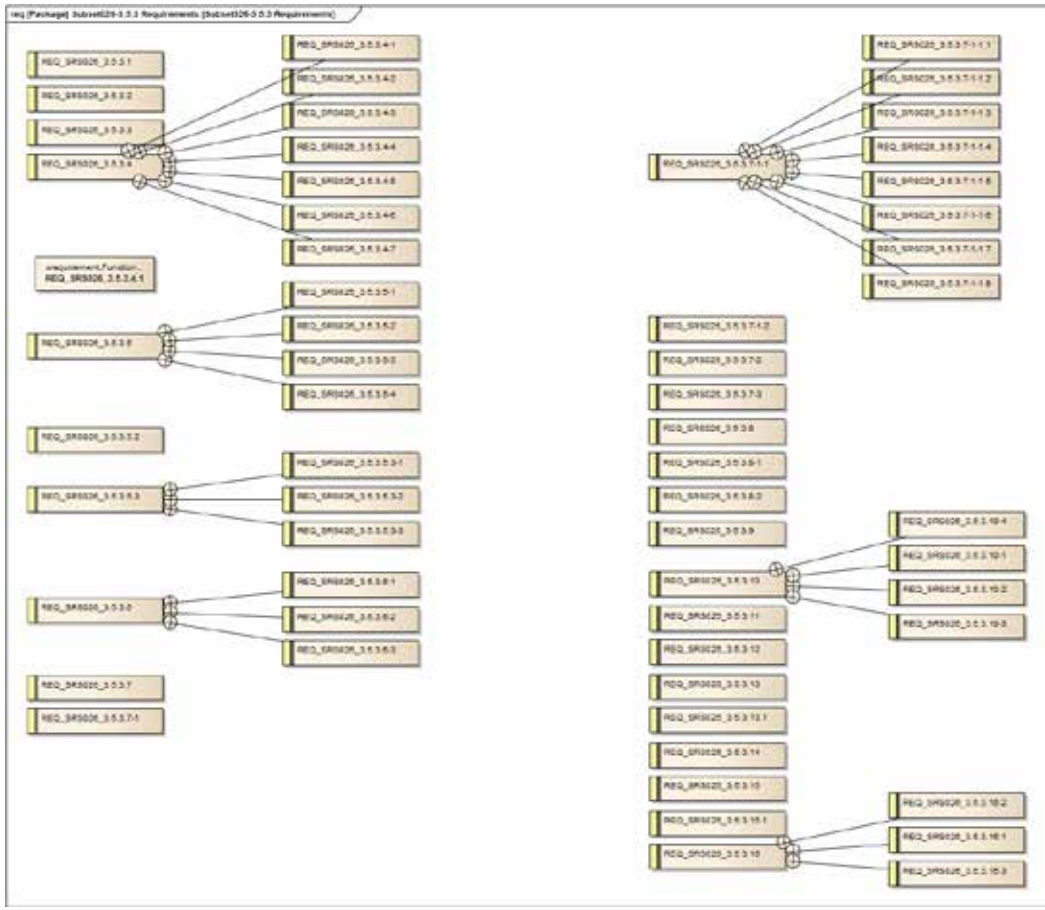
Model structure

- 3 main packages
- Define the **relation** between these **packages**



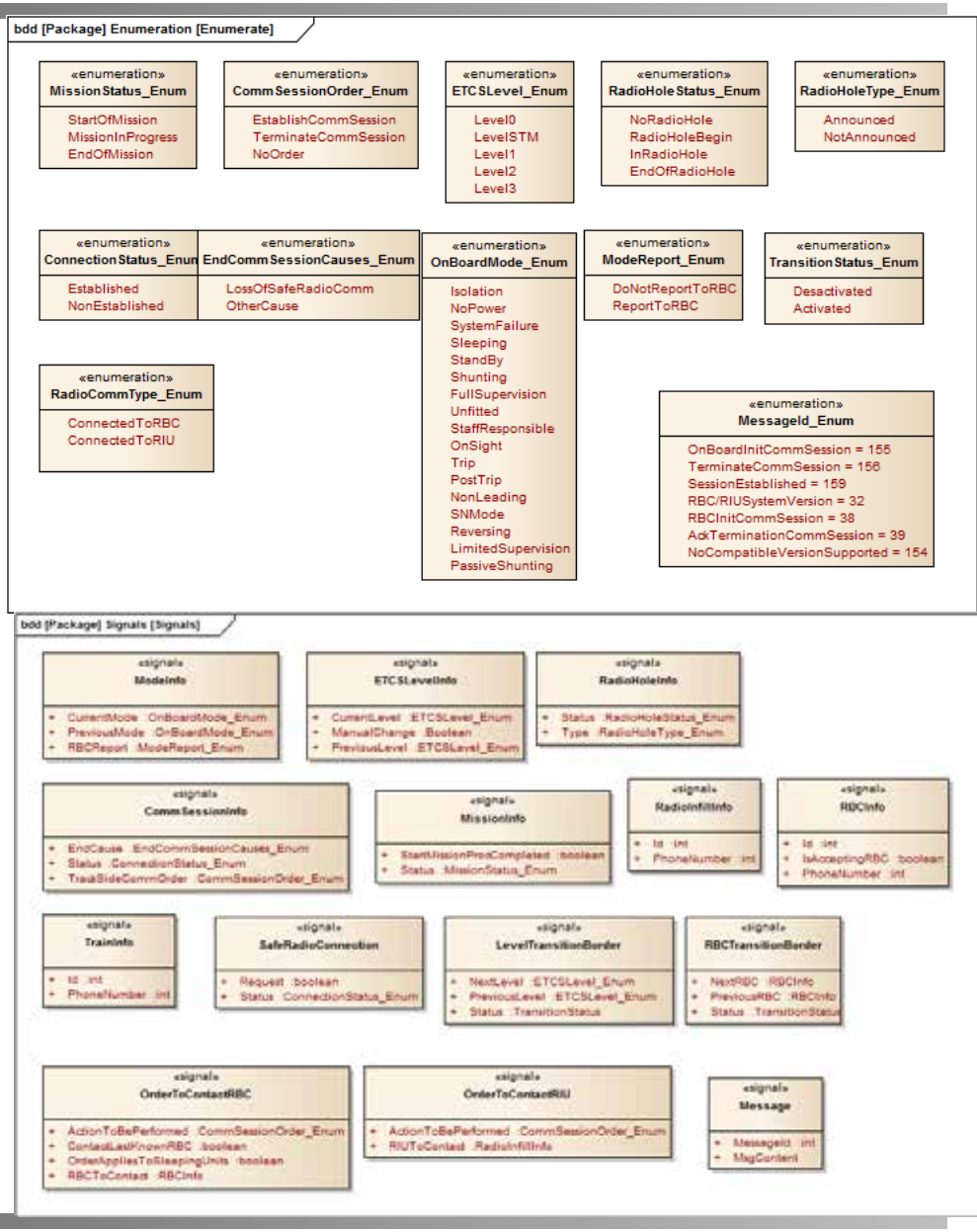
Requirements management

- Represent the **text** of **SRS SUBSET026 3.5.3**
- **Automatically imported** from a *.csv* file
- **Manually rearranged** on the diagram



