

An Adventure with Capella A study from NEXTRAIL

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2. NEXTRAIL's focus points on Capella
3. Project specific experiences/analysis with Capella
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Kick-off to the adventure

Who is Harish?

- ❑ 24 Years old
- ❑ Railway Engineering Graduate from Technical University of Munich (M.Sc.)
- ❑ Working as Systems Engineer at NEXTRAIL GmbH
- ❑ Area of expertise – Automatic Train Operation (ATO)

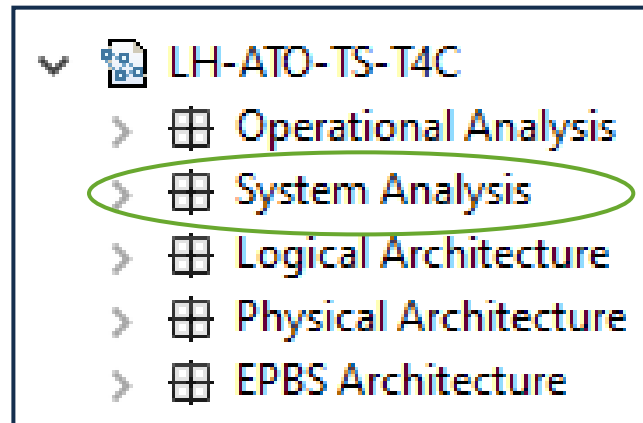
Likes to
Cook, Eat,
Travel ...



Harish Narayanan

Kick-off to the adventure - Personal Experiences with Capella

- Capella is comparatively easier to comprehend, as a first time modeller in Capella
- Capella is easy to navigate in terms of GUI
- Highly interactive in terms of viewpoints
 - Especially the Representations per category option
- Layered architecture modelling approach is beneficial, in terms of separating the needs of systems
- Hierarchy of elements provided in the modelling approach for interfaces is exceptional!
 - E.g. From creation of a data type to allocation of respective class in an functional exchange



Design Layers from Capella

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NEXTRAIL's focus points on Capella

Two major focus points,

- ✓ Systems modelling - SysML based
- ✓ Data modelling/Object Modelling – UML based

Systems Modelling:

- Used Capella to develop model based system requirement specifications
 - Using Use cases, Exchange scenarios, Functional flow diagrams, system architecture, data models (if needed), etc.

Data Modelling/Object Modelling:

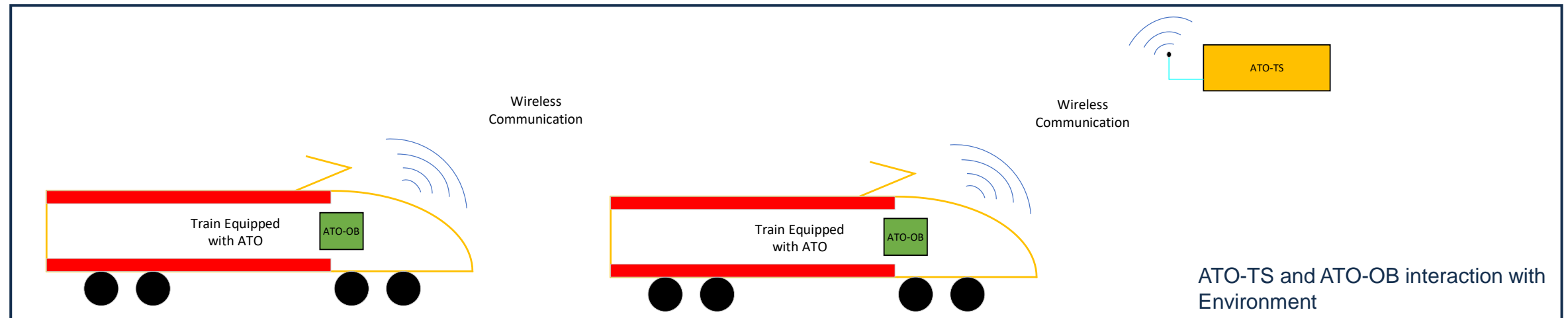
- Used Capella to develop object models for interface specifications
 - Using Class diagrams, Exchange scenarios, exchange items, etc.

