Adoption of Capella in COMAC

COMAC & Shanghai PGM

Technology Co., Ltd.

11/16/2022

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1.1 Introduction of COMAC

- COMAC functions as the main vehicle in implementing large passenger aircraft programs in China.

- COMAC is engaged in the research, manufacture and flight tests of civil aircraft and related products, as well as marketing, servicing, leasing and operations of civil aircraft.

- Vision: To deliver safer, cost-effective, comfortable and environment-friendly commercial aircraft.

1.2 Adoption of Capella in COMAC

- COMAC is adopting Capella since 2018, especially in avionics domain.
- PGM cooperates with COMAC for the implementation of Capella since 2020. Now we have developed an entire architecture design solution for avionics systems based on Capella, including interface design, common facillities design and safety analysis.
- What we will introduce today is a part of this architectual design solution, focused on interface collaborative design.

1.3 Shanghai PGM Technology Co., Ltd.

- PGM is short for Pu Gou Moutain, which is a mountain full of treasure, record in “Shan Hai Jing” (Classic of Mountains and Rivers, the earliest annals of geography in China, about 2,500 years ago).

1.4 Shanghai PGM Technology Co., Ltd.

- PGM is a leading provider of MBSE solution and consulting service in China.

TEAMCENTER

POLARION

Consulting

- MBSE training
- MBSE-transition consulting
- RE training
- Software development process consulting

IT Implementation

- Implementation of MBSE solution
- Implementation of RE solution
- Implementation of ALM solution

IT Support

- Support of MBSE System
- Support of RE System
- Support of ALM System

Co-Design

- Co-Design of complex systems as MBSE experts
- Review MBSE models of complex systems

1.5 Introduction of Speakers

- Xinyi Tang is from the Avionics Integration Department at COMAC. She and her team have adopted Capella and made efforts in collaborative architecture design modeling in the field of aviation from requirements, software specifications to detailed design work.

- Renfei Xu is the Technical Director of MBSE from PGM. He has participated in many implementation projects of MBSE in areas like Engine Control, Avionics, Mechatronics, RADAR and so on. In recent years, he is dedicated to the promotion of Capella and ARCADIA in China.

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2.1 Main Challenges Faced by COMAC

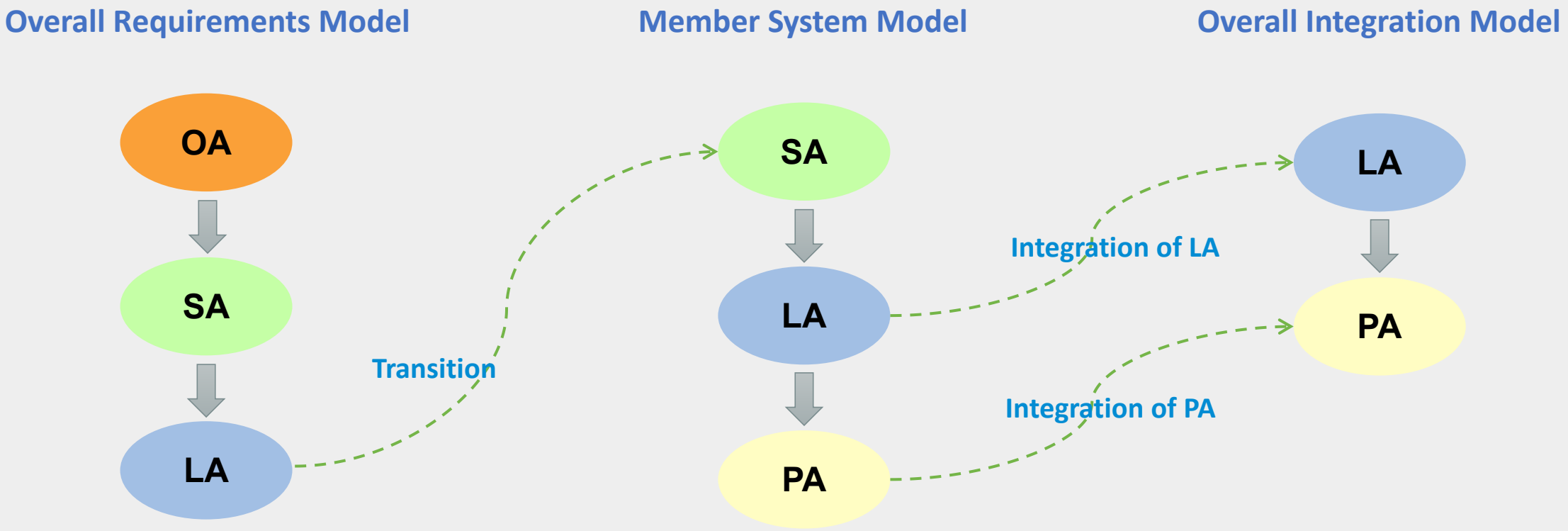
There are many member systems in avionics domain, and each of them work as an isolated island. The collaboration between different team is difficult, especially in interface design.

Different member systems will share some common facilities, for example a common switch network. Design of these common facilities also need effective collaboration.

There exist a gap between architecture design and safety analysis. Huge human effort is needed for safety analyzer to understand design solution and build safety models.

2.2 Overview of Our Architecture Design Solution

1. Modeling and transition of the overall requirements model
2. Modeling of member system models
3. Integration to the overall integration model



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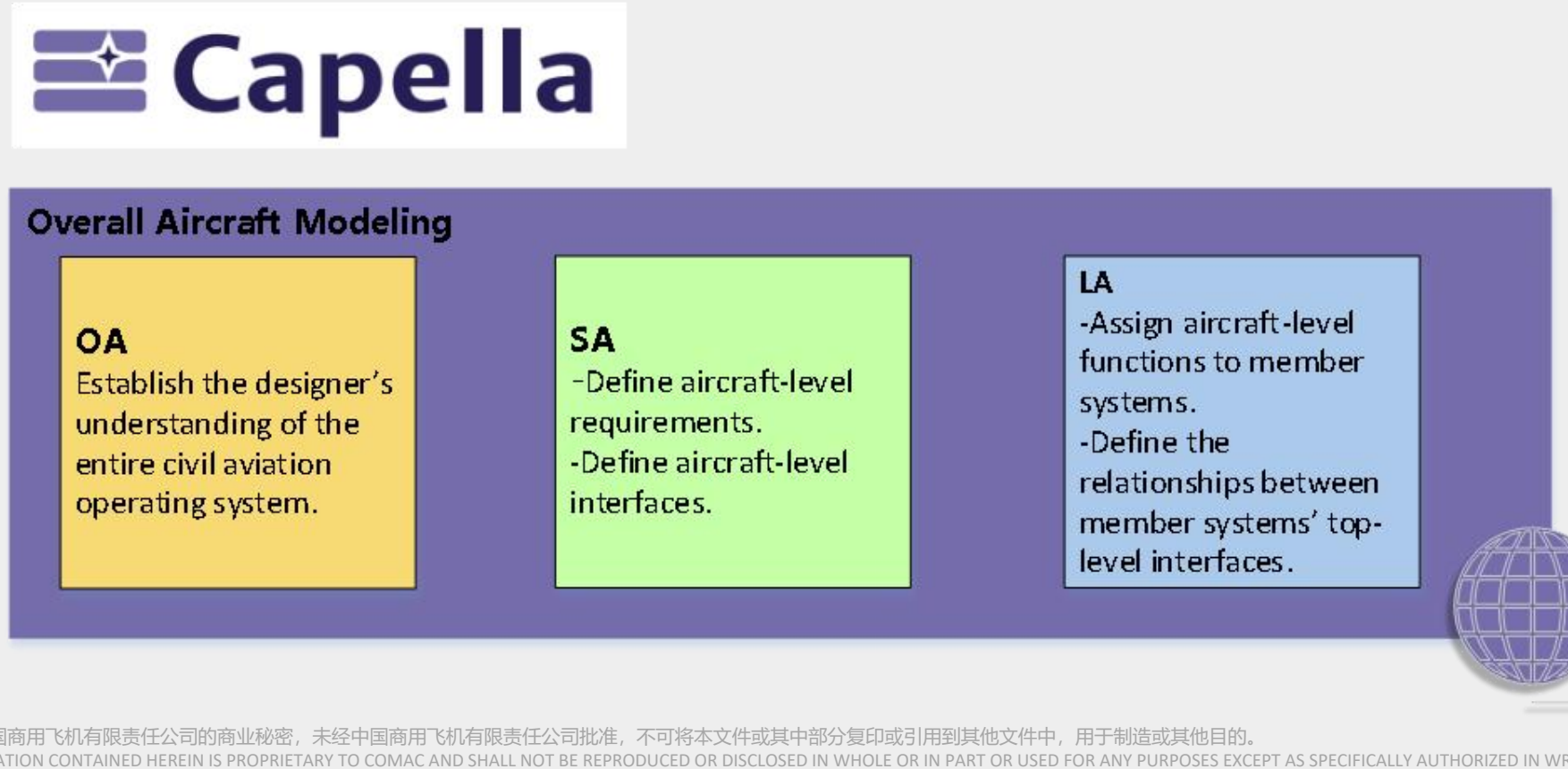
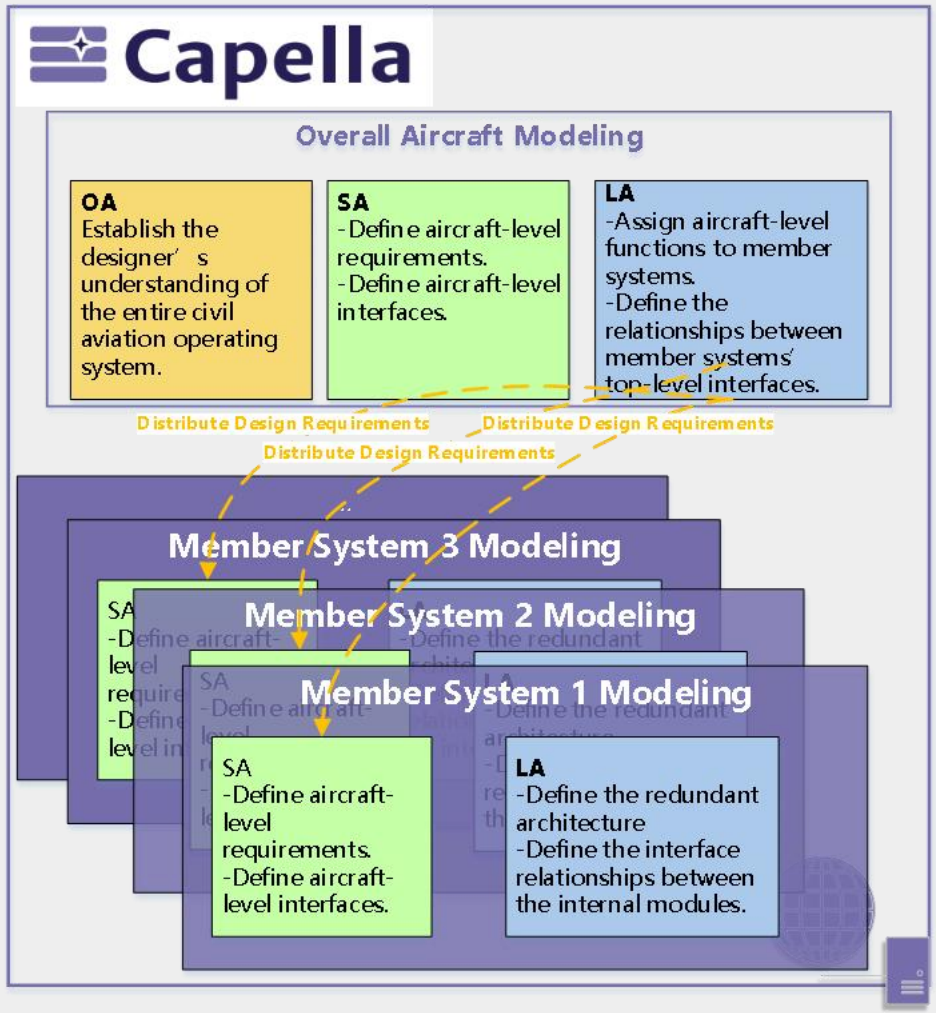
3.1 Modeling of the Overall Requirements Model

