Interface Protocol Design in Capella

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Agenda

1. Background

2. Interface Design in Capella

3. Extension to Interface Protocol Design
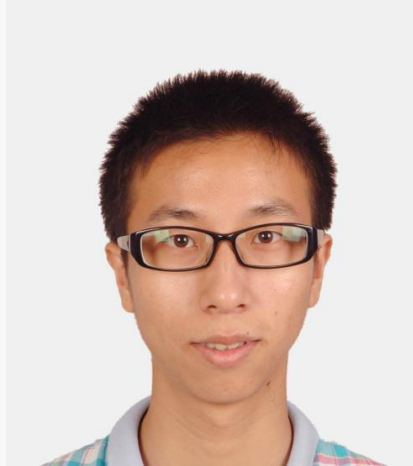
4. Conlusion

Agenda

1.Background

PGM

System
Engineering

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

- 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.

Challenge of Interface Design

- **In the development of complex systems, interface design is one of the core tasks. It mainly defines the interface structure, message protocol and cable connection between various equipment/subsystems/devices/modules.**

- **The traditional way to design interface is based on Interface Control Document (ICD). It is facing more and more challenges.**

1. ICD is hard to support collaborative design.	4. It's hard to automatically verify the correctness.	
2. ICD data is hard to be quickly reused.	5. The granularity of data management is too coarse.	Traditional ICD need to be improved
3. ICD has a large amount of data and complex formats, making it difficult to maintain.	6. Disconnected from the architecture design document.	

Example of Traditional ICD

Payload Name	Data Type	Length	Meaning	Unit	Description
Request	char[2]	2	PID	/	—
	uint16	2	CID	/	—
	char[2]	2	SID	/	—
	uint16	2	Length of this payload	byte	—
	uint32	4	Sending time	ms	—
	uint16	2	Counting number	/	—
	uint16	2	Check code	/	—
TimeStamp	char[2]	2	PID	/	—
	uint16	2	CID	/	—
	char[2]	2	SID	/	—
	uint16	2	Length of this payload	byte	—
	uint16	2	Year	/	—
	byte	1	Month	/	—
	byte	1	Day	/	—
	uint32	4	Sending time	ms	—
	uint16	2	Counting number	/	—
	uint16	2	Check code	/	—