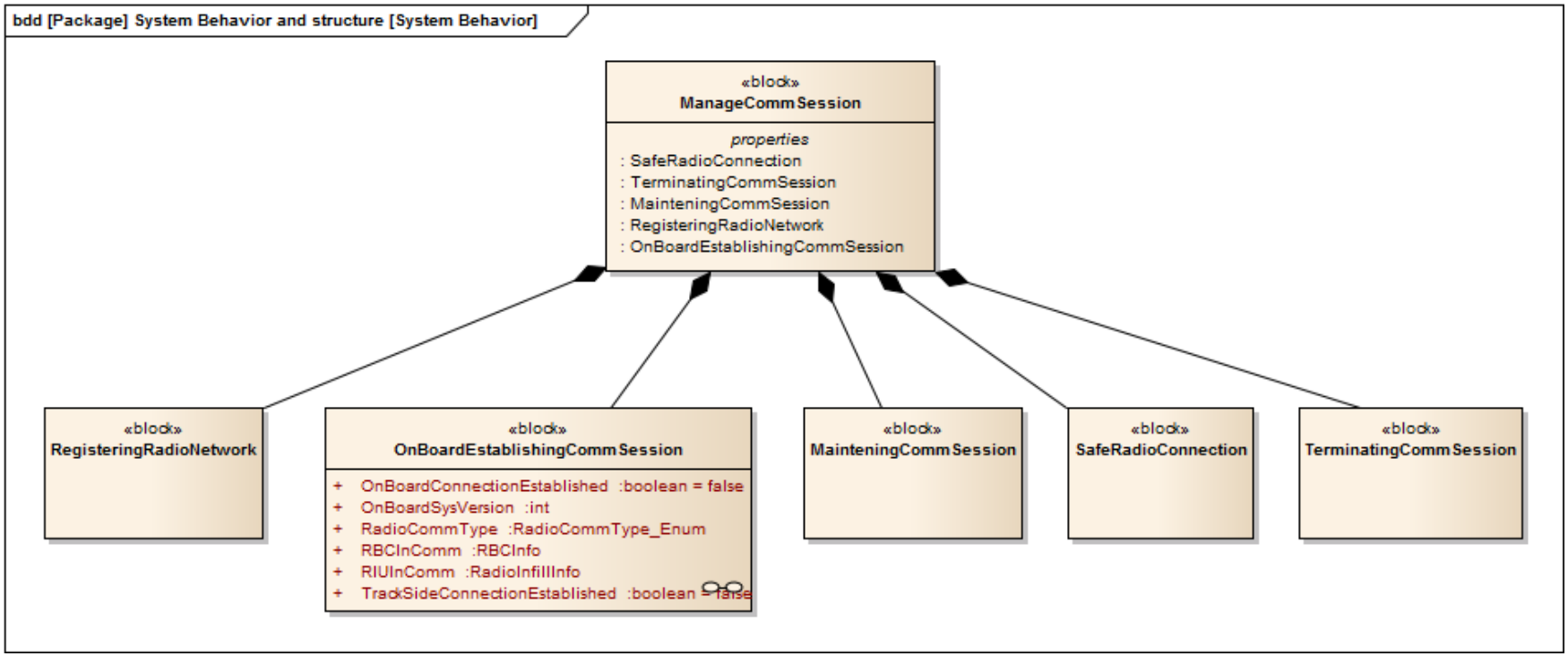
Data package

- Definition of **data used** by the model
- Use of **Enumerates** and **signals**