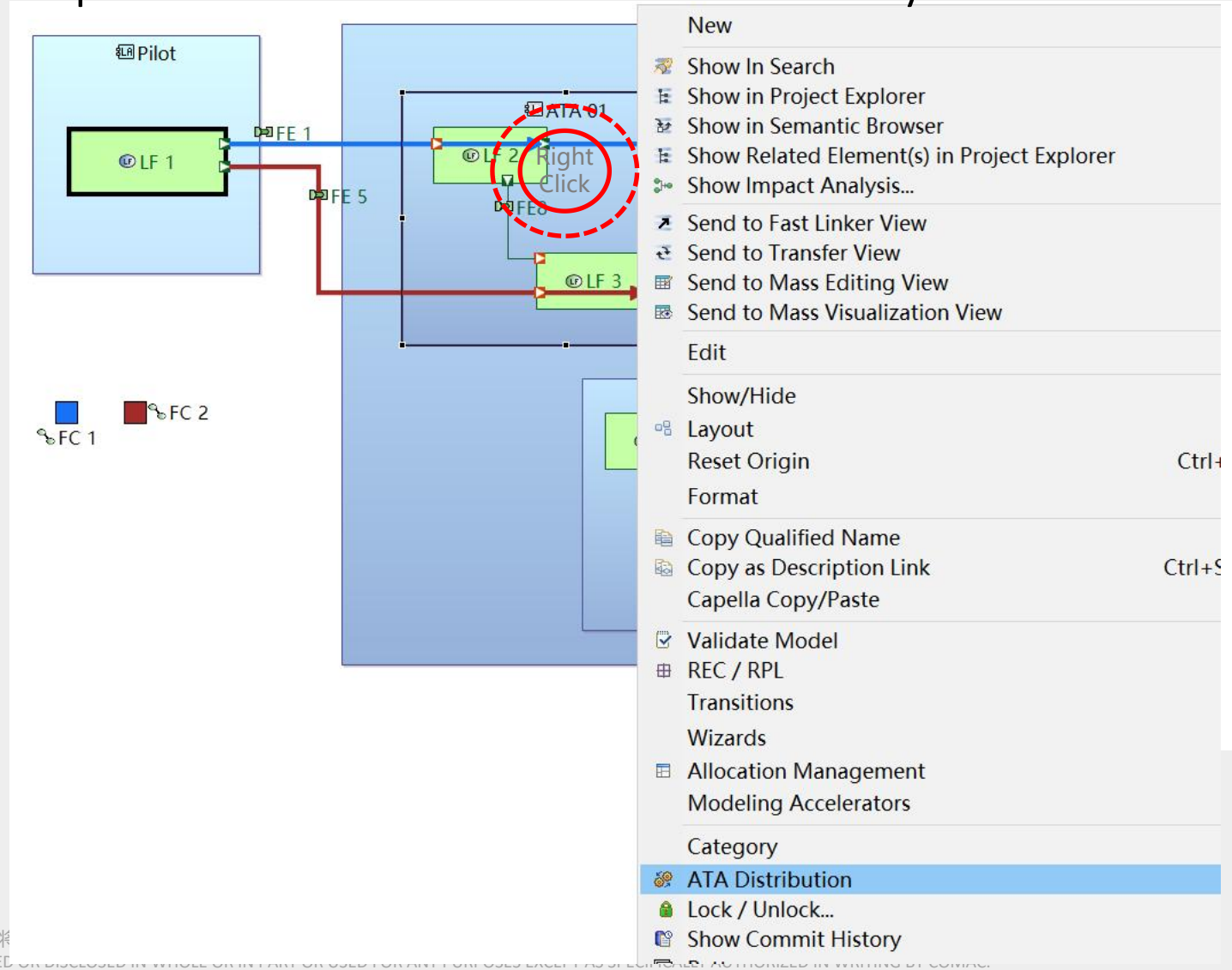
- Establish the designer’s understanding of the entire civil aviation operating system.
- Define aircraft-level requirements and aircraft-level interfaces
- Assign aircraft-level functions to member systems, and define the relationships between member systems’ top-level interfaces.



3.2 Distribute the overall requirements model

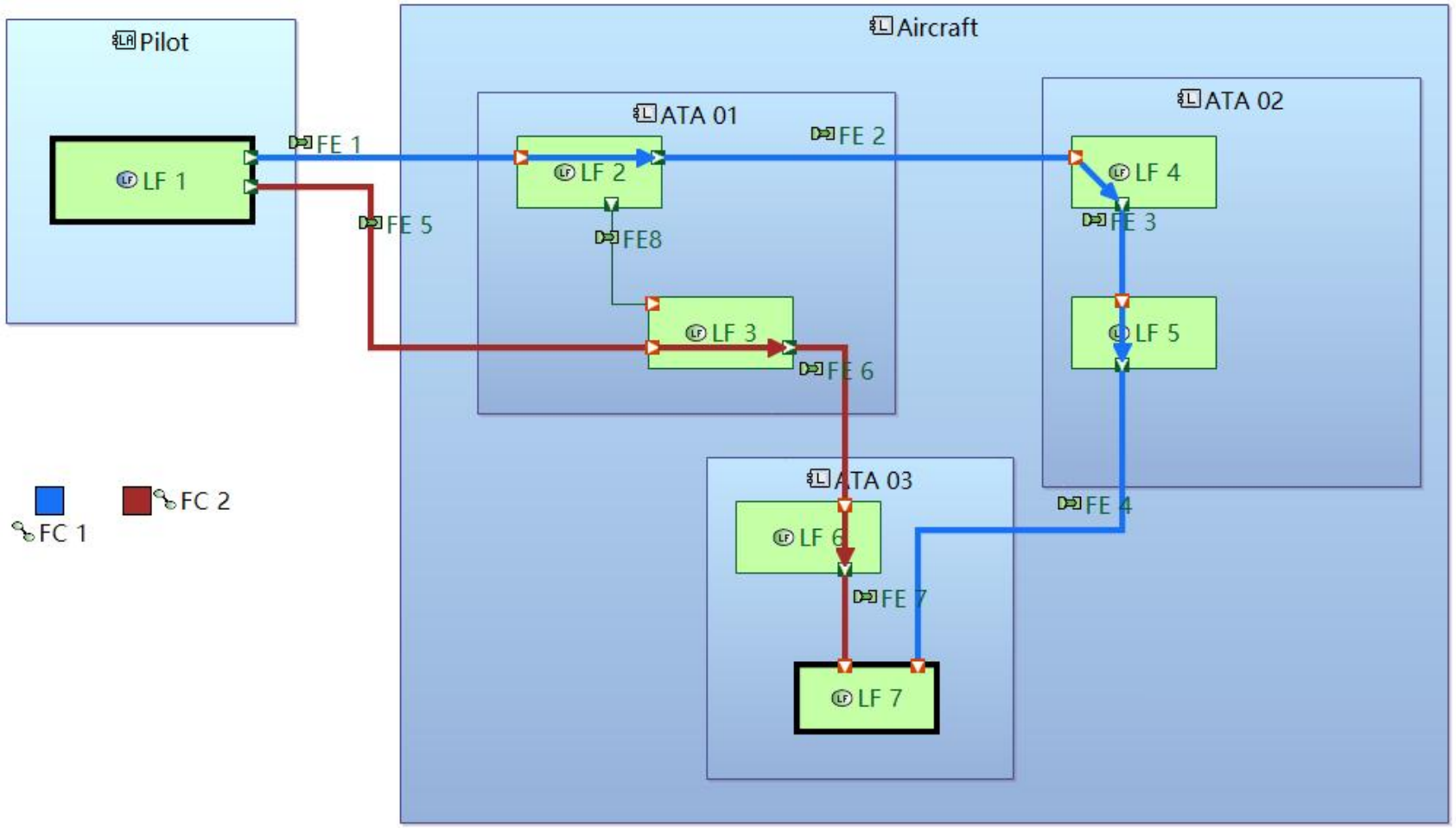
- The overall requirements model distributes top-level functions and interfaces to member systems.





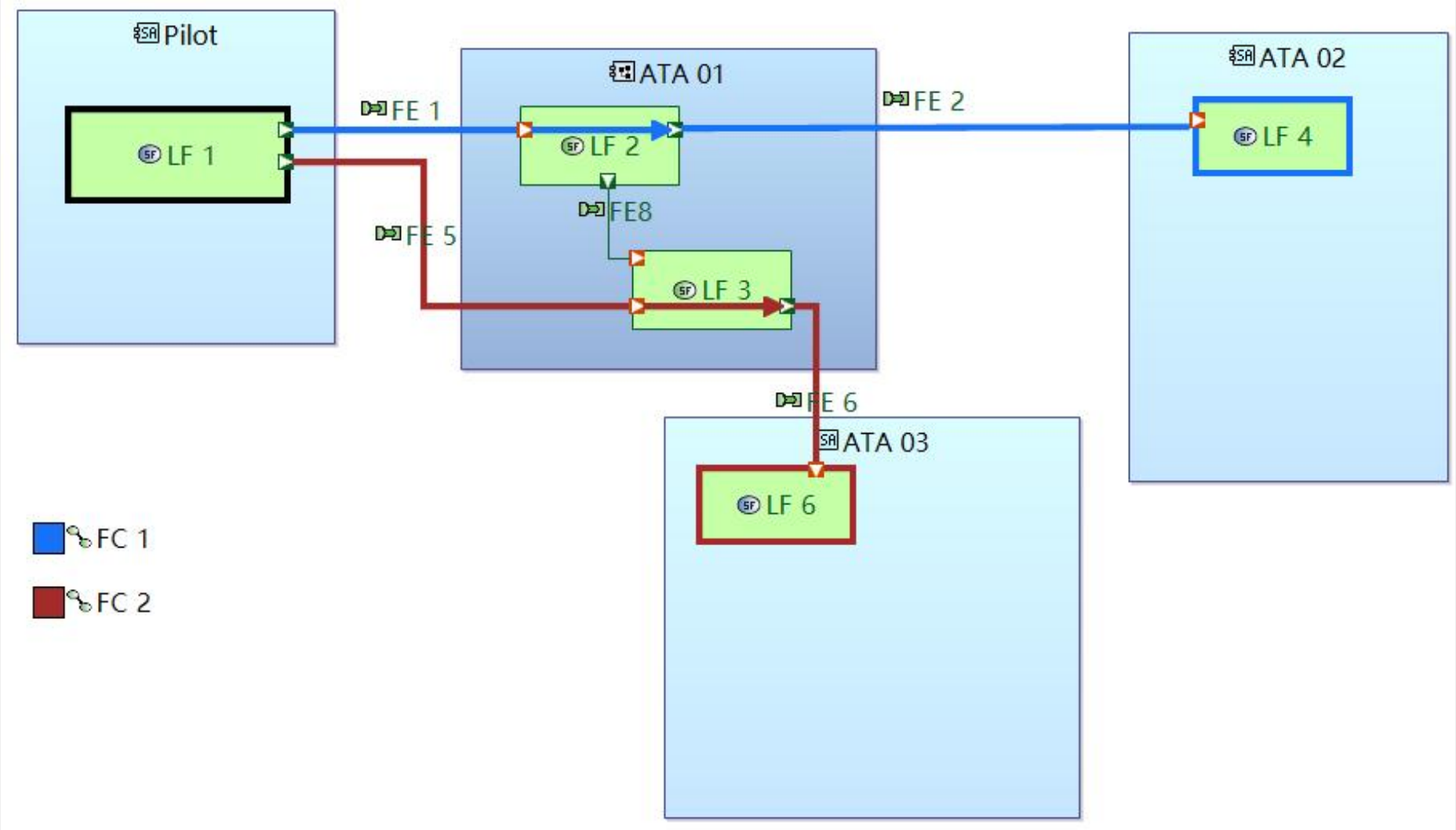
3.2 Distribute the overall requirements model