- What is the relationship with the architecture definition (in a .vsd file) ?
- Is it the same in the document of the source module and target module?
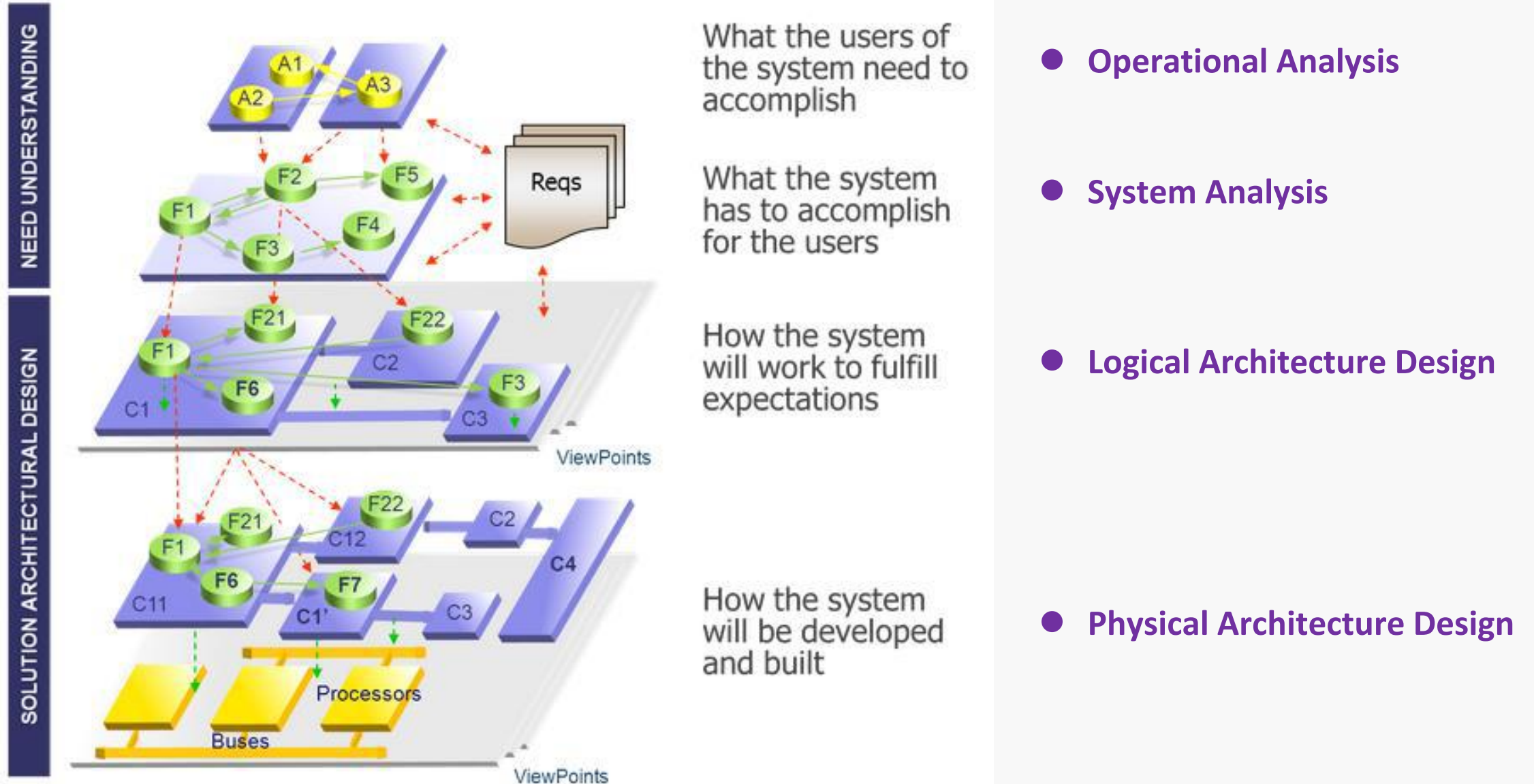- Who has the authority to modify it?
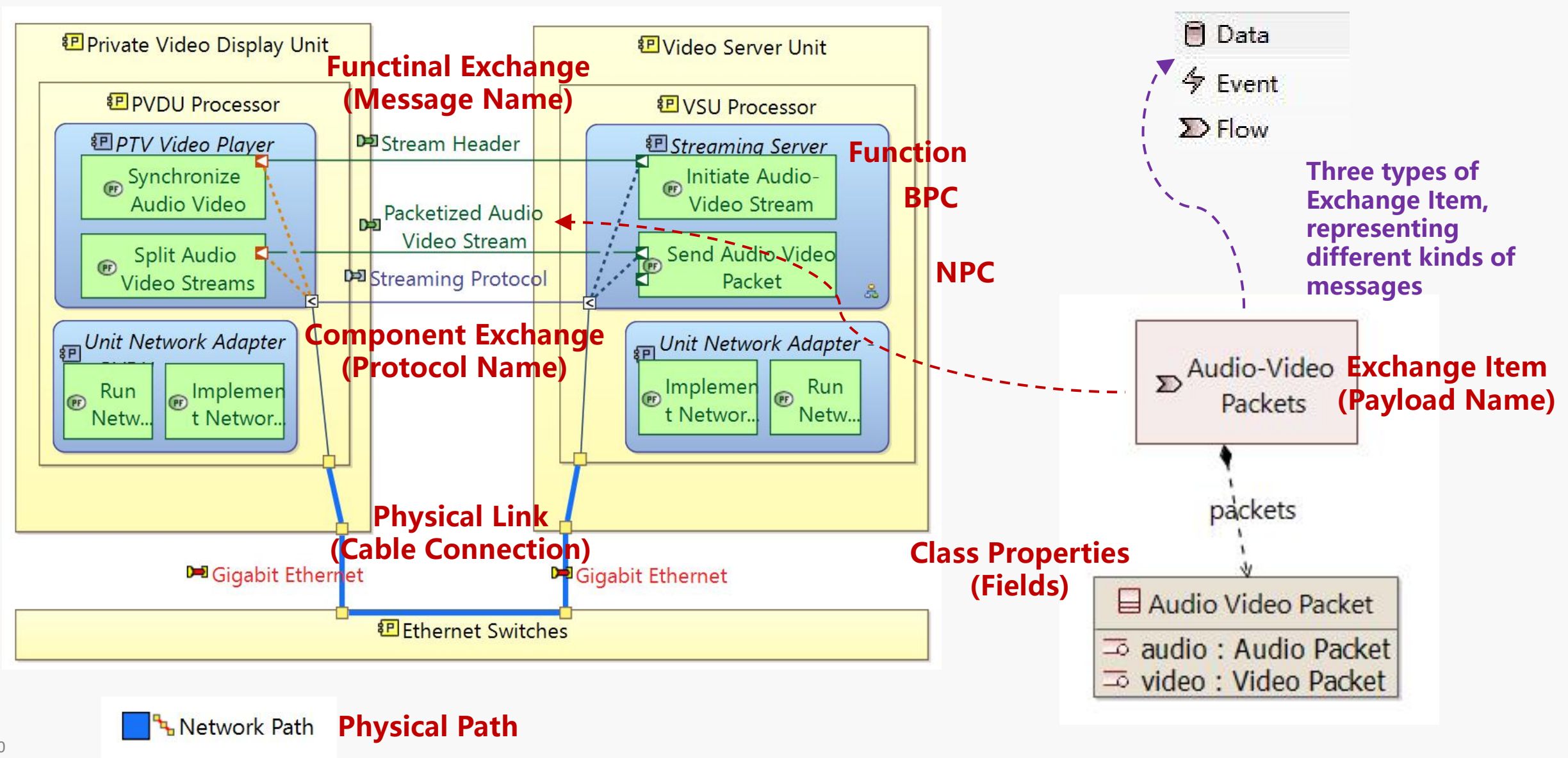- …