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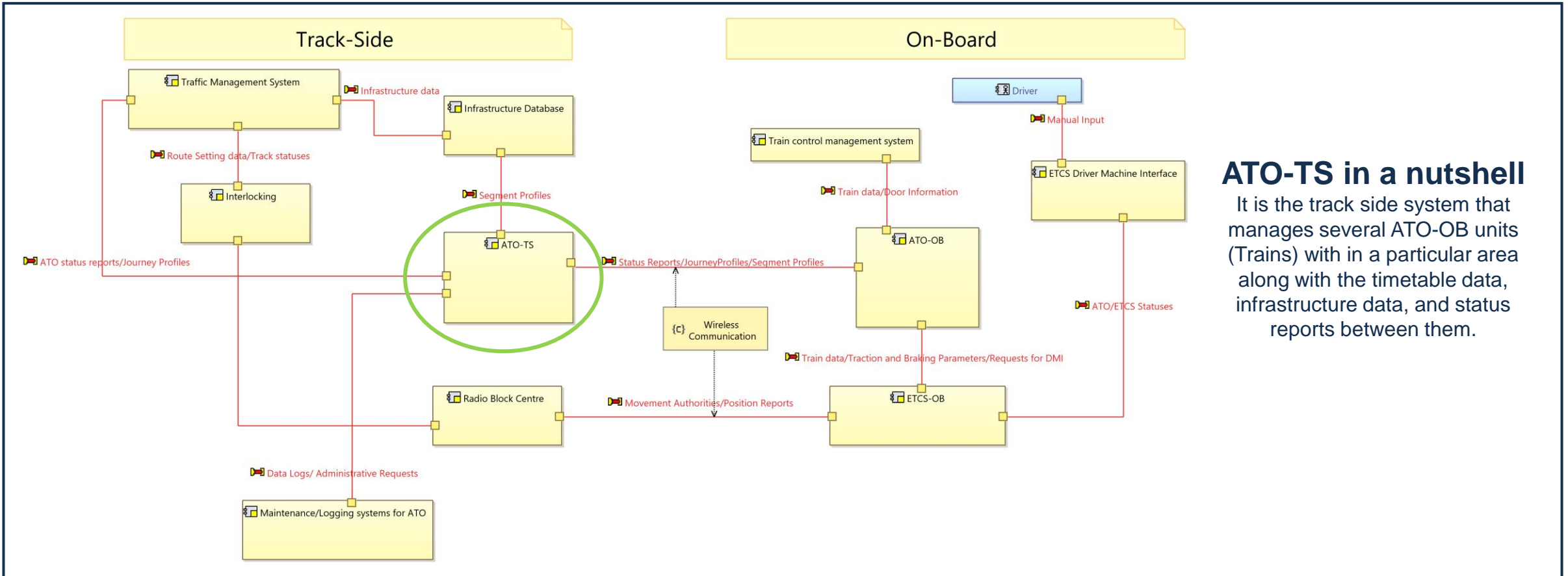
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Project specific experiences with Capella

- Involved with development of system requirement specifications for a Automatic Train Operation – Track side unit (ATO-TS)
- The project scope needed development of model based specifications using semi-formal model i.e. Use cases and sequence diagrams
 - ✓ Capella served as a perfect fit meeting our MBSE needs.
 - ✓ Added perk was Capella being open source.
 - ✓ Layer based approach proved effective to identify project specific aspects for each layer.