LA model of overall requirements model



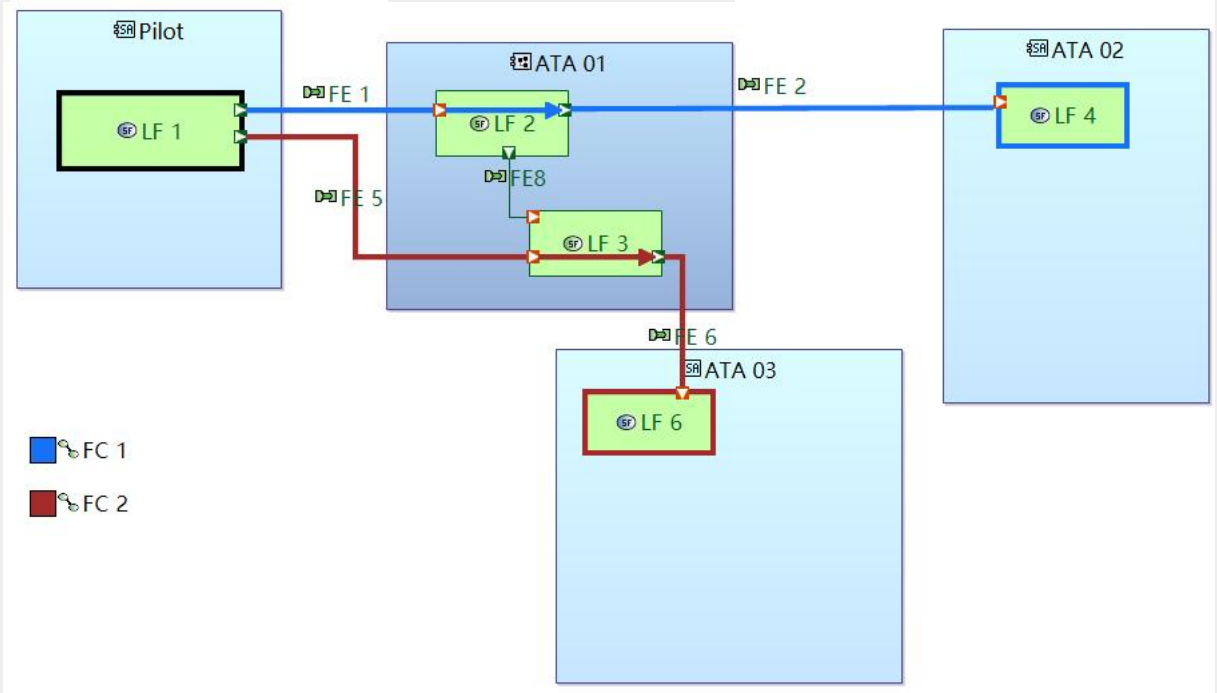
3.2 Distribute the overall requirements model

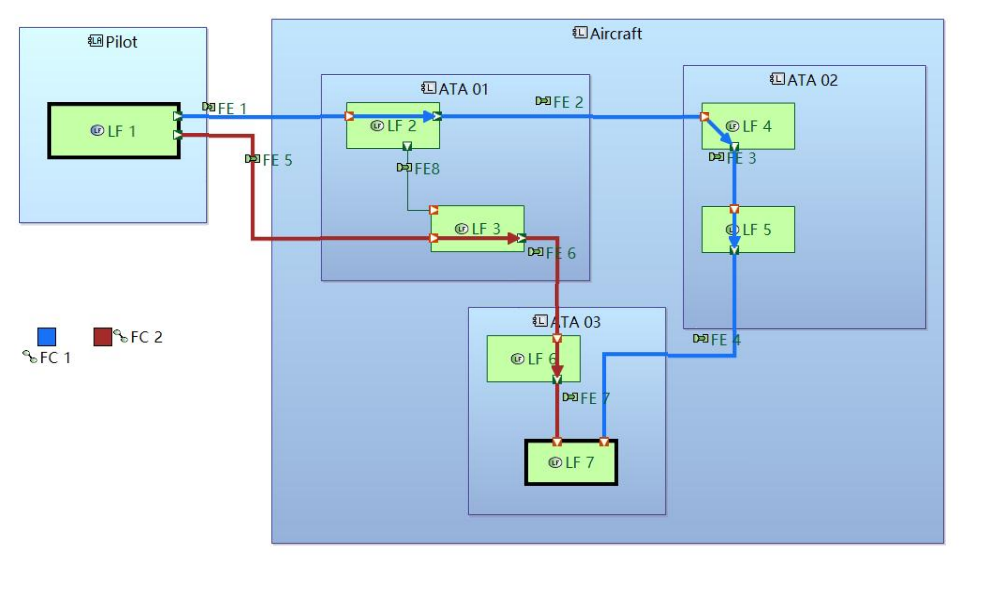
SA model of member system model after transition



3.2 Distribute the overall requirements model

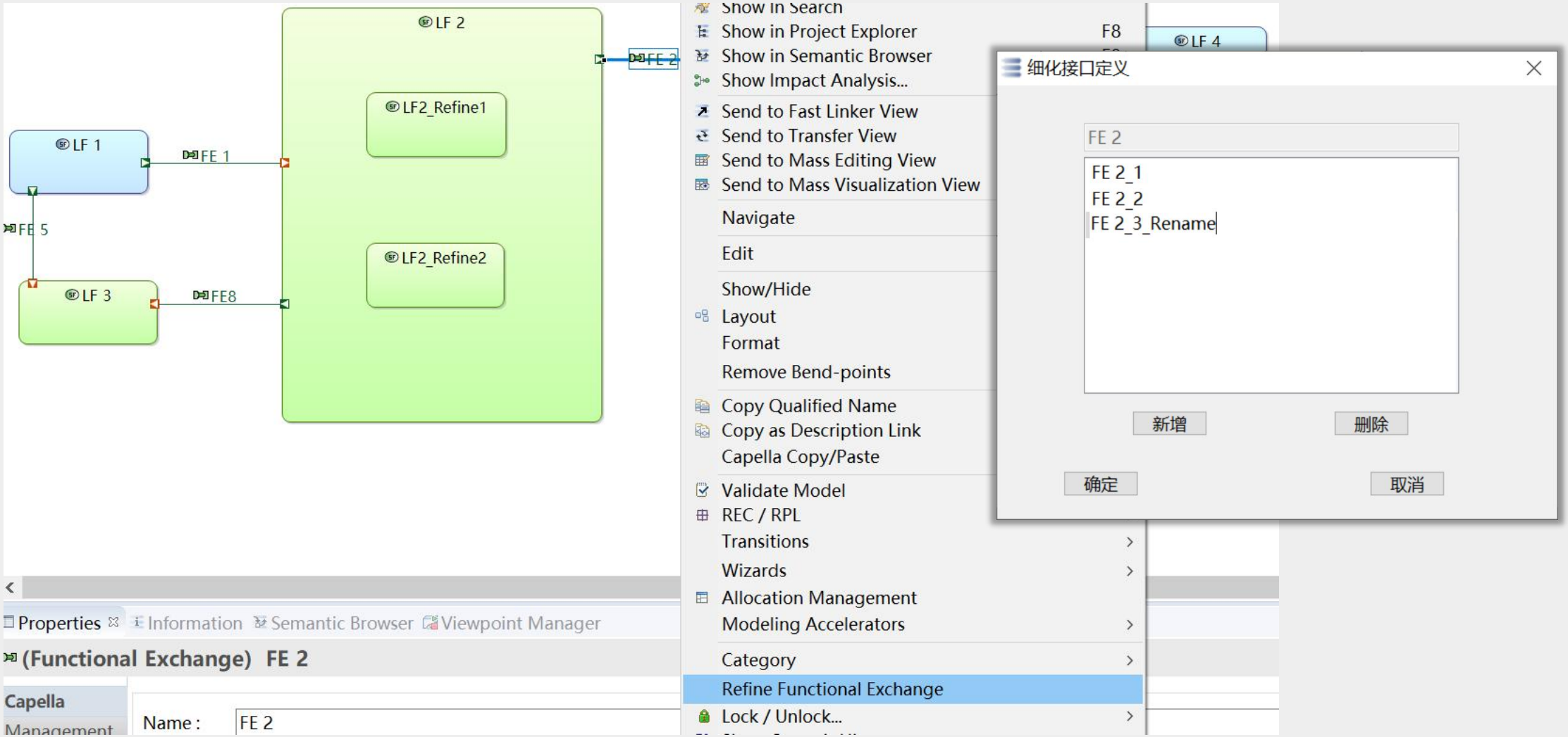
1. Distributed components are auto-created as the System element in member systems.
2. The components relevant to the distributed system will become actors after distribution.
3. The allocation relationship between functions and components as well as the functional chains will be distributed to member systems.





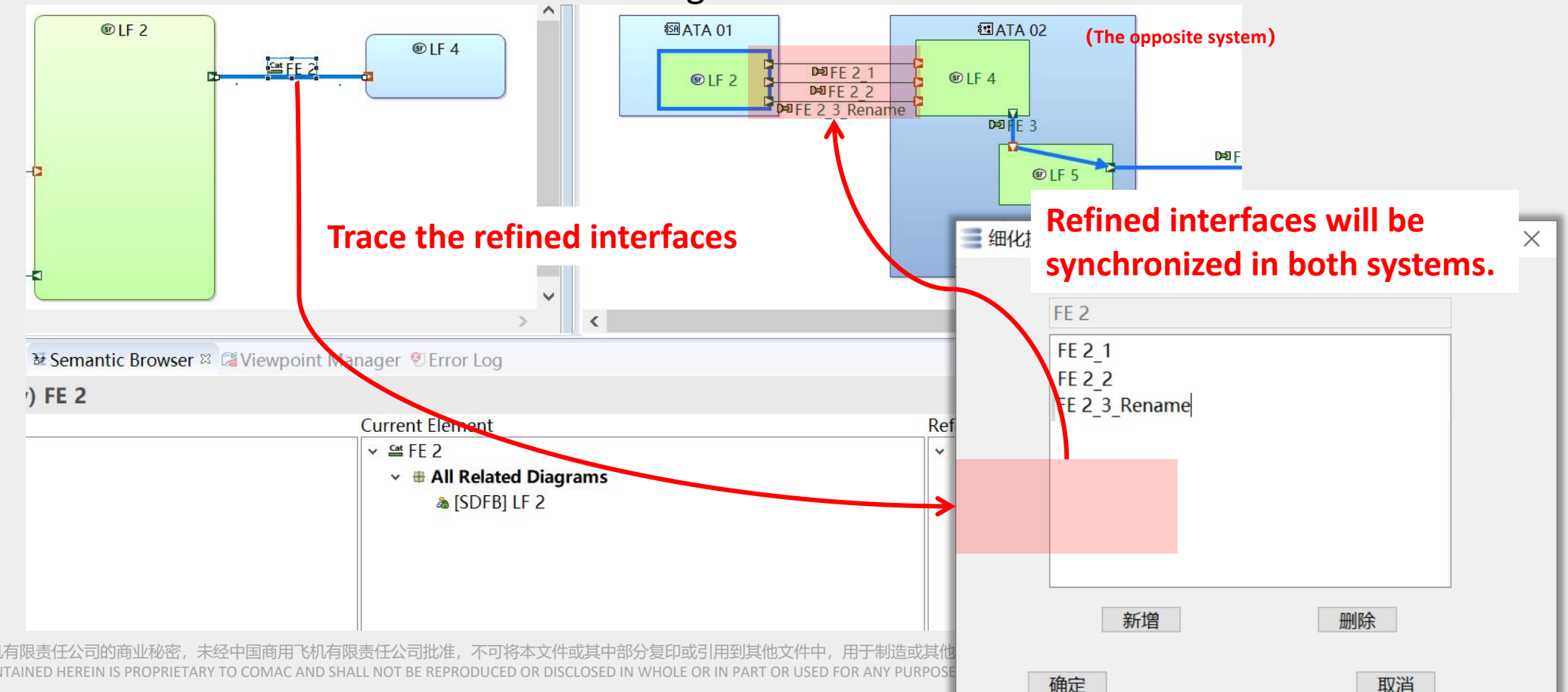
3.3 SA/LA modeling--refine interfaces

- Each ATA system design team can refine the internal and external interfaces in their own ATA system model.