Agenda

PGM

System
Engineering

A Global View of ARCADIA/Capella

- **Operational Analysis**

- **System Analysis**

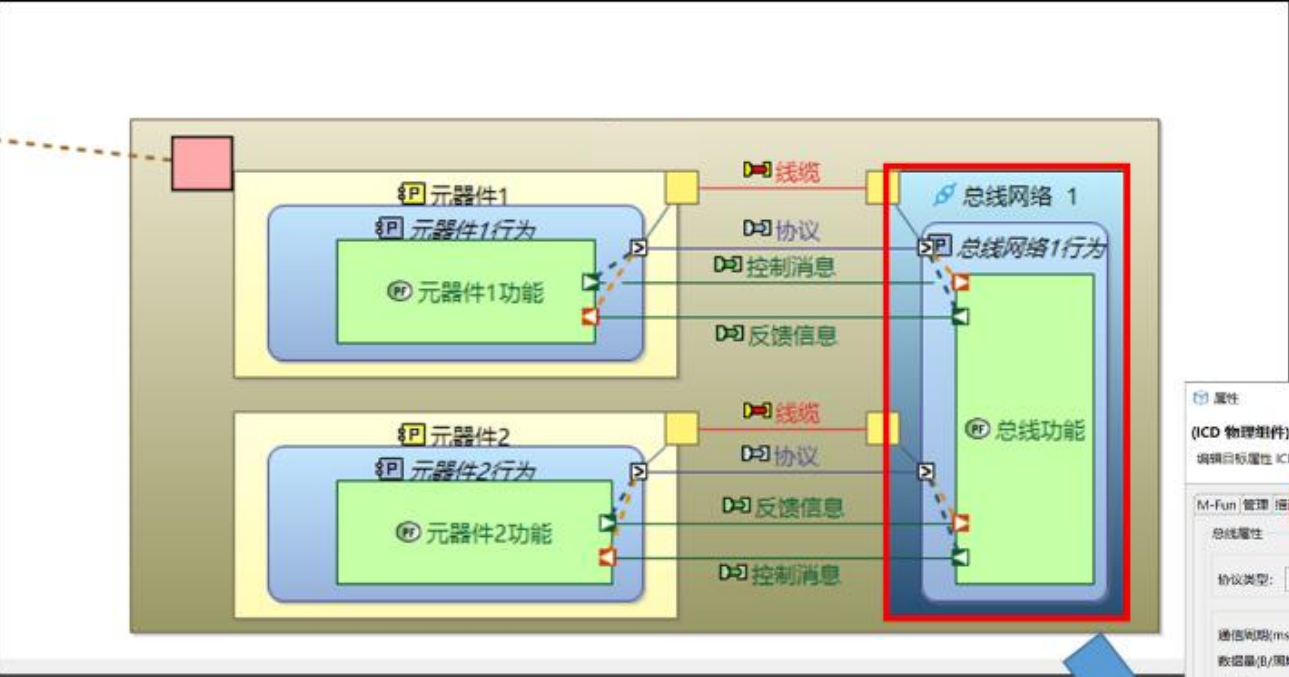- **Logical Architecture Design**

- **Physical Architecture Design**

Interface Design In Capella (Example of PA)

Functinal Exchange (Message Name)

Component Exchange (Protocol Name)

Physical Link (Cable Connection)

Physical Path

Function

BPC

NPC

Three types of Exchange Item, representing different kinds of messages

Exchange Item (Payload Name)

Class Properties (Fields)

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Bus Structure Definition

Bus type can be like 1553B, CAN, HDLC and so on.

We have developed a model element called "Bus Network". Users can define bus type, basic properties, roles and addresses of each module by it.
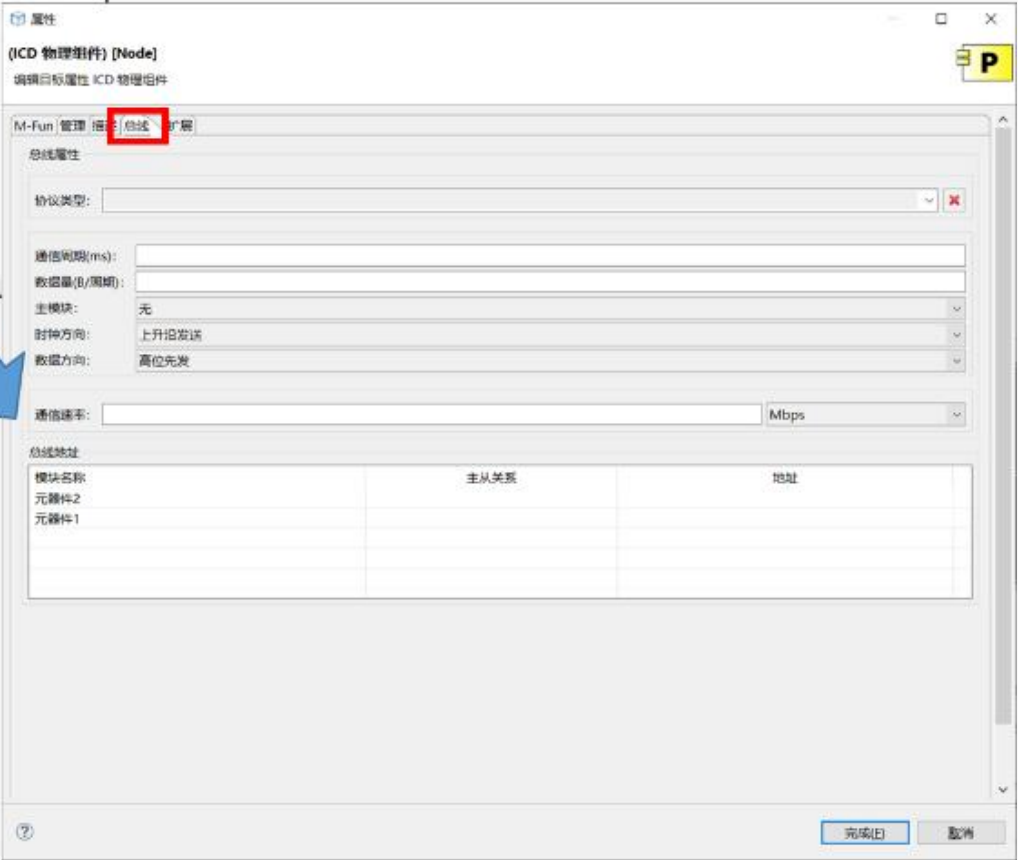
Message Design (1/3)
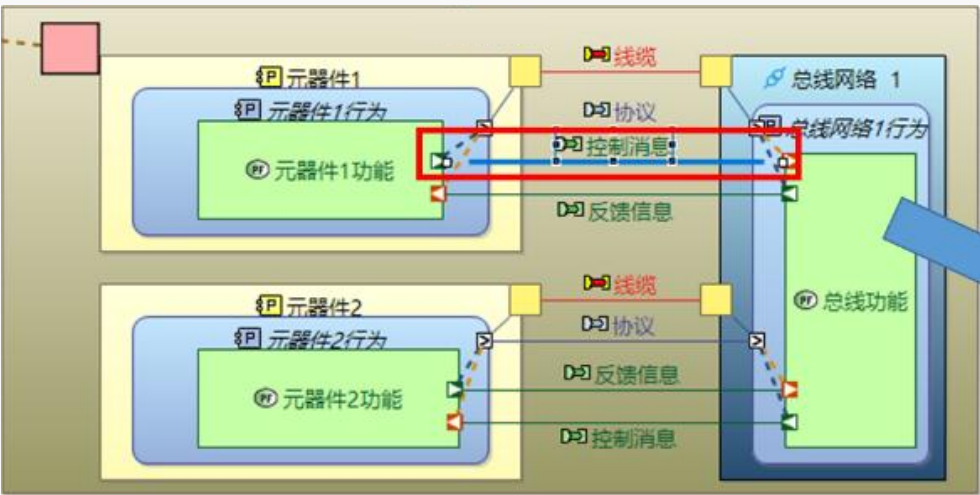
For each funcitonal exchange, users can
define its relavant messages.