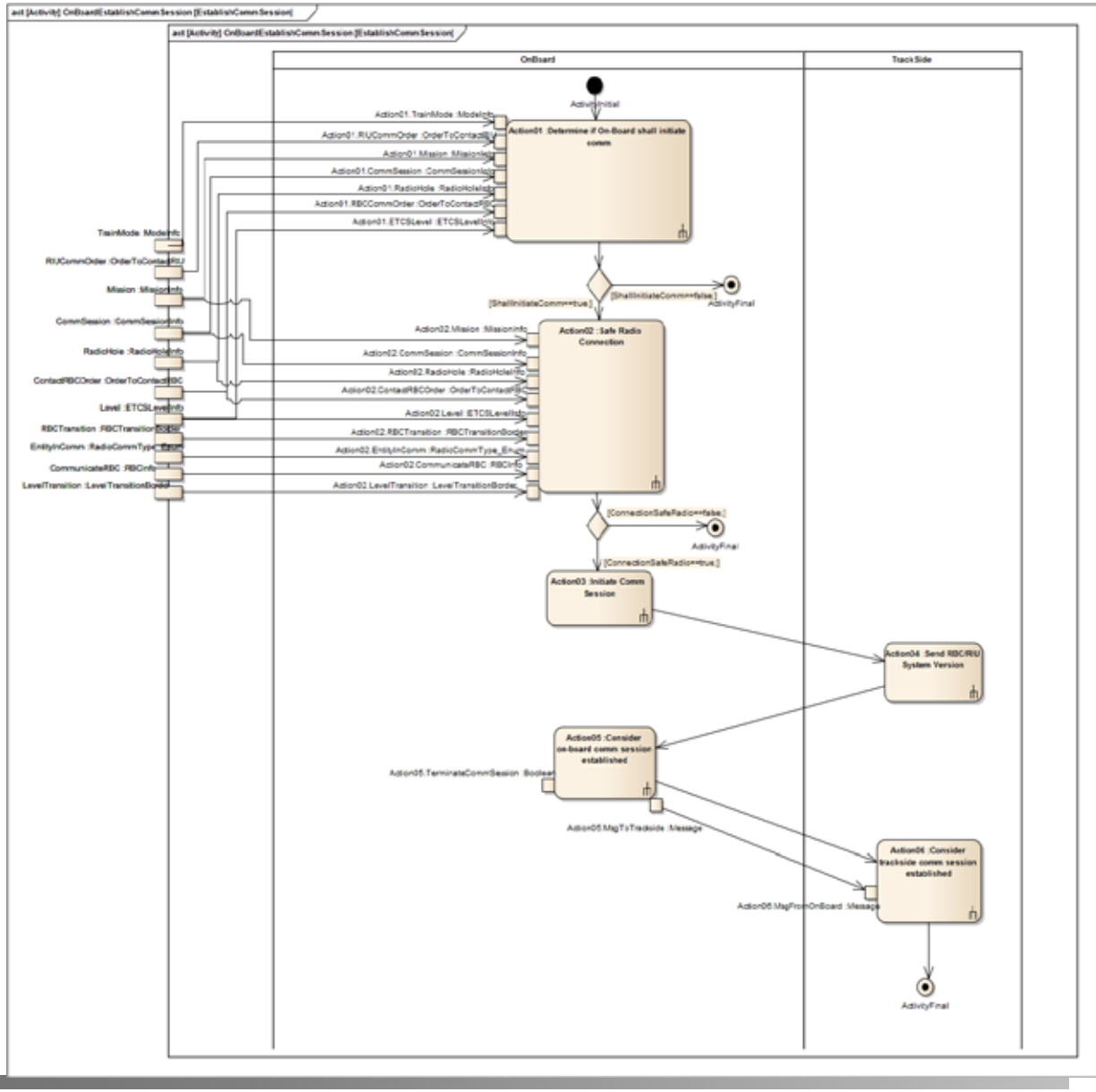
Function structure

- Very brief description of the function structure
  - **Behavior** of the Block “OnBoardEstablishingCommSession” is described