ATO-TS as a viewpoint in the ATO architecture



ATO-TS in a nutshell

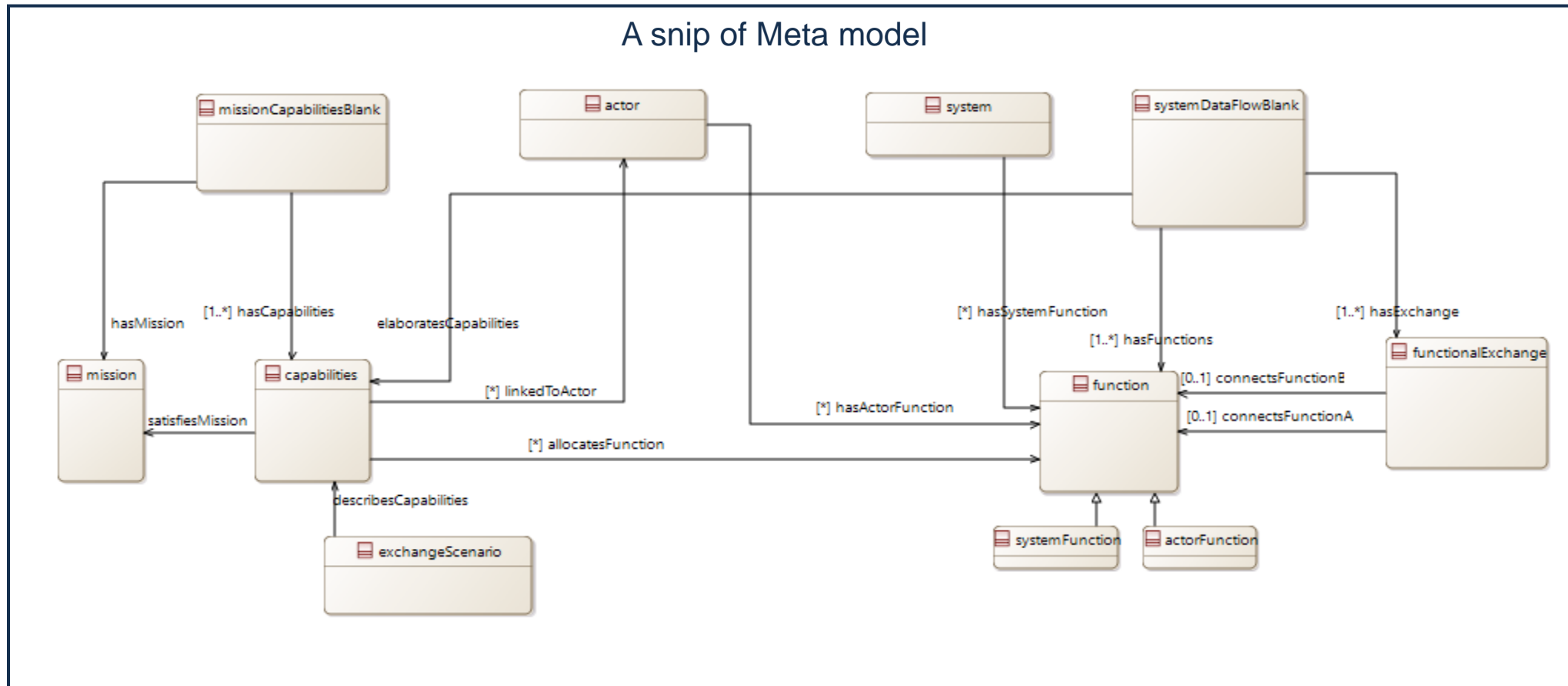
It is the track side system that manages several ATO-OB units (Trains) with in a particular area along with the timetable data, infrastructure data, and status reports between them.

Simple ATO over ETCS Architecture

Modelling Practices - Explored aspects in Capella

- ✓ The model was designed under the system analysis (SA)
- ✓ For every Use case,
 - ✓ Appropriate Capabilities were created (MCB)
 - ✓ Appropriate Functional block diagrams were created (SFDB)
 - ✓ Appropriate Exchange scenarios were created using the pre-defined functions (ES)
 - Useful functionality from Capella which allows the functions to be used in ES's provided a more holistic understanding of the model
 - ✓ Requirement modelling and linking