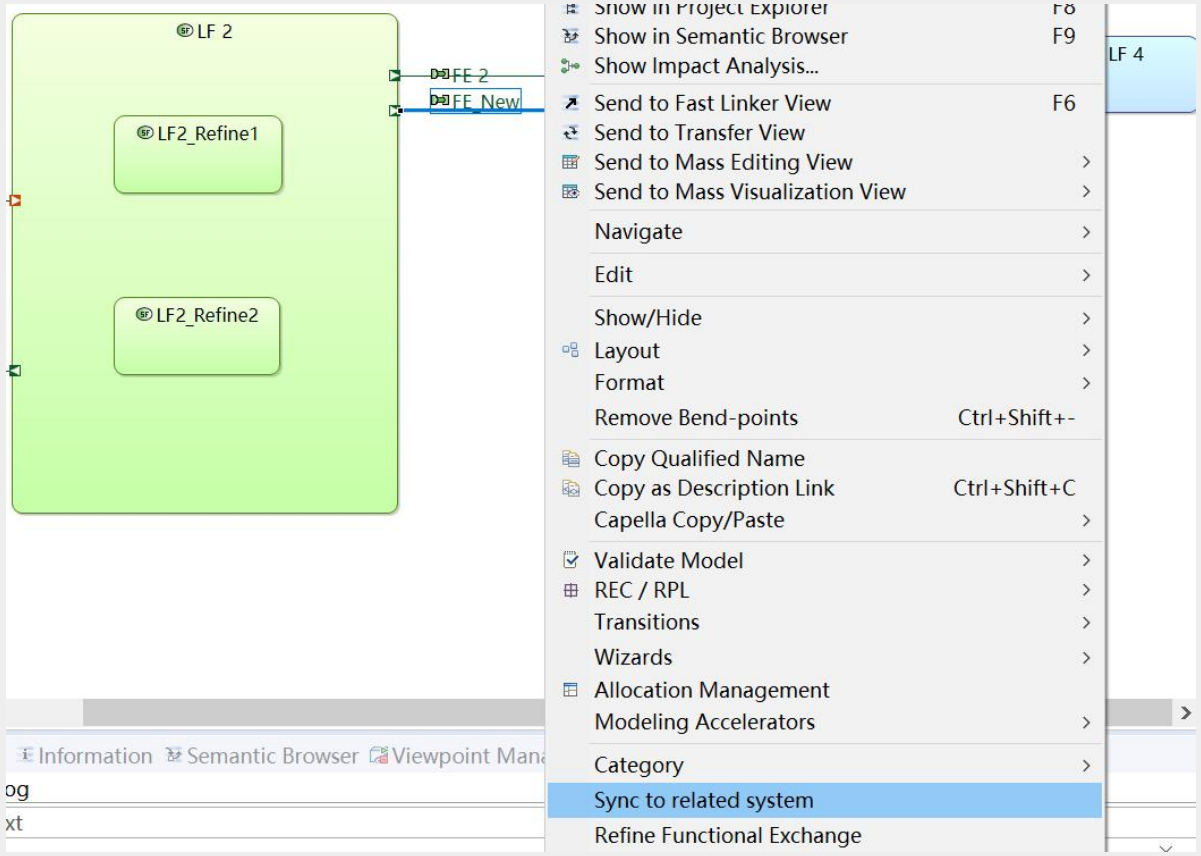
3.3 SA/LA modeling--refine interfaces

- Each ATA system design team can refine the internal and external interfaces in their own ATA system model.
  - Users can add, modify and delete the refined interfaces in the pop-up dialog.
  - If all refined interfaces are deleted, the interface will restore to original.
  - The refined interfaces can be traced back to the original interfaces.



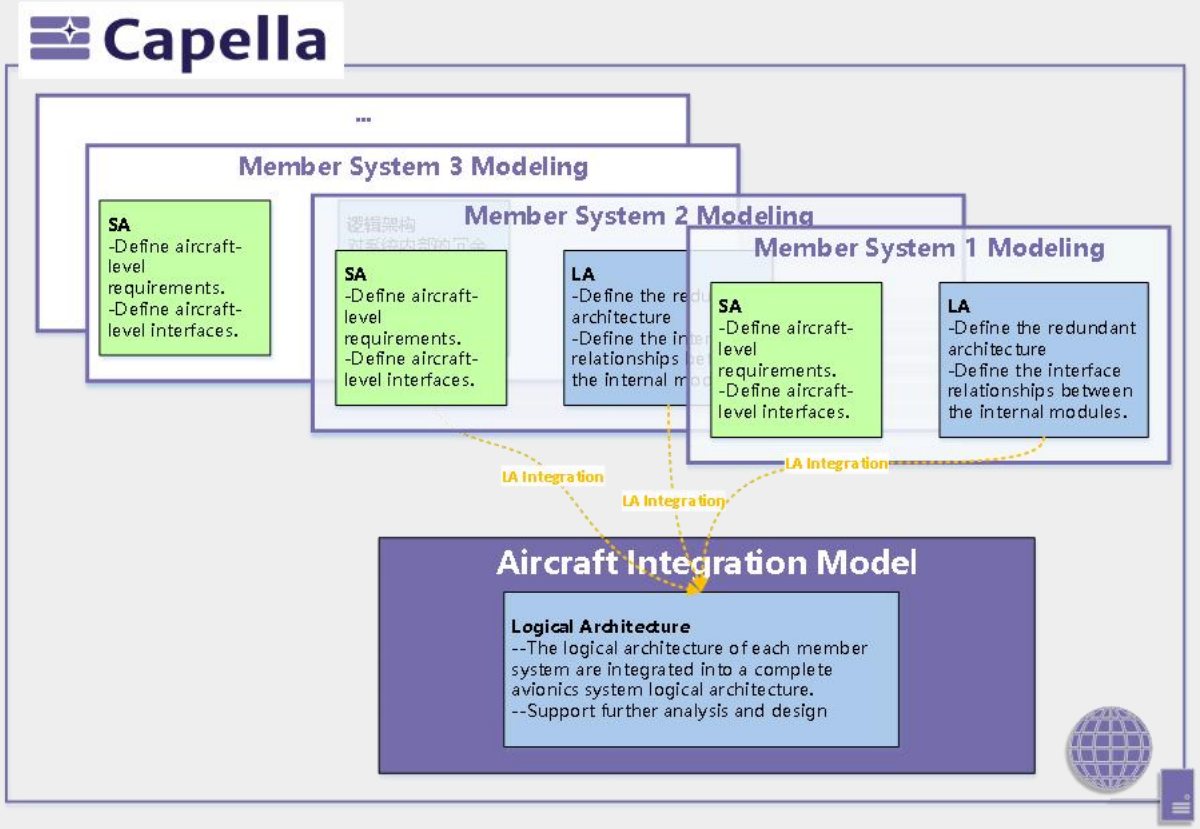
3.4 SA/LA modeling--synchronize interfaces

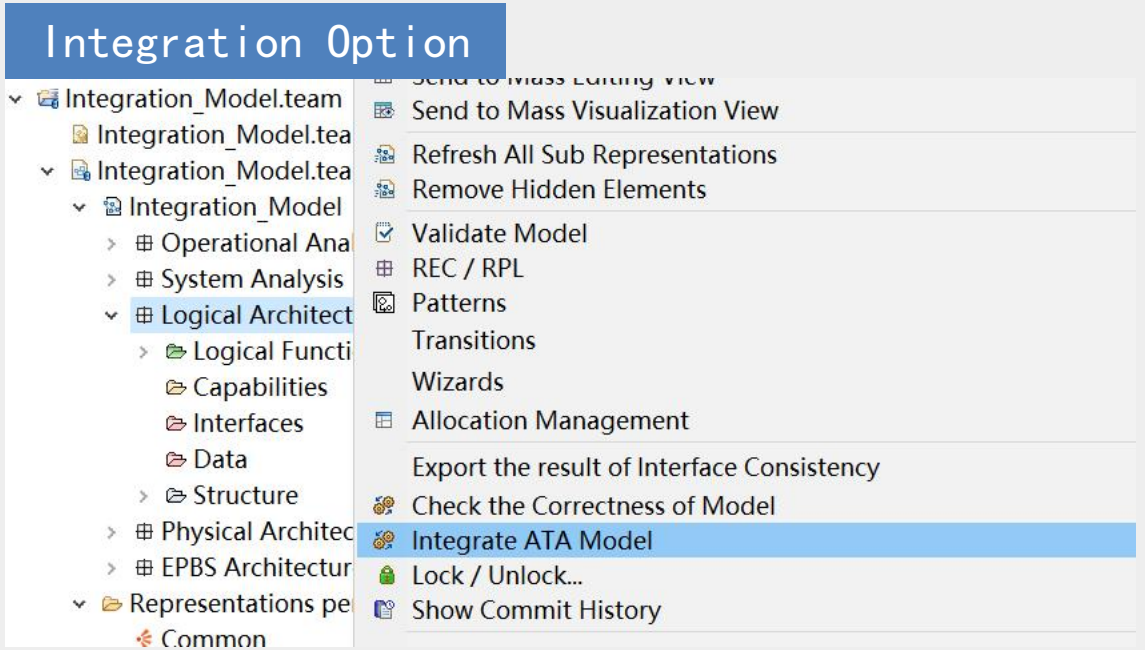
- Each member system can refine the functions and interfaces defined by the overall requirement model during SA modeling.
  - Refine top-level functions. Since new functions may interact with multiple systems, they can only be refined by the overall designer and redistributed to the relevant member systems.
  - Refine functional exchanges between top-level functions. Member systems can create interfaces and click the “Sync to related system” option to synchronize the interfaces in the other system.



3.5 Integrate the Logical Architecture of member systems

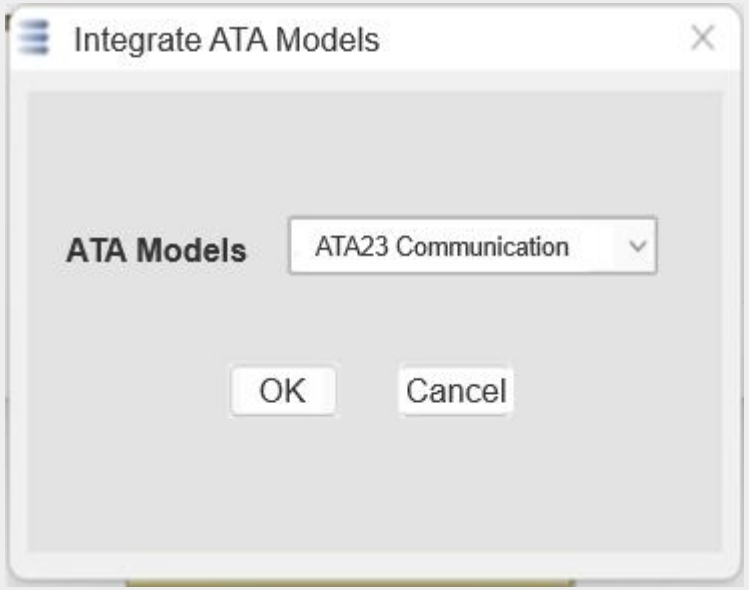
- The member systems can be merged to the integration model to get the complete set of logical architecture, which supports further analysis and design.
  - The synchronized interfaces will be identified as one interface during integration.
  - After integration, the refined interfaces can still be traced back to the original interfaces.