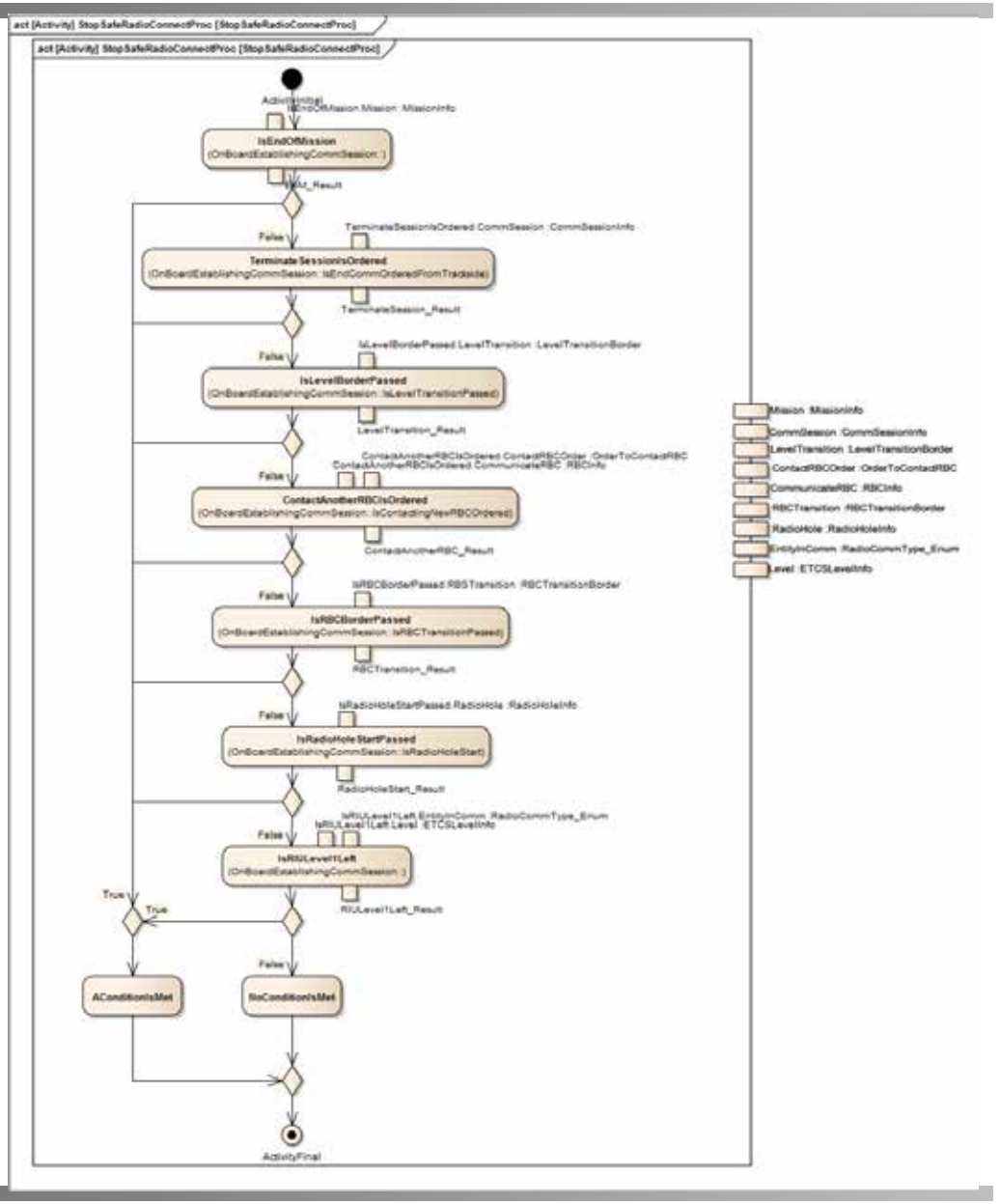
Main activity diagram

- A **main activity** describe the **behavior** of the block “OnBoardEstablishing CommSession”
  - **Call behavior actions** are used to call **nested activities**
  - **Data flow** pass through activities input and output parameters



Sub-activity

- Basics computation are made by **calling operation**
- **Operation results** are used to take **decision**
- **Connectors** with the activity input parameters are **hidden**