Message Design (2/3)

For each message, users can define its basic properties and inside structure, including its header, body and trailer. If the message body has more than one payload, users can also define the name, length, content and description of these payload.

Message Design (3/3)

All messages can be defined and managed on a server, which can be referenced from Capella model, for quick reuse and standardization.

Payload Design (1/2)

For each payload in a message, users can define its basic properties and the meaning of each bit or byte.

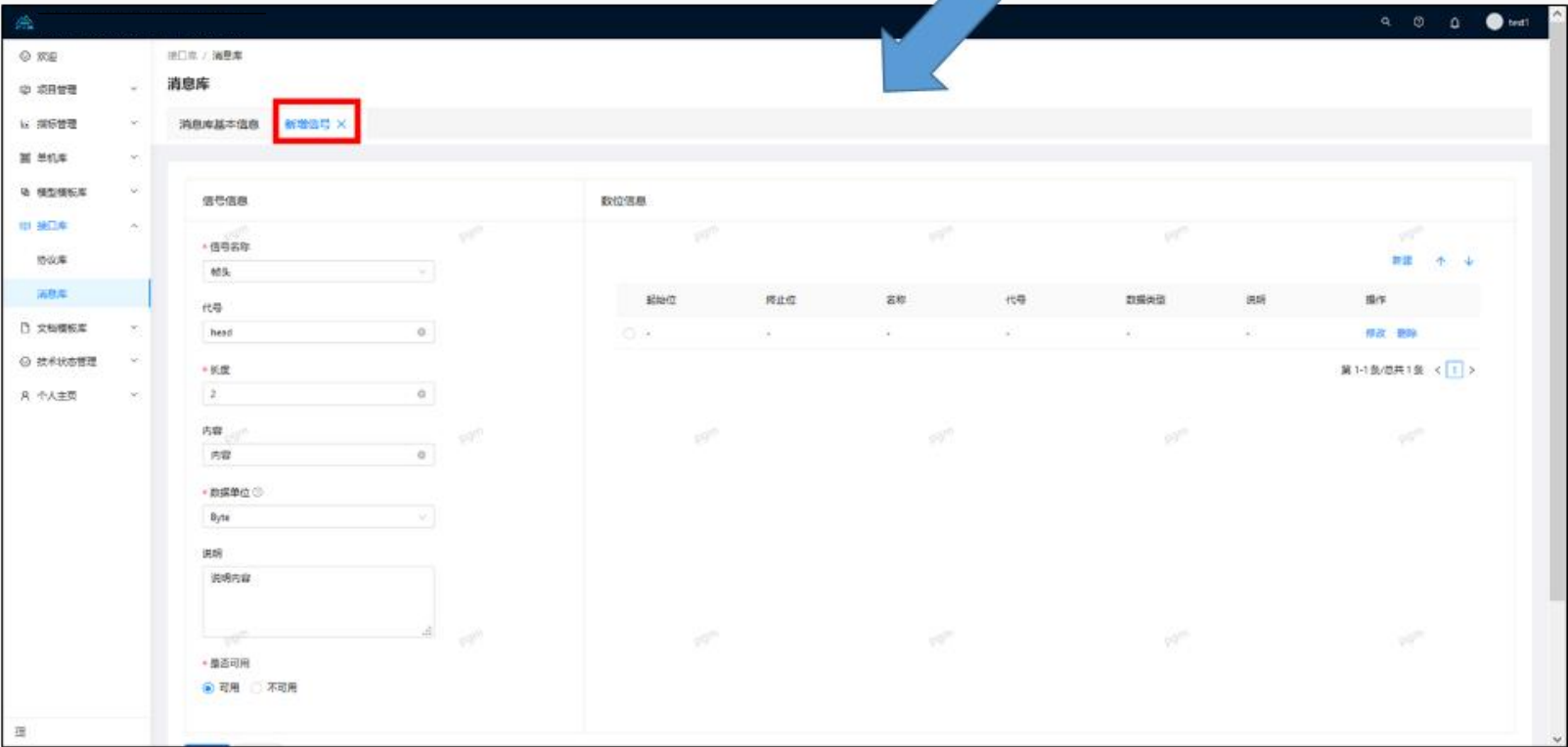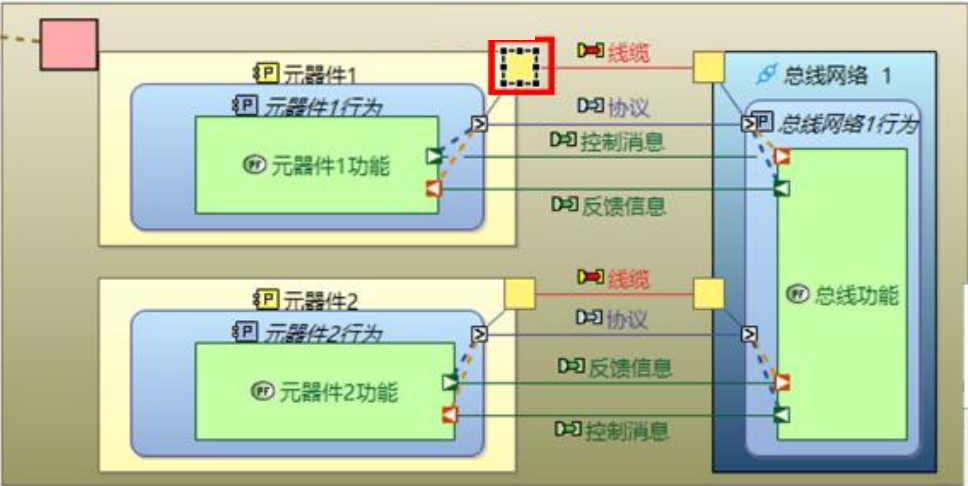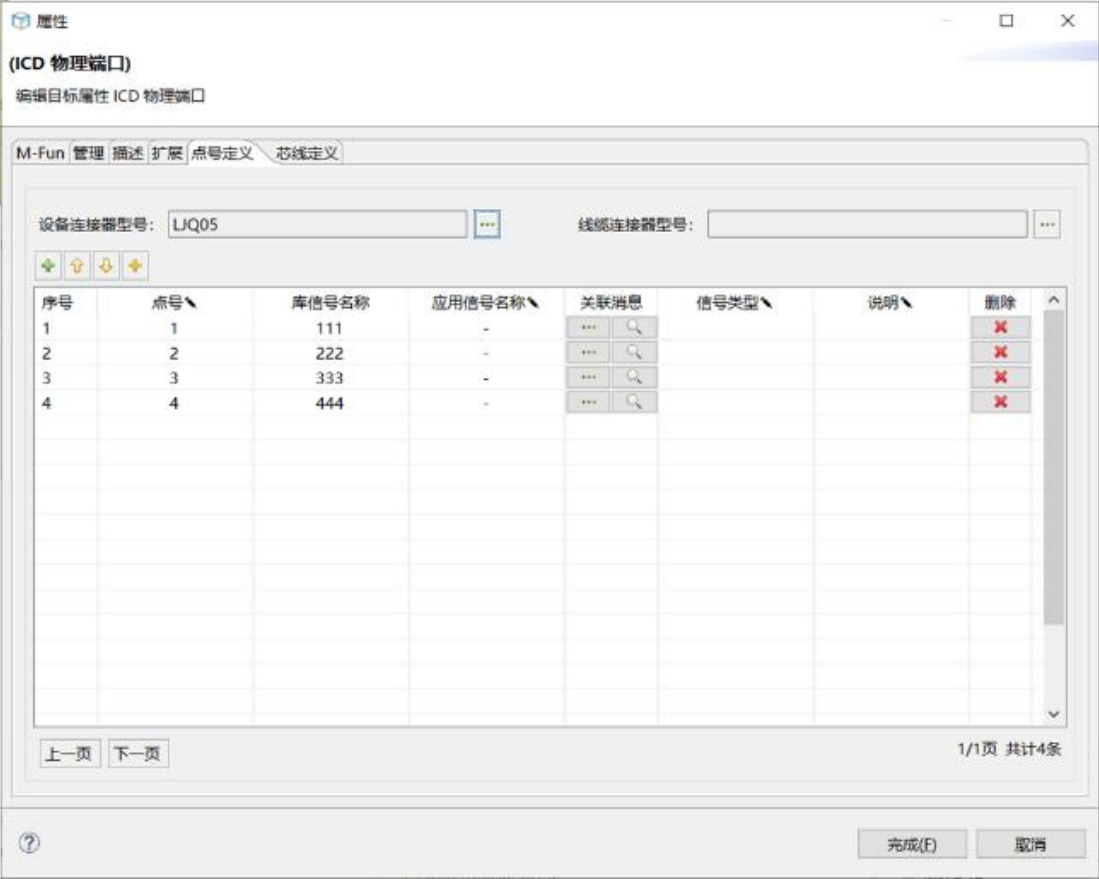**Payload Design (2/2)**
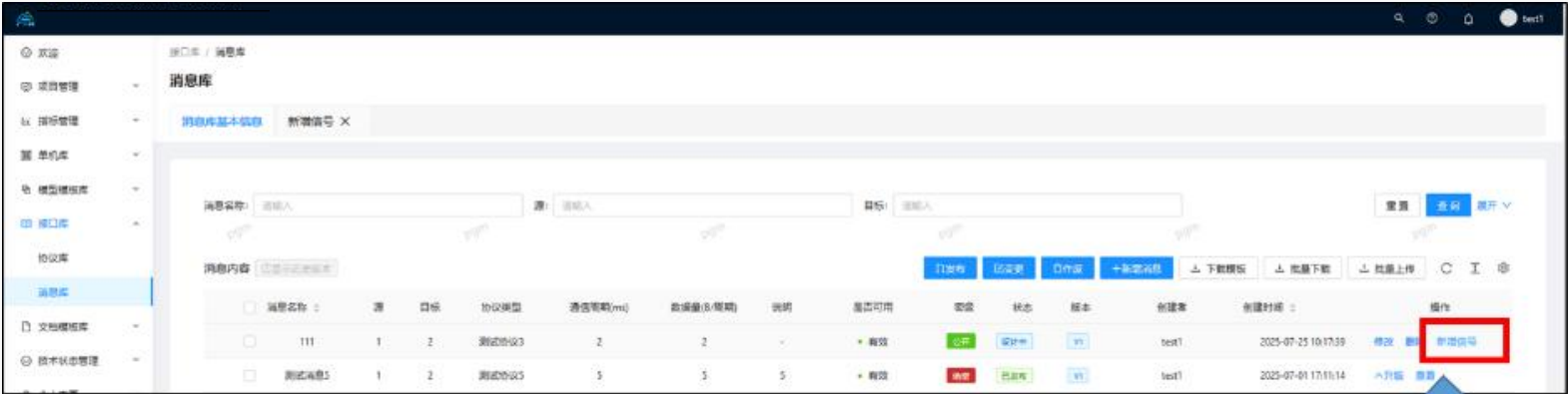
All payloads can also be defined and managed on a server, which can also be referrenced from Capella model, for quick reuse and standardization.