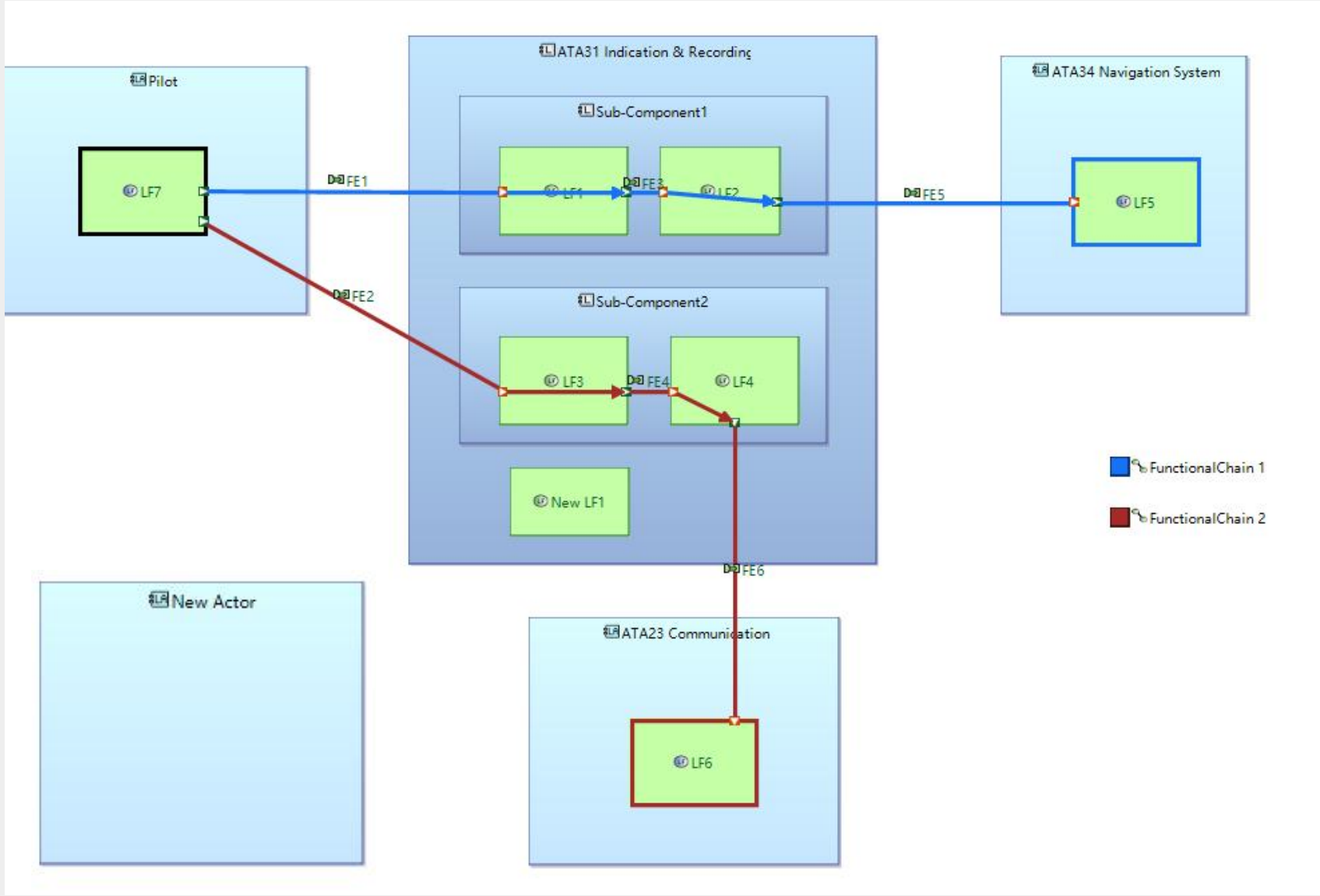
3.5 Integrate the Logical Architecture

- After clicking the "Integrate ATA Model" option, the ATA system model selection dialog will pop up.
- After selecting the ATA models to be integrated, click "OK" to complete the model integration.



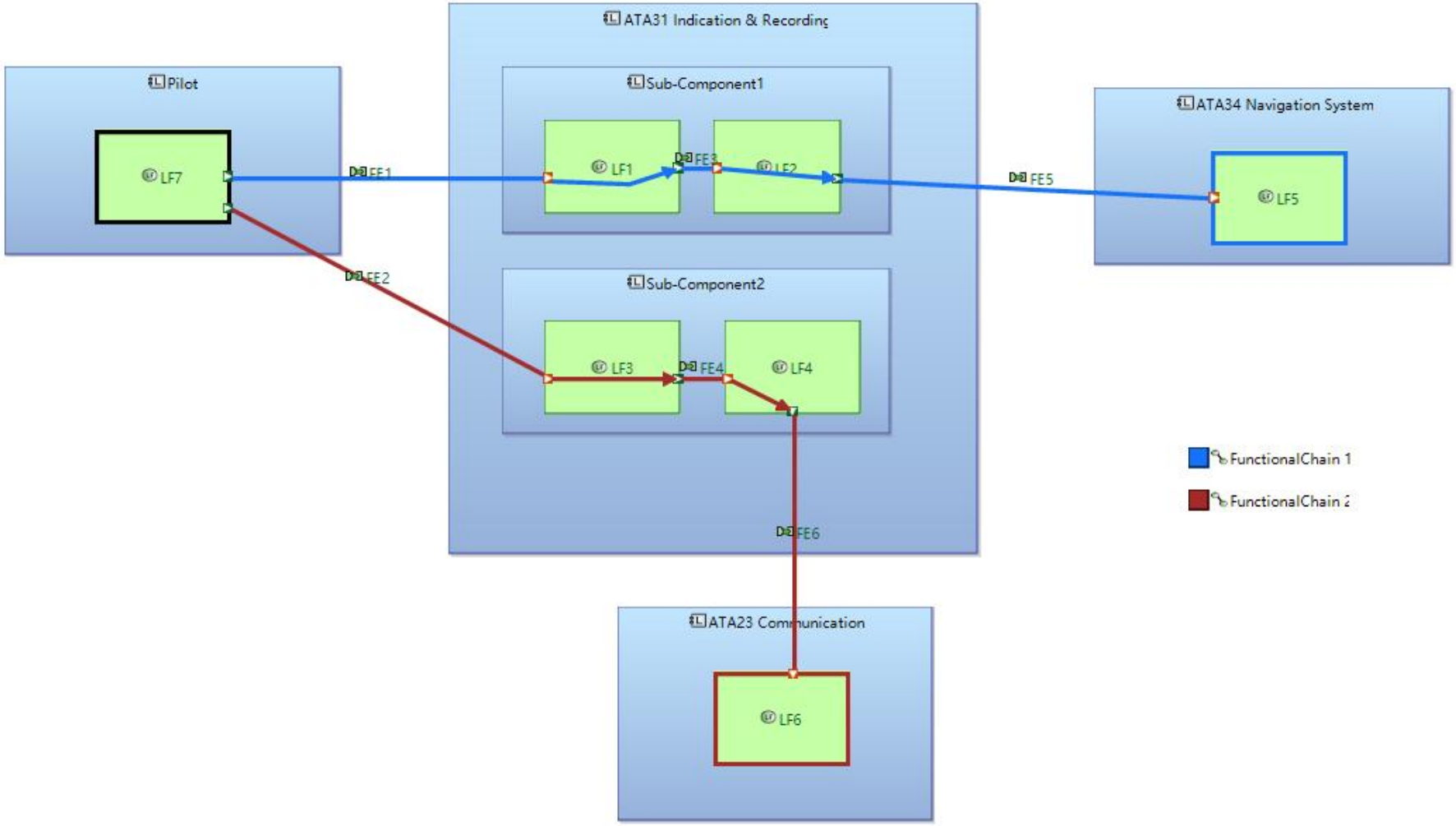
3.5 Integrate the Logical Architecture

LA model of member system model before integration



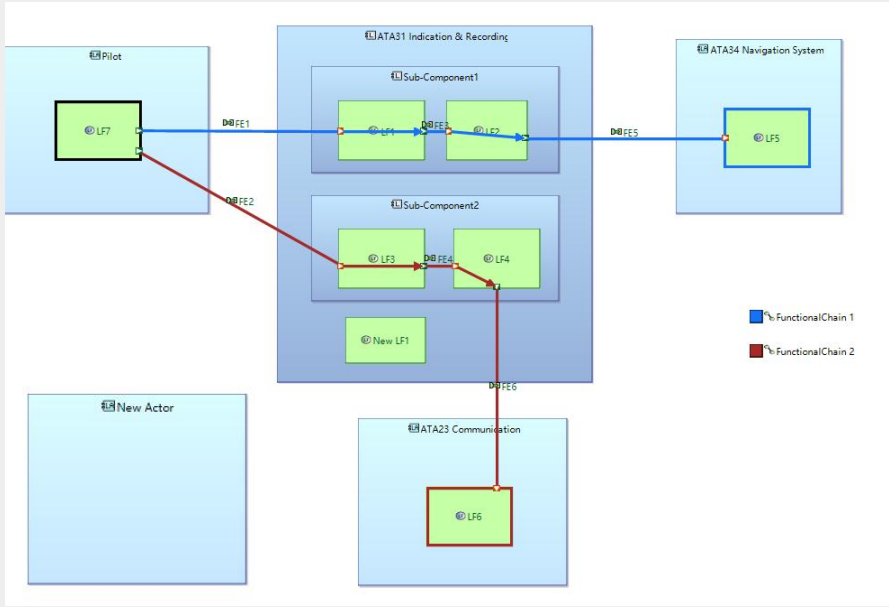
3.5 Integrate the Logical Architecture

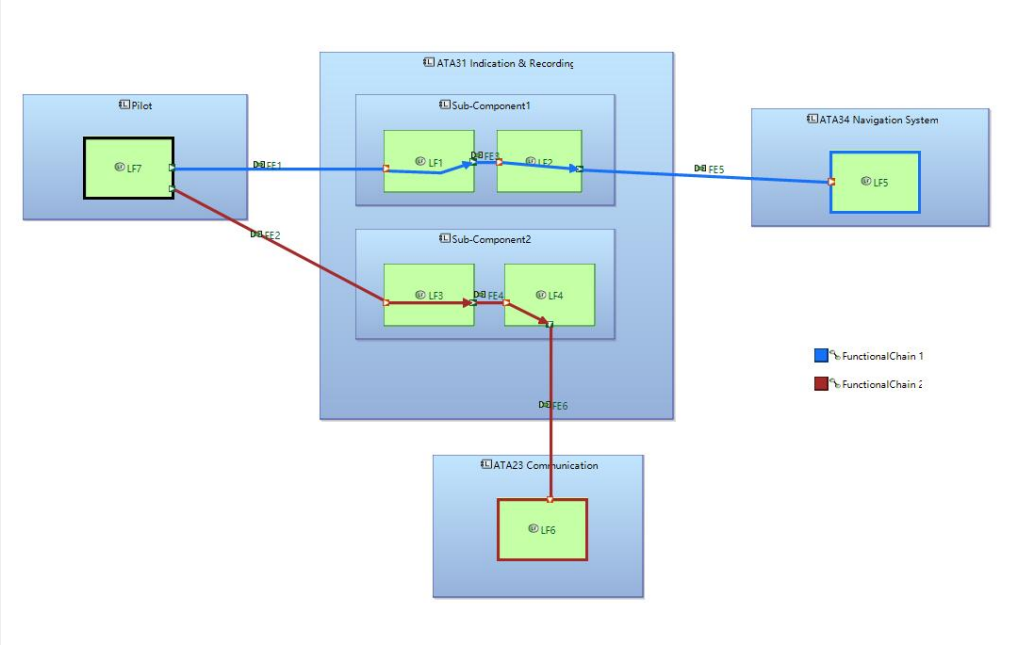
LA model of overall integration model after integration