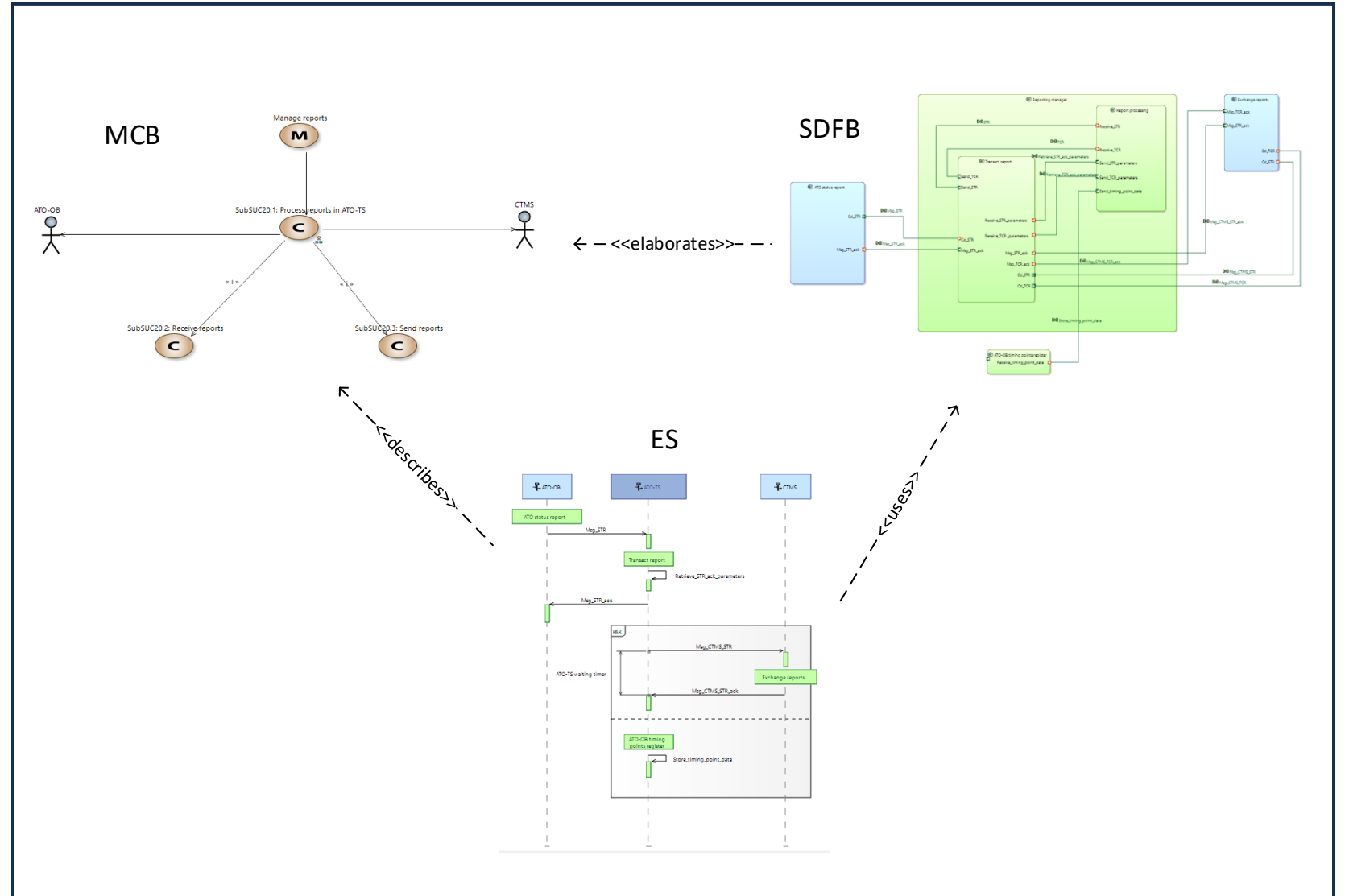
Modelling Practices - Process definition using a Meta model



System Analysis - Meta model

Modelling Practices - System requirements modelling process workflow

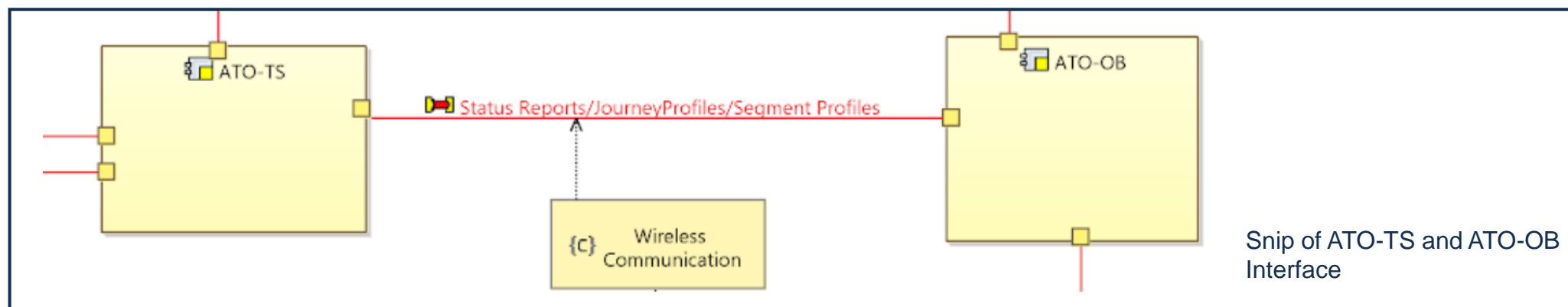
- An elaborated view with an example use case and relations between them
- Approach based on the meta model