Preliminary Cable Design (1/6)

For the physical ports in Capella model, which can represent physical connectors, users can define every pins inside, including pin number, name, type and description.

Standard pin information can be predefined in a database. When users choose a standard physical connector from a device library for a physical port, all the predefined pin information will show up.
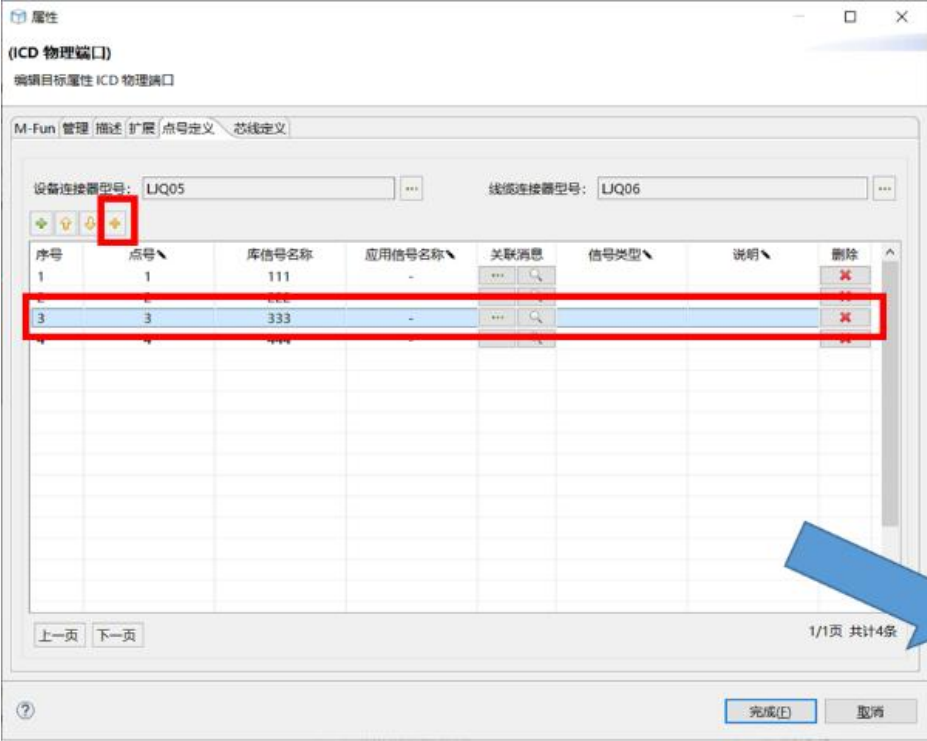