RESULTS OF BENCHMARK

Conclusion on the use of EA

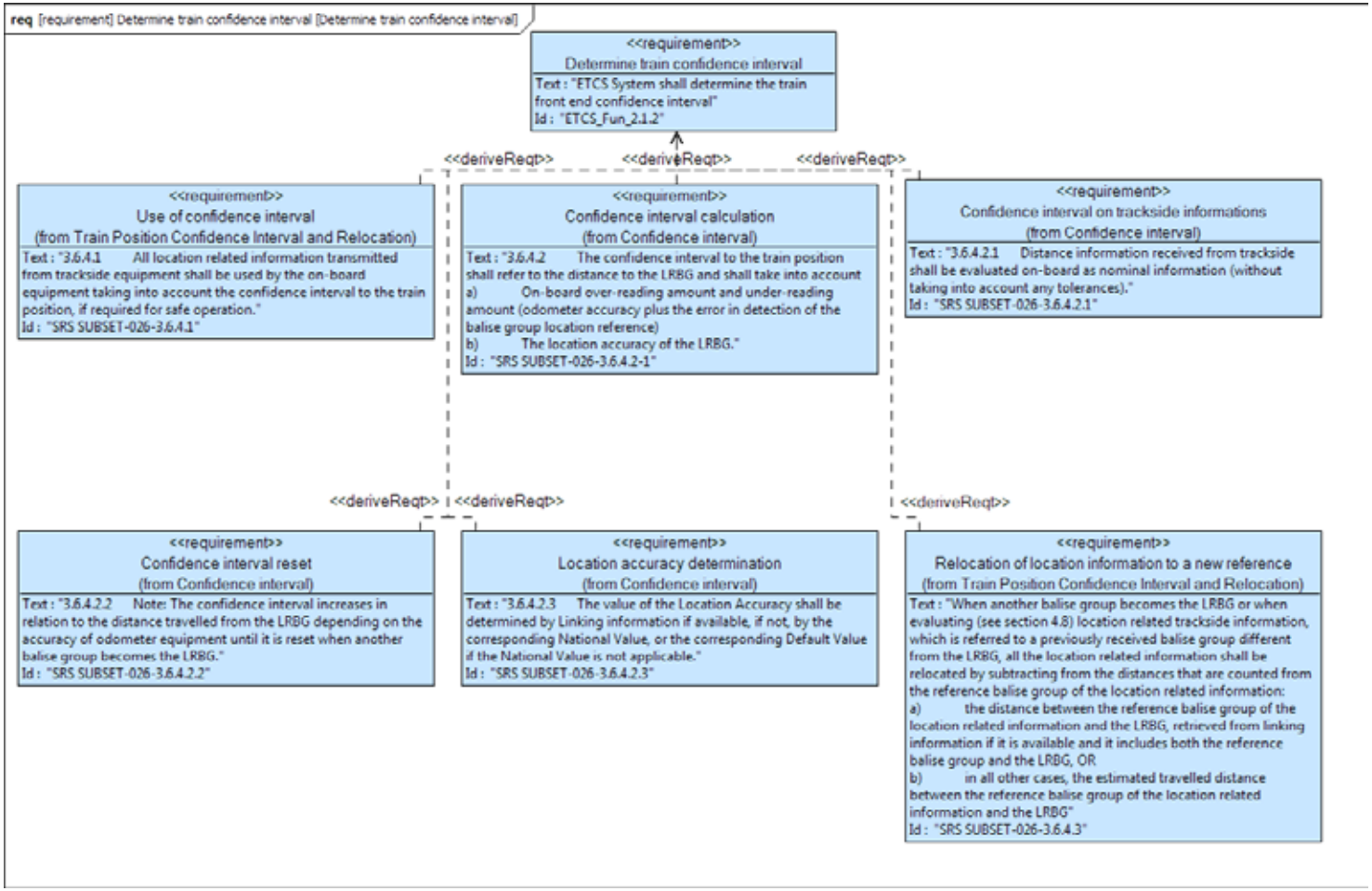
- Benefits
  - ***User-friendly*** tool
  - Showing **good performance** (looks stable, responsive UI)
- Shortcomings
  - Difficulty to **hide / show** parts of model
  - Browsing through model diagram could be better
  - Simulation or code generation need to create a specific and **different model**
  - Creating manually the requirements **takes too long** and produces **too many diagrams**