Example – elaborated view point using the meta model

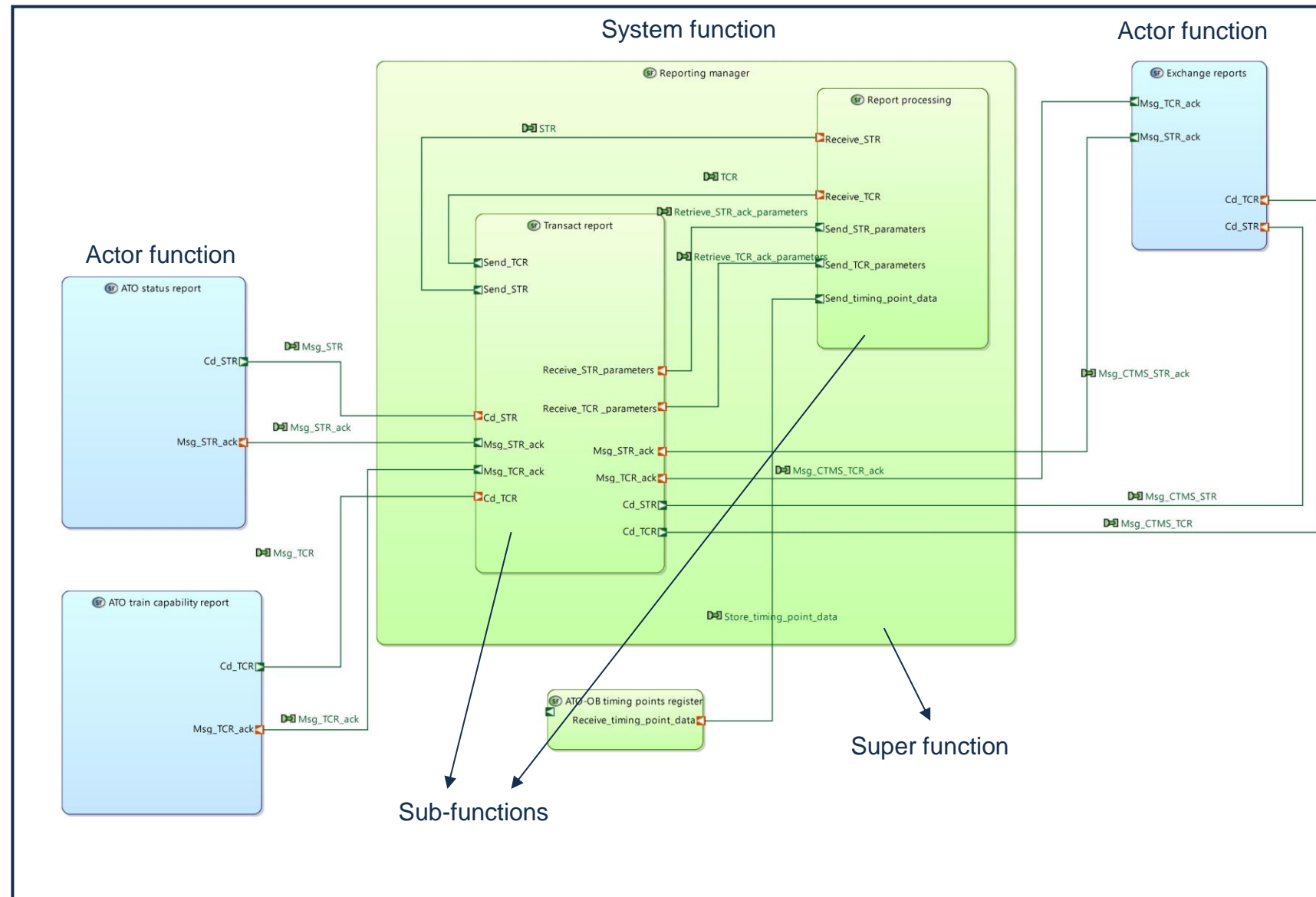
Example Use case – Status Report Management

- Status report management is one of the imperative use cases of the ATO-TS
- Prime focus / Use case story:
 - Forward the status reports from Trains to Traffic management systems
 - Forward the train capability reports from Trains to Traffic management systems
 - To generate and transmit acknowledgement reports to respective actors
- Modelling approaches:
 - Designed as a generic use case
 - Includes the management of multiple features i.e. status reports and train capability reports
 - Additional Exchange scenarios can be defined, when/where needed