If there are differential signals used, users should define differential pairs based on physical pins.
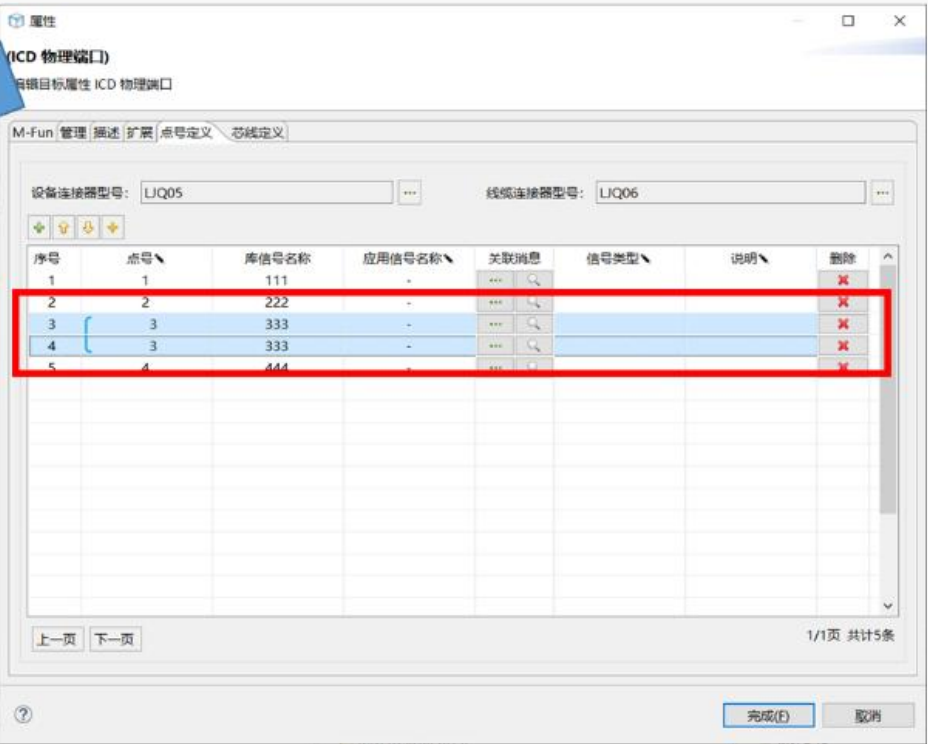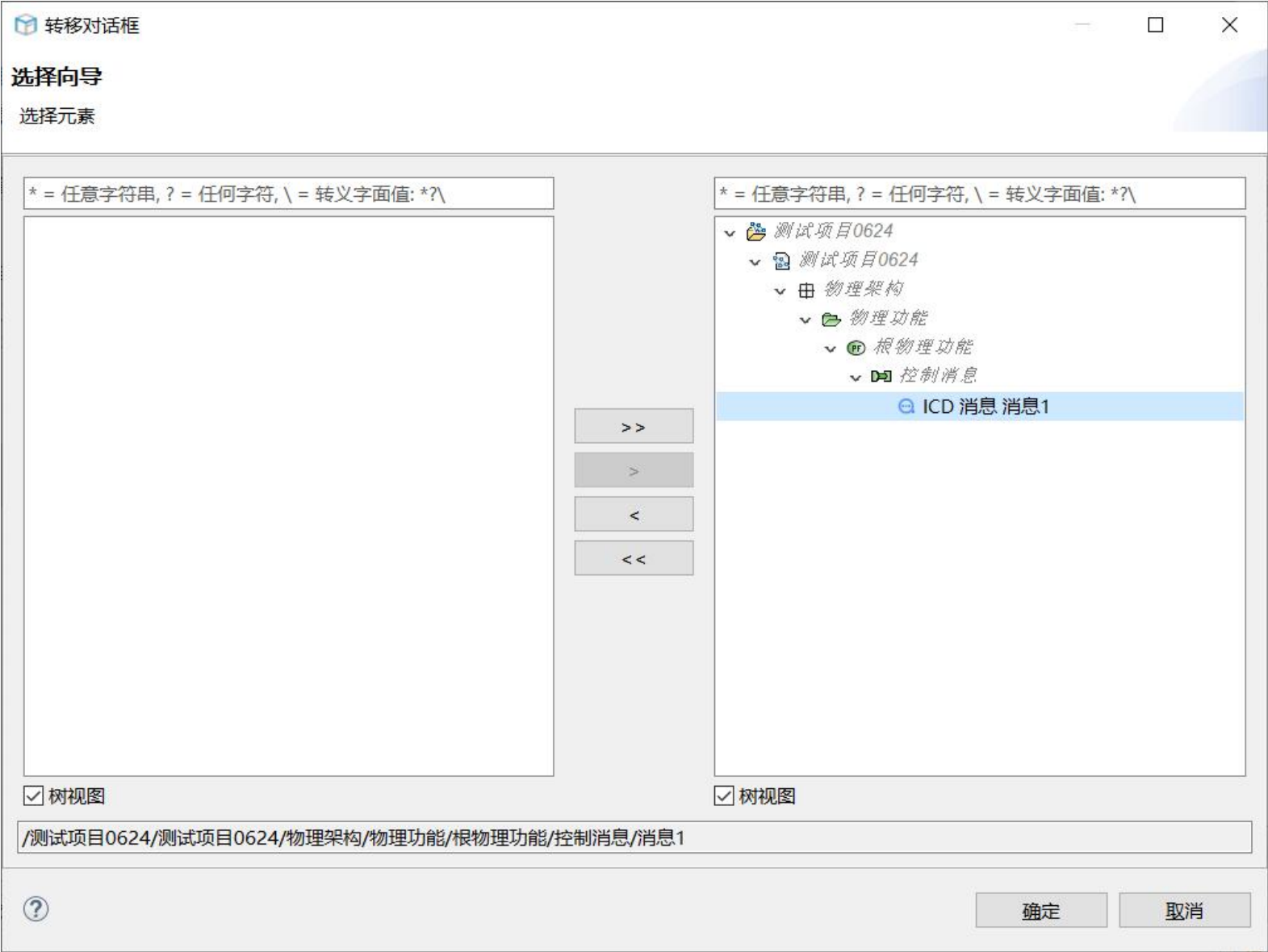
Cable mapping can also be defined based on physical pins. It can even be automatically done by the compare of their names.
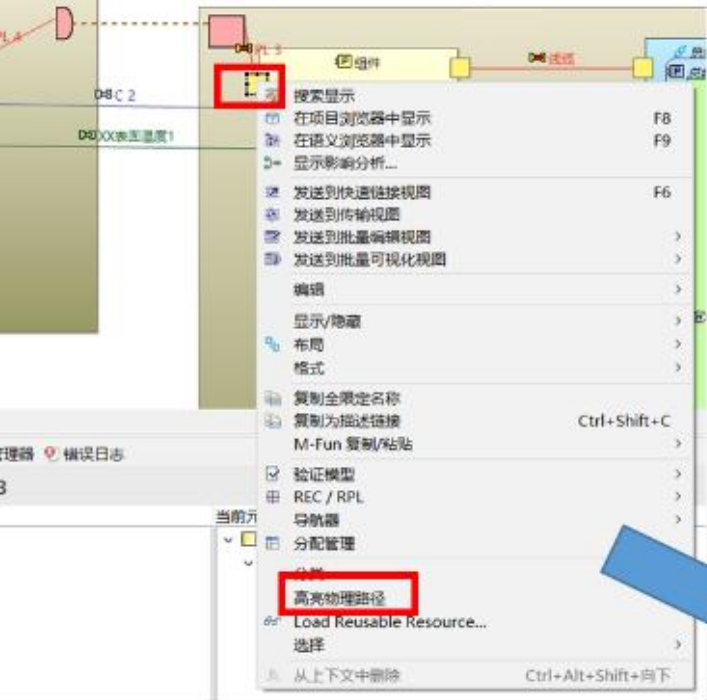
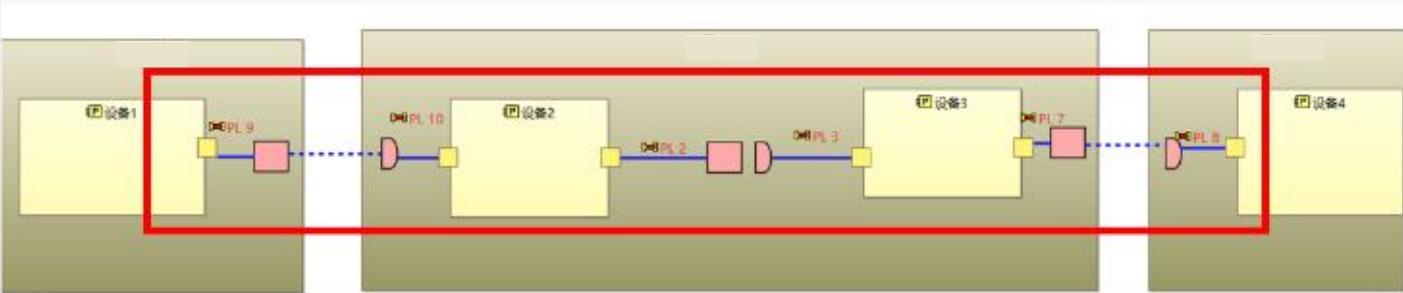**Preliminary Cable Design (5/6)**