Conclusion of the use of SysML

- Benefits
  - Graphical language **easy to understand**
  - **Different view** of a system: requirements, logical structure, behavior, physical structure, etc.
  - Modeling the SRS functions **structure** with SysML **improves the comprehension** of how the functions interact
    - More important than the **behavior** model
- Shortcomings
  - **Semantic not strong** enough: language has to be adapted for OpenETCS
  - All the model information **cannot stand only on diagrams**

Questions ?

BACKUP


req [requirement] Determine train confidence interval [Determine train confidence interval]
<<requirement>>
Determine train confidence interval
Text : "ETCS System shall determine the train front end confidence interval"
Id : "ETCS_Fun_2.1.2"
<<deriveReqt>>
<<deriveReqt>>
<<deriveReqt>>
<<requirement>>
Use of confidence interval
(from Train Position Confidence Interval and Relocation)
Text : "3.6.4.1 All location related information transmitted from trackside equipment shall be used by the on-board equipment taking into account the confidence interval to the train position, if required for safe operation."
Id : "SRS SUBSET-026-3.6.4.1"
<<requirement>>
Confidence interval calculation
(from Confidence interval)
Text : "3.6.4.2 The confidence interval to the train position shall refer to the distance to the LRBG and shall take into account
a) On-board over-reading amount and under-reading amount (odometer accuracy plus the error in detection of the balise group location reference)
b) The location accuracy of the LRBG."
Id : "SRS SUBSET-026-3.6.4.2-1"
<<requirement>>
Confidence interval on trackside informations
(from Confidence interval)
Text : "3.6.4.2.1 Distance information received from trackside shall be evaluated on-board as nominal information (without taking into account any tolerances)."
Id : "SRS SUBSET-026-3.6.4.2.1"
<<deriveReqt>>
<<deriveReqt>>
<<deriveReqt>>
<<requirement>>
Confidence interval reset
(from Confidence interval)
Text : "3.6.4.2.2 Note: The confidence interval increases in relation to the distance travelled from the LRBG depending on the accuracy of odometer equipment until it is reset when another balise group becomes the LRBG."
Id : "SRS SUBSET-026-3.6.4.2.2"
<<requirement>>
Location accuracy determination
(from Confidence interval)
Text : "3.6.4.2.3 The value of the Location Accuracy shall be determined by Linking information if available, if not, by the corresponding National Value, or the corresponding Default Value if the National Value is not applicable."
Id : "SRS SUBSET-026-3.6.4.2.3"
<<requirement>>
Relocation of location information to a new reference
(from Train Position Confidence Interval and Relocation)
Text : "When another balise group becomes the LRBG or when evaluating (see section 4.8) location related trackside information, which is referred to a previously received balise group different from the LRBG, all the location related information shall be relocated by subtracting from the distances that are counted from the reference balise group of the location related information:
a) the distance between the reference balise group of the location related information and the LRBG, retrieved from linking information if it is available and it includes both the reference balise group and the LRBG, OR
b) in all other cases, the estimated travelled distance between the reference balise group of the location related information and the LRBG"
Id : "SRS SUBSET-026-3.6.4.3"