Example Use case – Status Report Management

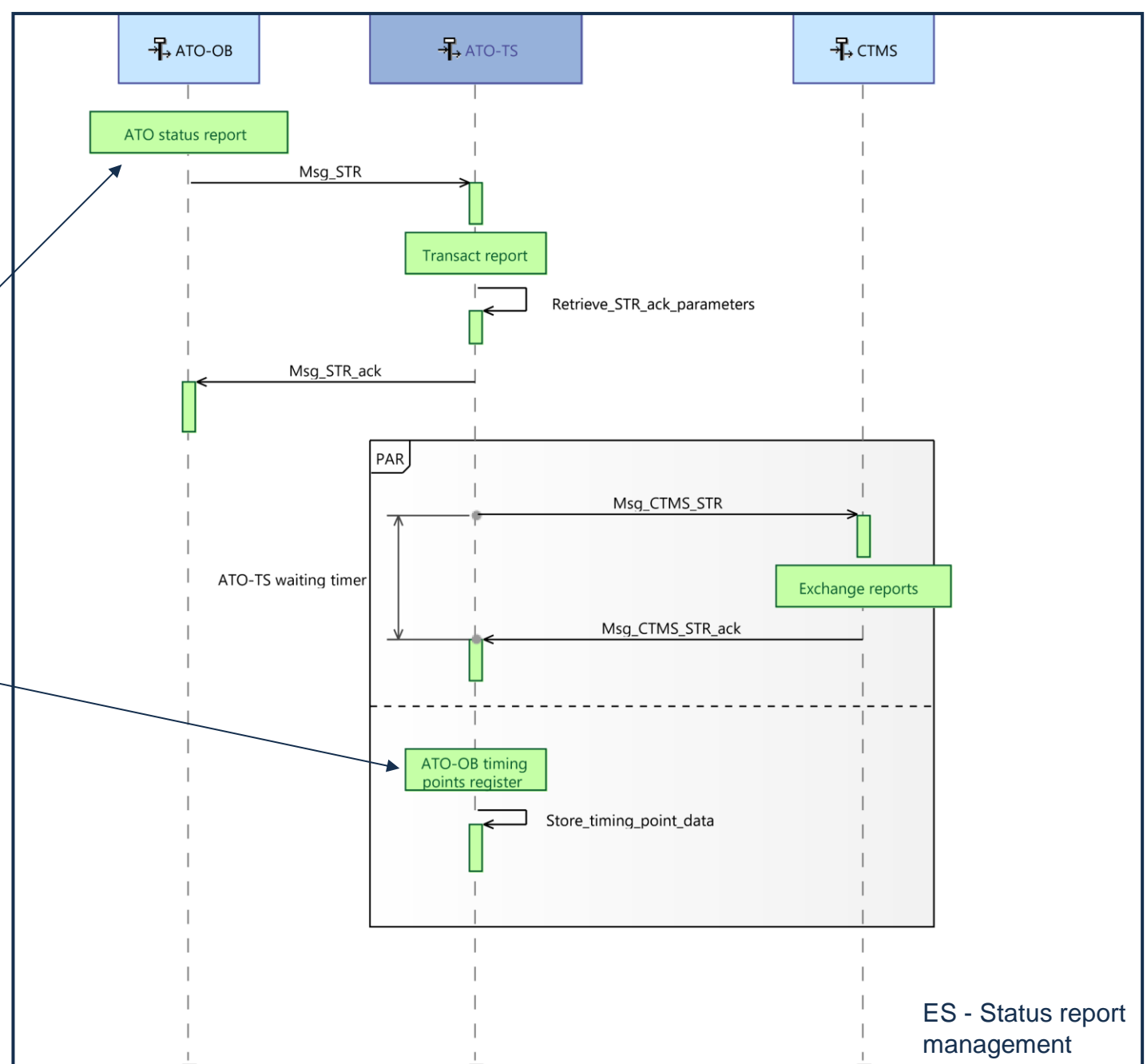
- System data flow bank diagram of Status report use case
- Provided better segregation of functions with the help of System and actor functions
- Use of Super functions for ATO-TS functionalities



SDFB – Status report management

Example Use case – Status Report Management

- Exchange scenario for a status report from ATO-OB to CTMS through ATO-TS
- Impacts of underlying SDFB's,
 - Improved visual stimulus through the functions
 - Faster ES instantiations