3.5 Integrate the Logical Architecture

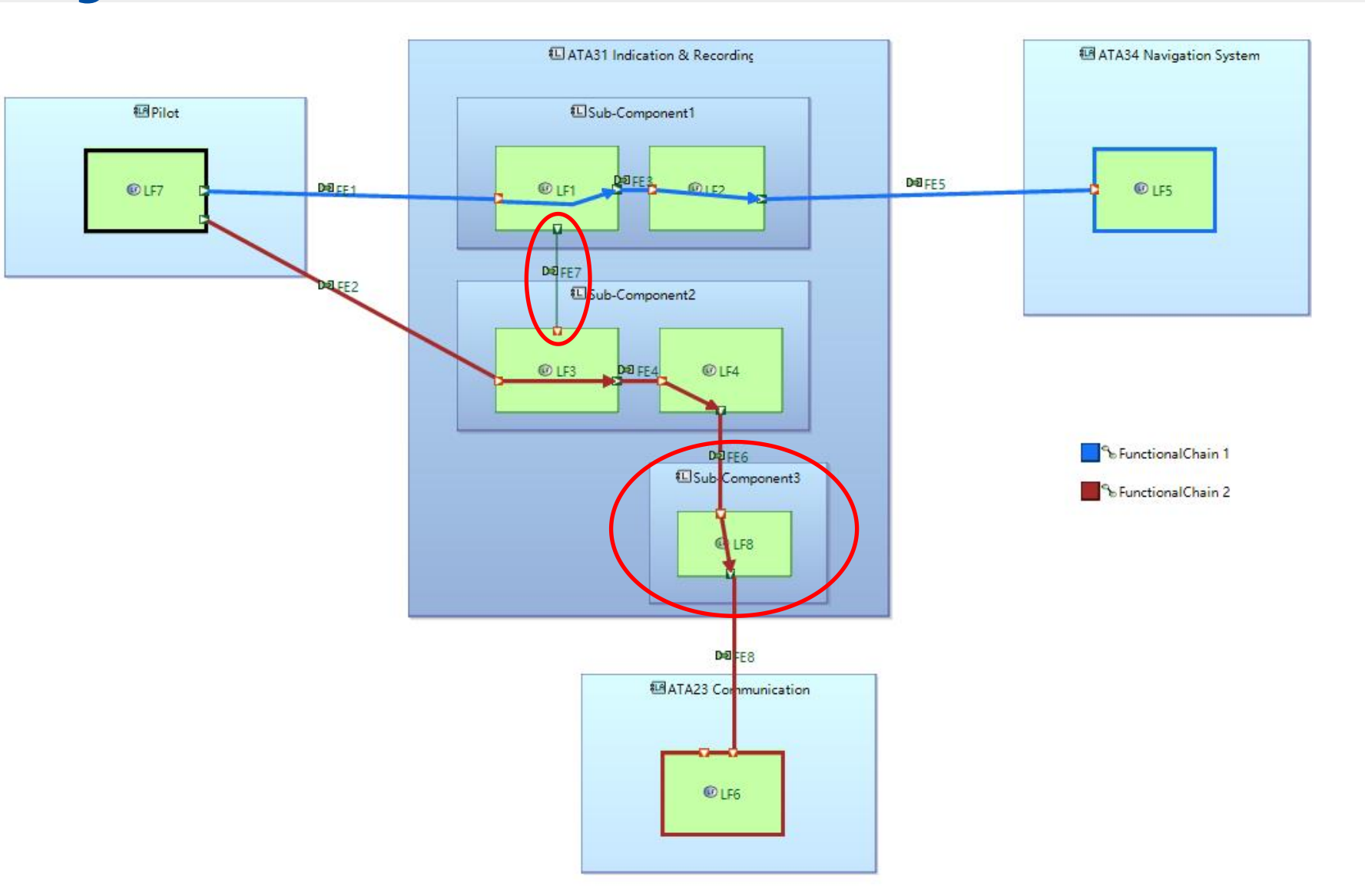
- Initial Integration rules:
  - After the integration, the system element of member systems will be integrated as aircraft components.
  - The sub-logical component hierarchy of member systems is merged into the integration model.
  - The function hierarchy of member systems is merged into the integration model.
  - Functional exchanges, functional chains, and component exchanges of member systems are merged into the integration model.
  - Note： Actors which are not distributed by aircraft model will not be integrated.





3.5 Integrate the Logical Architecture

When LA model of member system is modified

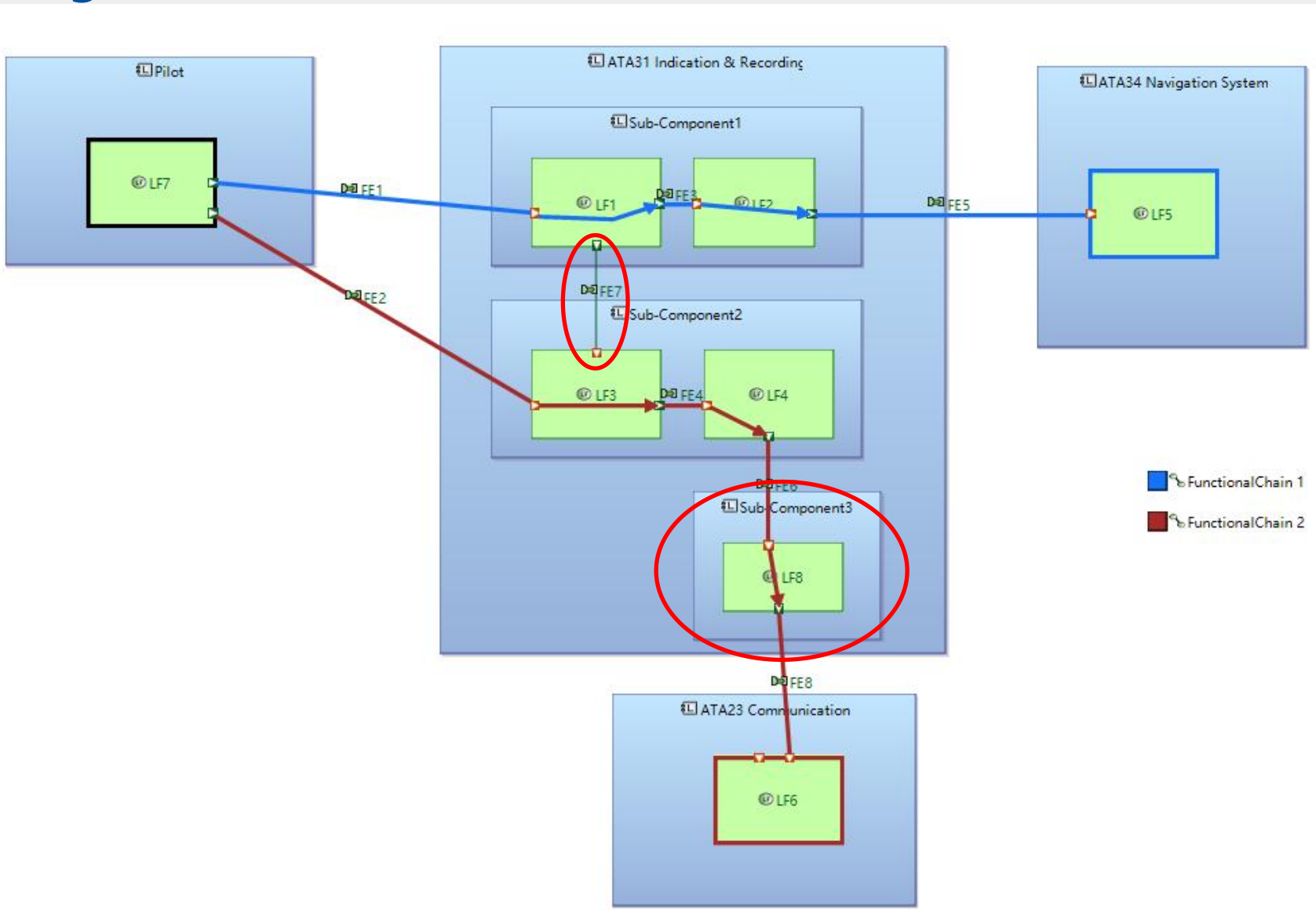


3.5 Integrate the Logical Architecture

Incremental

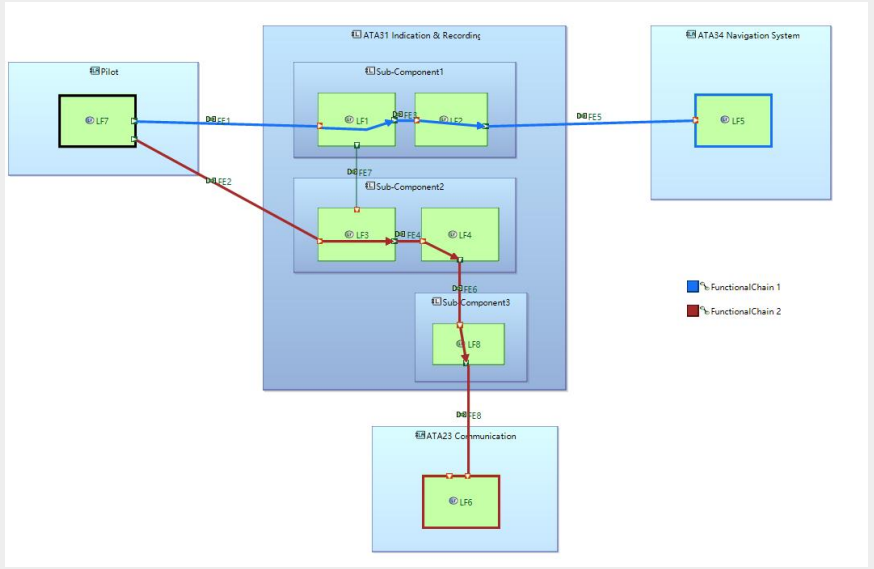
integration of overall

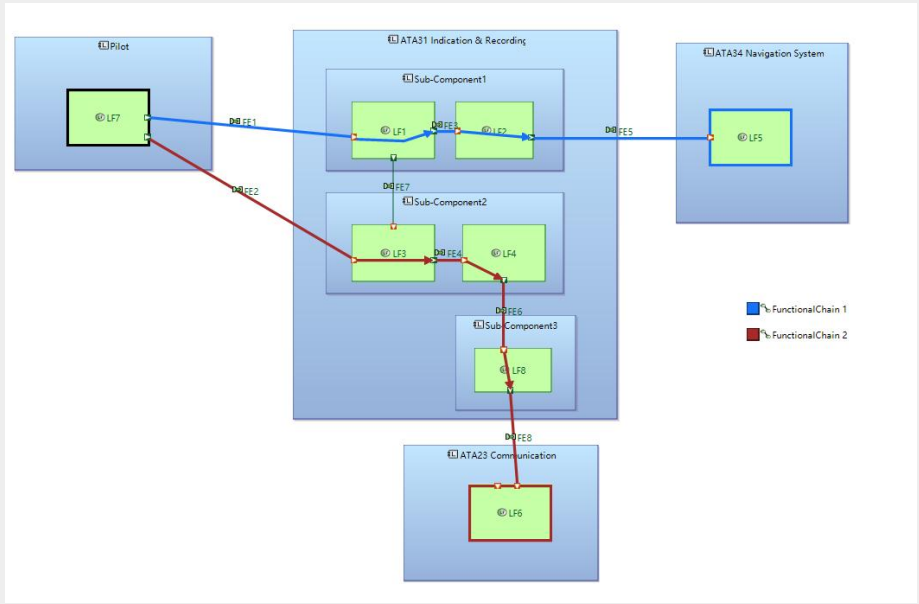
integration model



3.5 Integrate the Logical Architecture

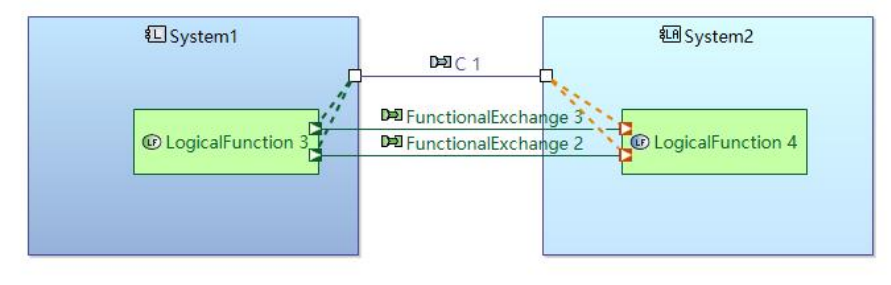
- Incremental Integration rules:
  - Added and modified sub-logical components will be synchronized to the integration model.
  - Added and modified functions will be synchronized to the integration model.
  - Added and modified functional exchanges, functional chains and component exchanges will be synchronized to the integration model.
  - Added and modified the source/target function of a functional exchange will be synchronized to the integration model.

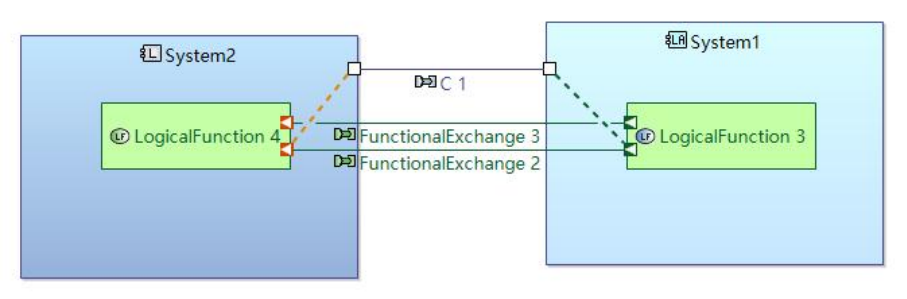


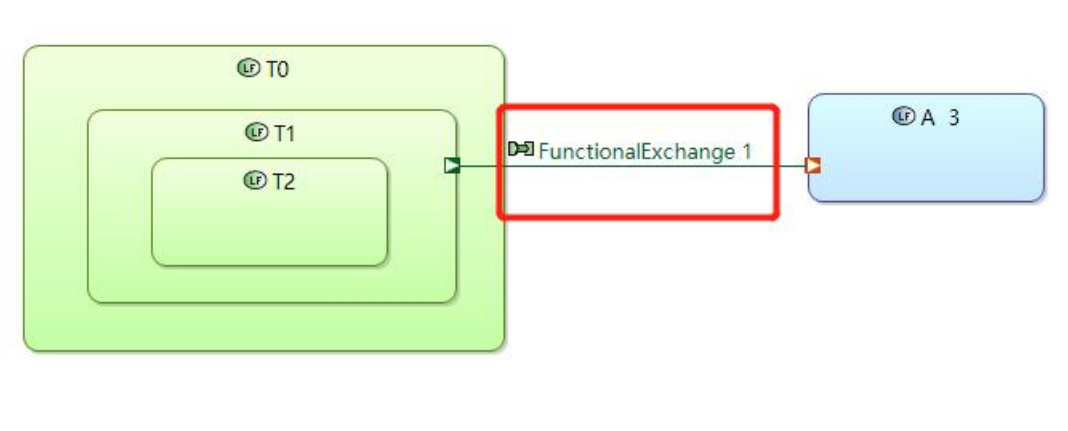


3.5 Integrate the Logical Architecture

- Integration validation rules:
  - If a functional exchange is not allocated to the same component exchange in two member systems, the error log will print a message “Functional exchange XX is not allocated to the same component exchange in two systems, please check!”
  - If a functional exchange’s source or target function is not a leaf function, the error log will print a message “There are interfaces that are not assigned to the lowest level function, please check!”