Each physical pin or differential pair can be linked to one or more messages (with the right allocation).

Preliminary Cable Design (6/6)

If your model is defined completely, then you can highlight the entire message transmission path within your physical architecture model.

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Benefits

Integrated Design Process

Design interface protocol withnin the architecture model directly

Verification of Correctness

Use pre-defined rules and message path highlight to check the result

Effective Data Control

Control interface data along with architecure model

PGM

Standardized Design

Use standard process, method and template to design interface

Easier Collaboration

Collaborate based on structured and fine-grained model

Efficient Data Reuse

Build database of messages, payloads and devices for quick reuse
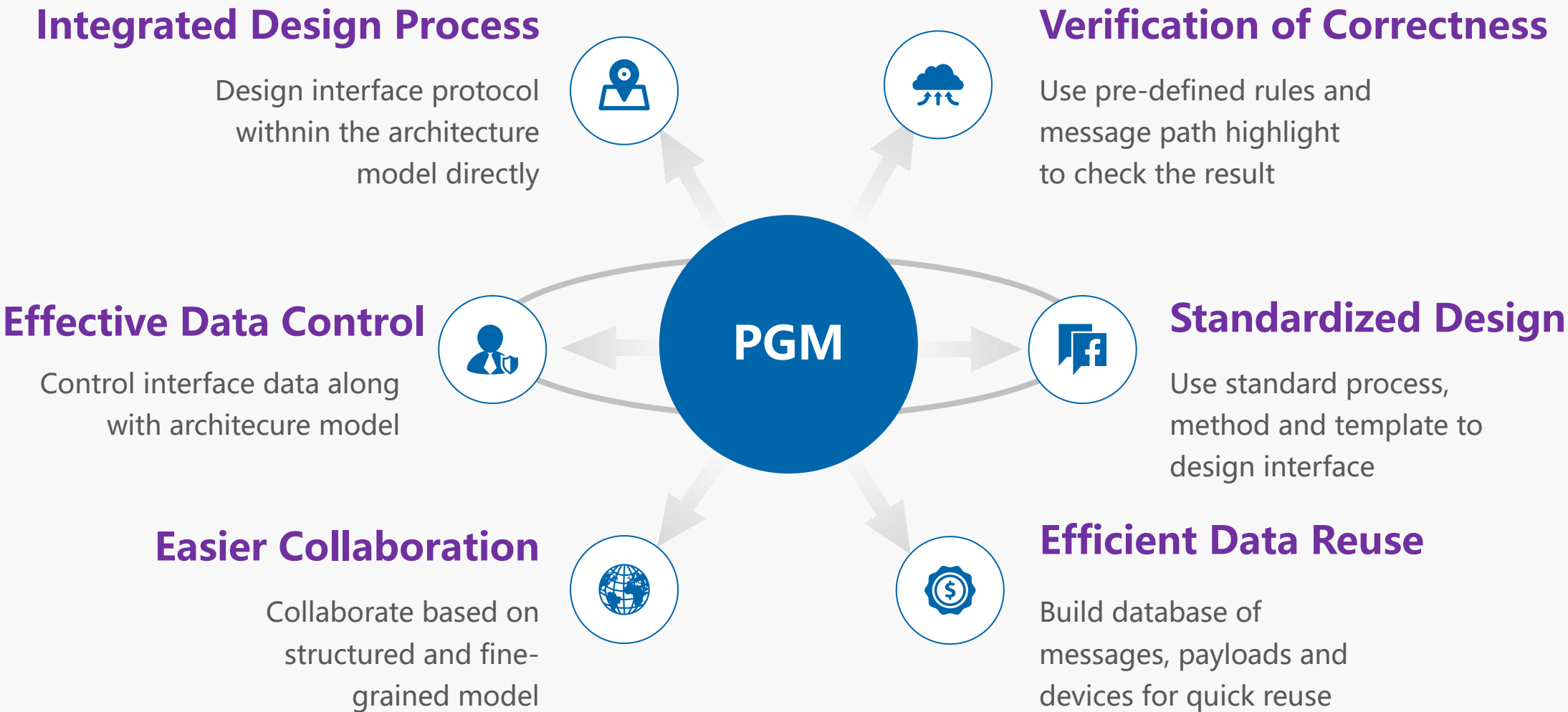
Conclusion

Capella is a good platform for architecture design. Engineers can use it to define functional exchange, component exchange, physical link, and relative data structures. But it's not enough for interface protocol design. For those who are still using documents to do interface detailed design, or using several separated tools to design protocol and cables, it will be much easier for them to design interface protocol based on architecture model directly. We have developed an extension on Capella to do bus structure definition, message design, signal design, and preliminary cable design. All these information is tightly connected and is traceable.

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