Modelling Practices – Integration with Team for Capella

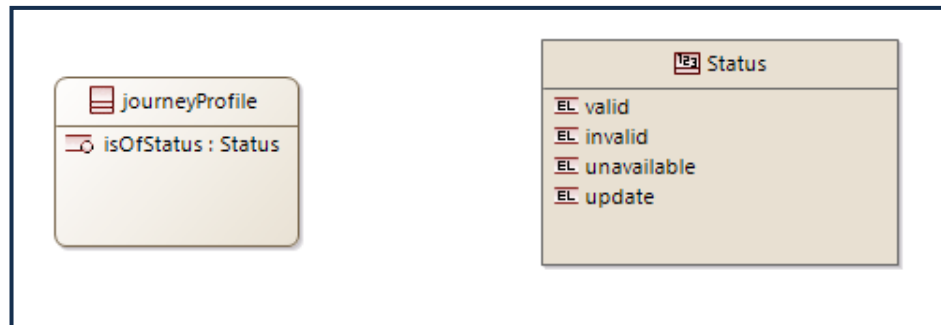
- ✓ Initially the project began without Team
- ✓ Challenges were faced in terms of sharing models, combining work, creating backups, etc.
- ✓ Later, Capella integrated with Team provided us with a safer modelling environment
 - ✓ Automatic model backup facilities
 - ✓ Better work splits
 - ✓ Remote working

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Possible propositions for improvised modelling in Capella

- Classes linking to ENUM lists (Data modelling)
 - ✓ Providing relations from classes to ENUM lists were not possible, but linking the ENUM list through the properties was possible
 - ✓ When present, it can provide better visual paradigms to the data modelling

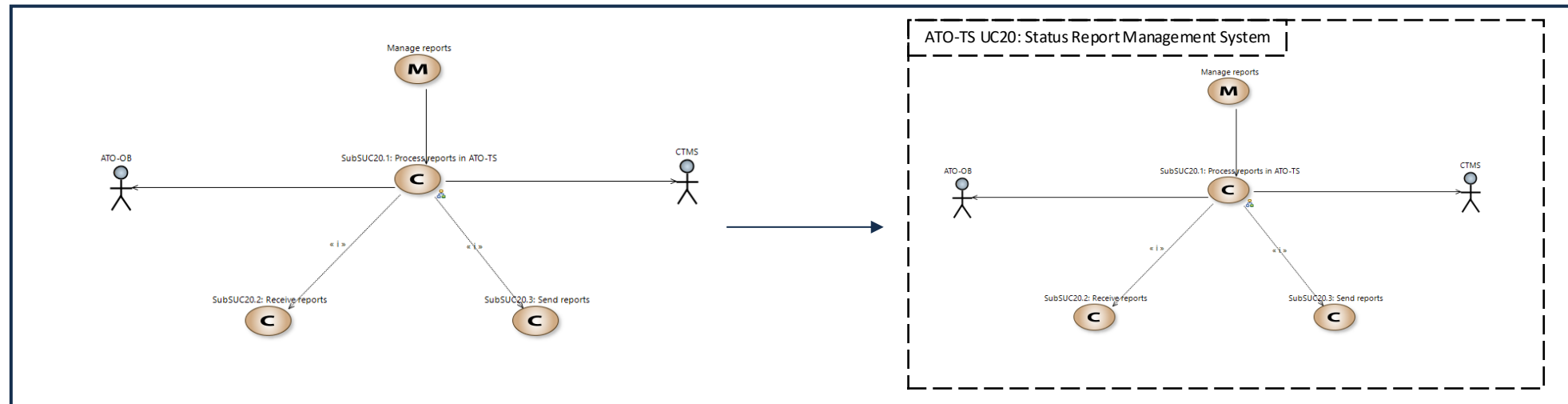


Example - Class Diagram relation

- Add-ons to convert Capella models to other SysML based software's and vice-versa
 - ✓ Can help to explore several new modelling aspects from other software's

Possible propositions for improvised modelling in Capella

- More aspects to improve the framework of a diagram e.g. options to add a frame around a use case diagram to provide heading and subheadings



Example – Diagram framework

- Merge/Diff function for local models
 - When it supports with transfer of representations as well in addition to model elements, it shall prove to be very powerful function

Q&A session!



Thank you.

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With **Virgin Hyperloop**

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