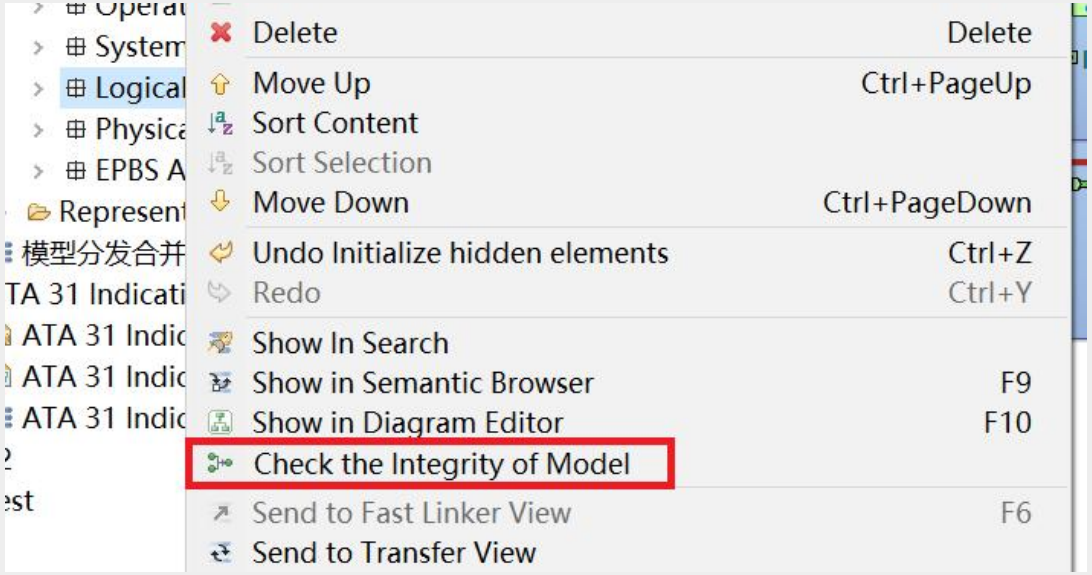






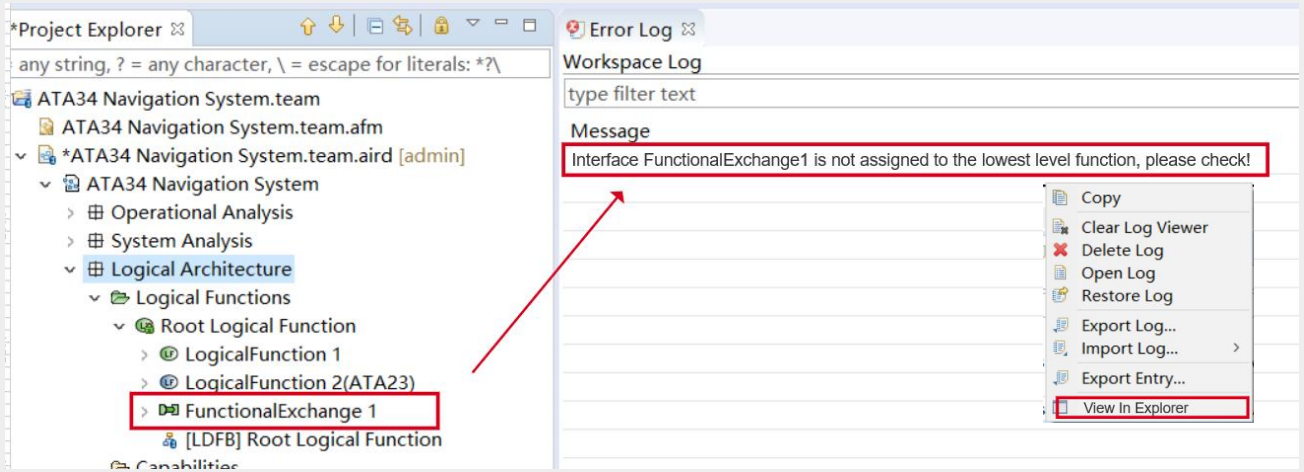
3.5 Check the Integrity of the Model

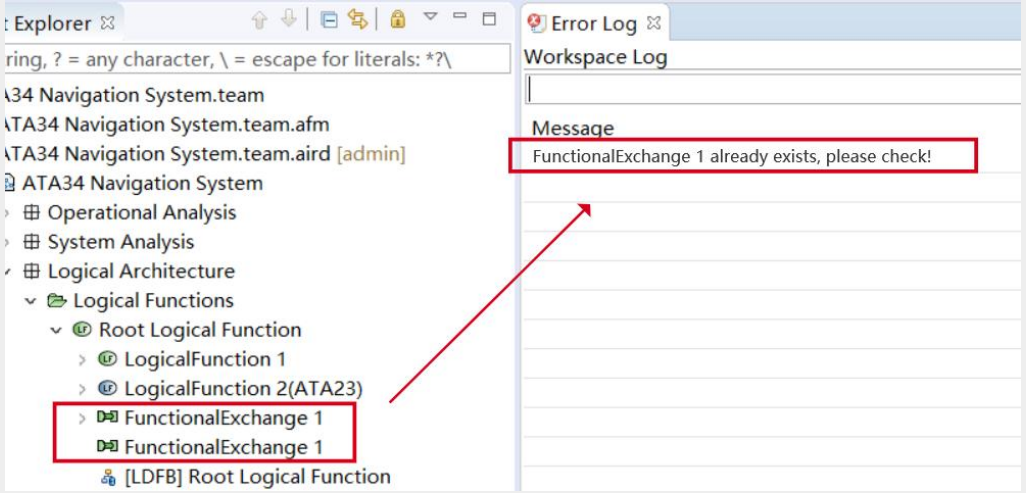
- The system integration designer selects the Logical Architecture of the overall aircraft model in the Project Explorer, and selects "Check the Integrity of Model" in the contextual menu, as shown in the figure below.
- The system will auto-check the integrity of the model, and print the corresponding error message in the "error log" if any design errors are found.

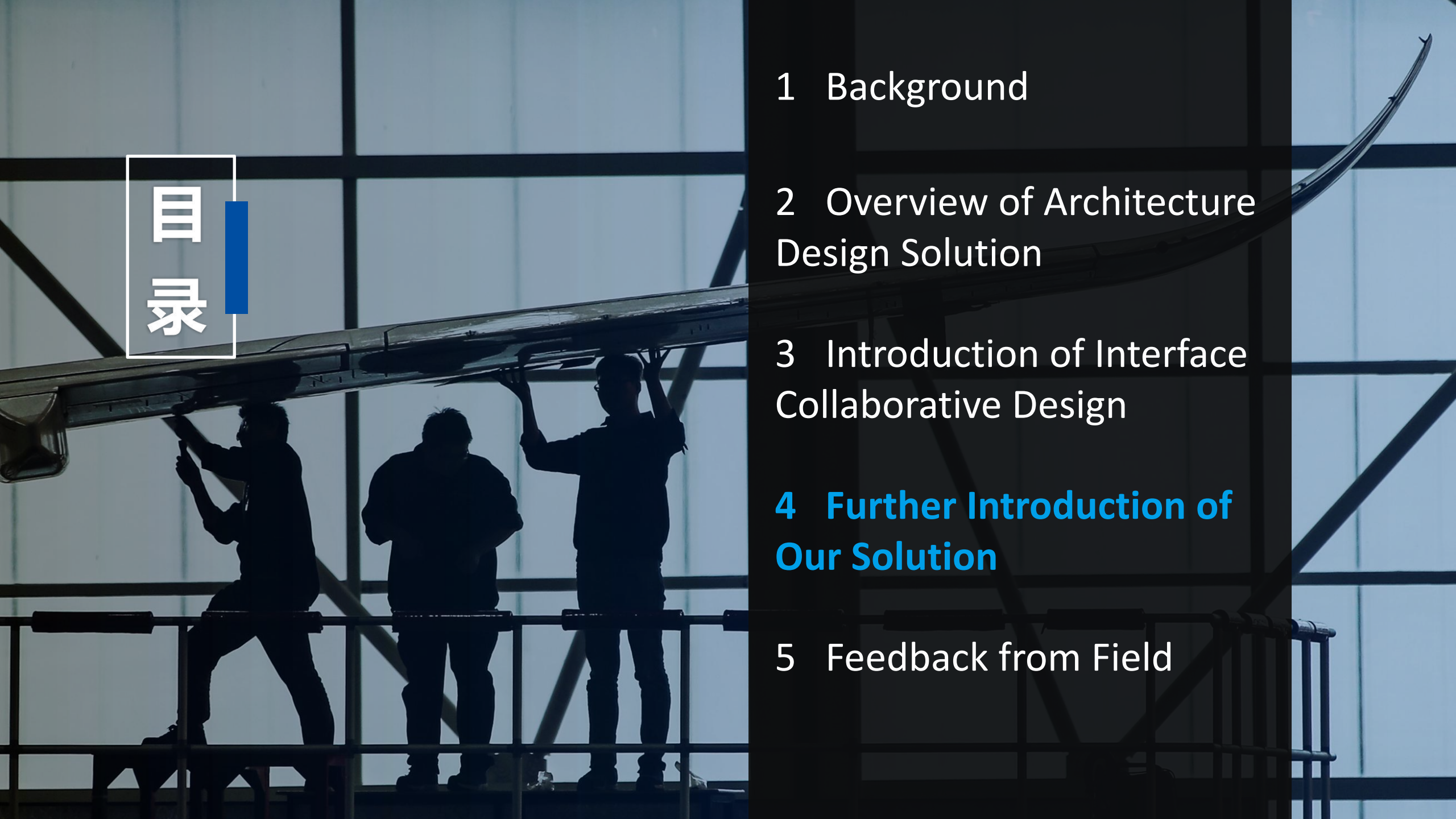


3.5 Check the Integrity of the Model

- After clicking the “check the Integrity of the Model”, two items will be checked：
  - Whether the source and target functions of every functional exchange have sub-functions. If there are, the error log will print a message “Interface XXX is not assigned to the lowest level function, please check! ”
  - Whether two functions or two functional exchanges have the same name. If there are, the error log will print a message “Function XXX already exists, please rename!”
  - The error log has a “View in Explorer” option in the contextual menu. After clicking, the model element will be located in the Project Explorer.







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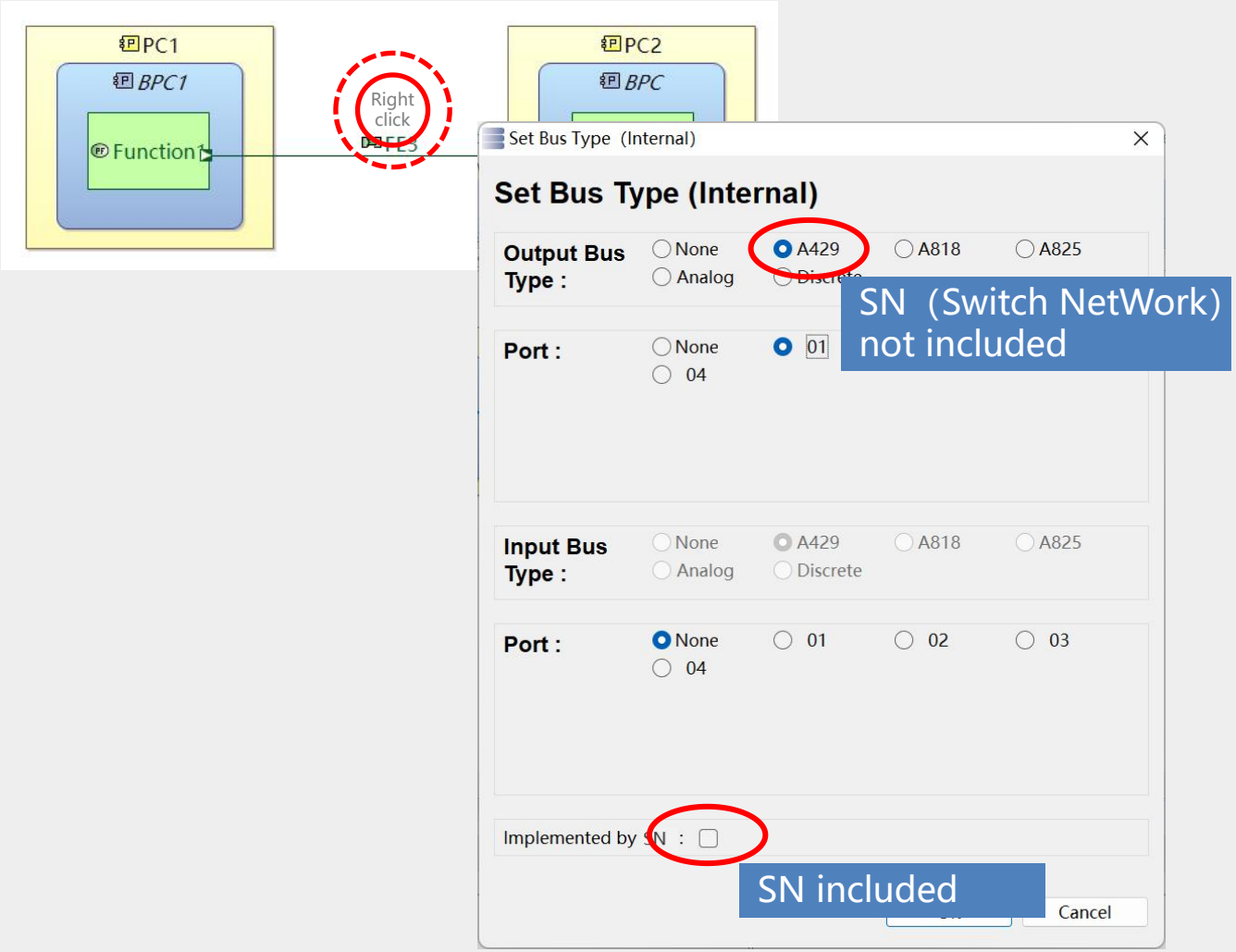
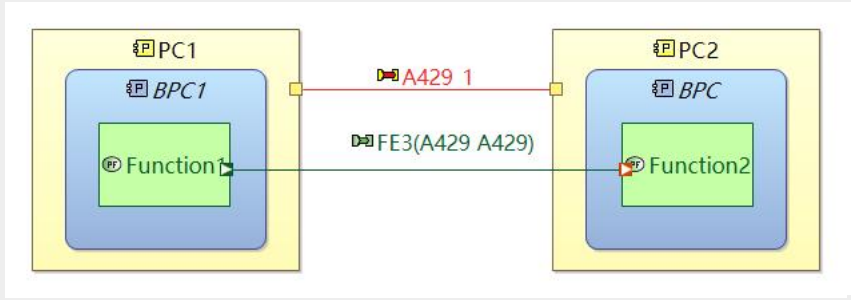
4.1 Part of Collaborative Common Facilities Design



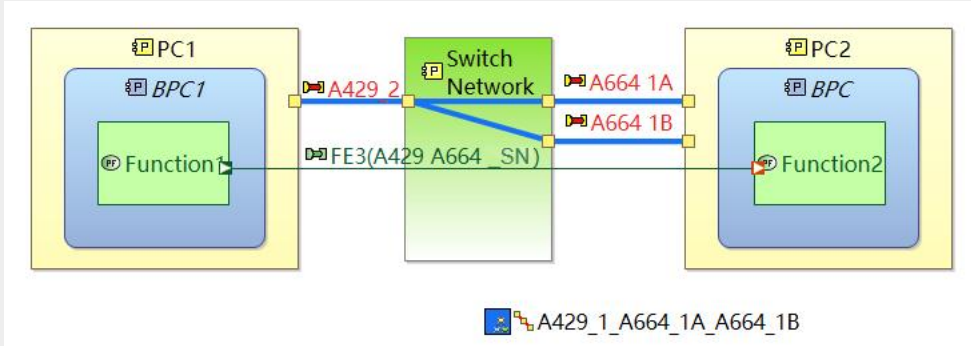
SN（Switch NetWork）not included

SN included

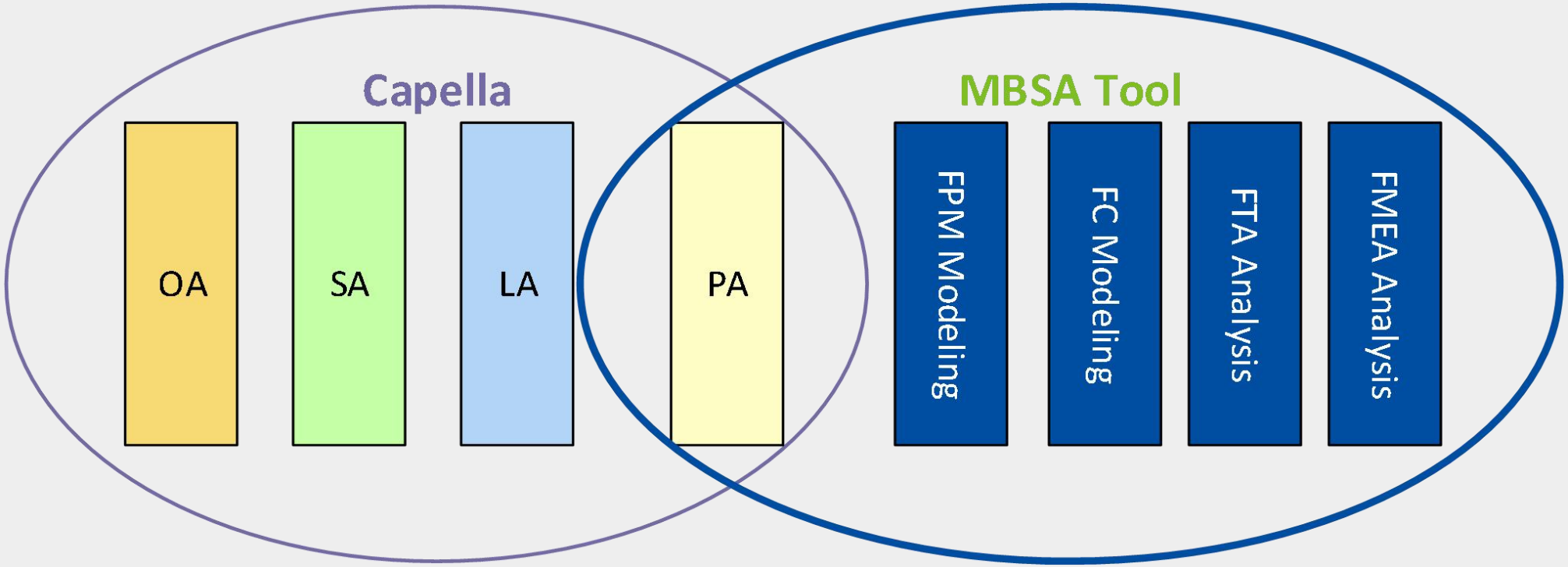
Auto-creation of physical link



Auto-creation of physical path



4.2 Part of Model based Safety Analysis



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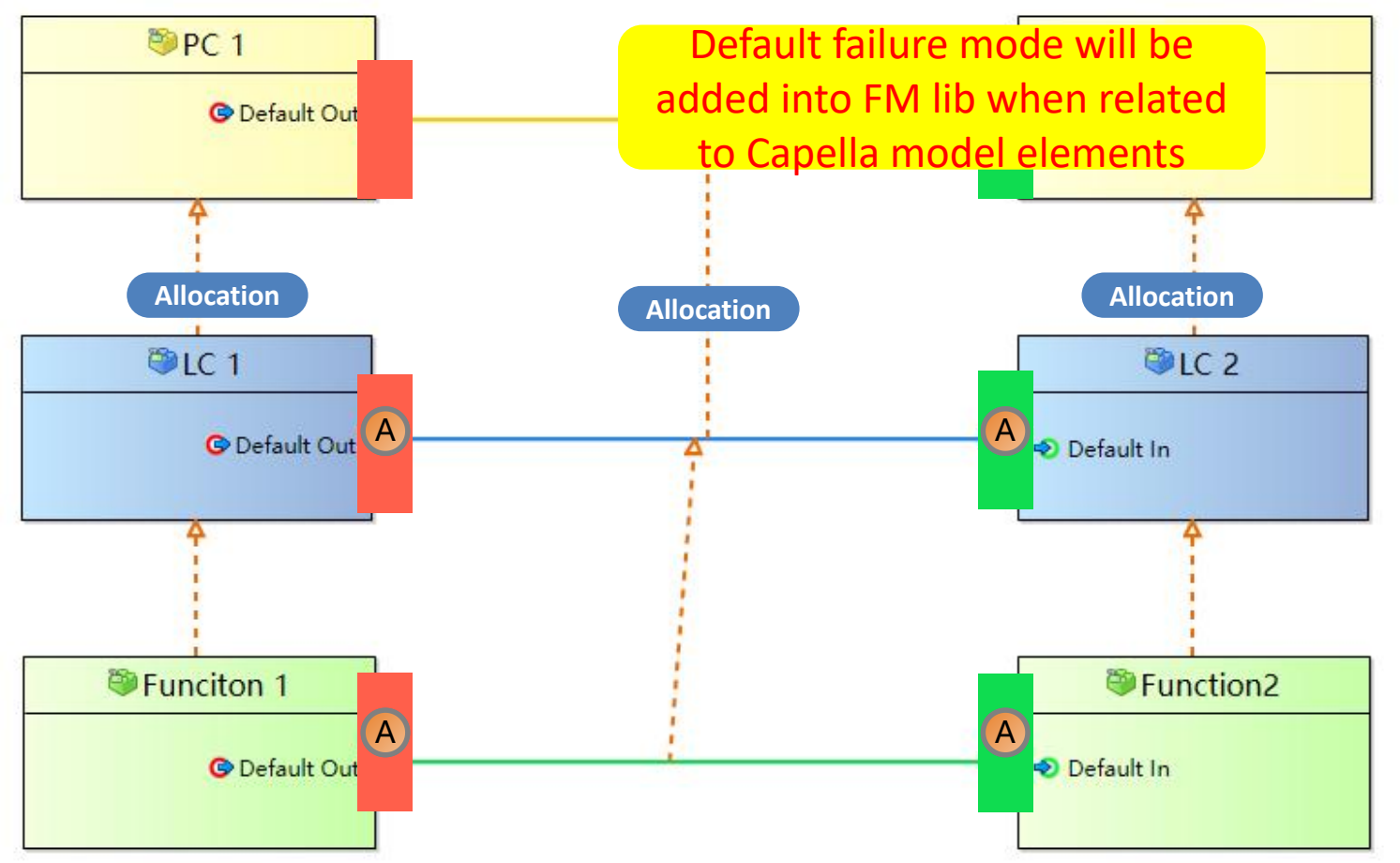

Failure Mode Lib

- Loss of LC 1
- Loss of LC 2
- Loss of function 1
- Loss of function 2

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5.1 Feedback from Field

- The solution offers a powerful platform to support our design and engineering requirements.

--- **Ge Song**, Deputy Minister of Department of Avionics Integration

- We’re seeing incremental improvements via the design process with this modeling tool.

--- **Jinling Cheng**, Assistant of Model Chief Designer

THANK YOU !

Q&A