Use Cases for Nested Ports
RTF – 2009-11-24

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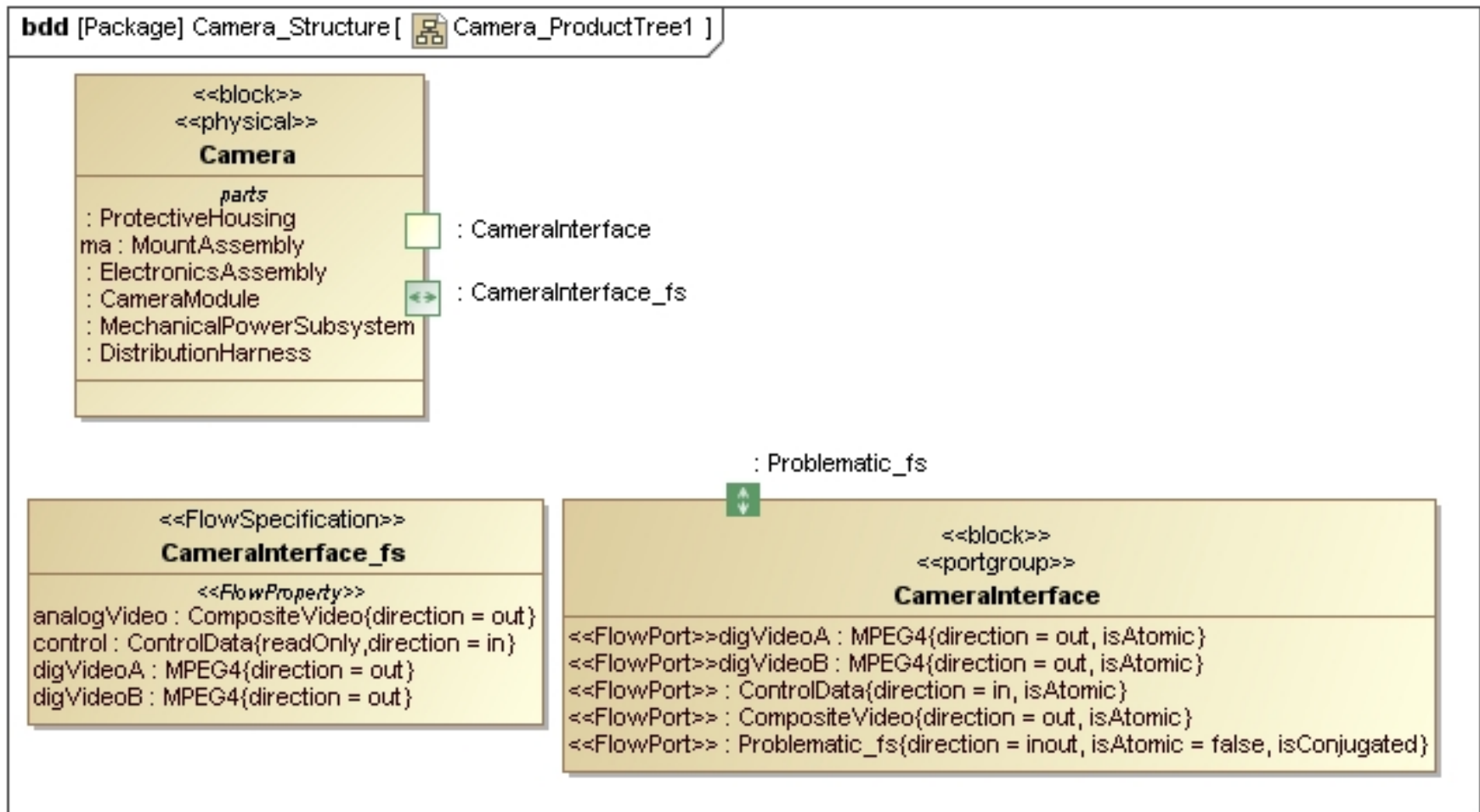*Images on this slide were produced by ESO*

Agenda

- Connecting Flow Properties in IBDs
- Grouping of Ports
- Combining physical connector type and flow
- Re-usable Command and Data Interfaces
- Logical Channels

Connecting Flow Properties in IBDs

- Aim of the modeling aspect
    - Delegation of flows to nested flows

- Benefit of nested port usage
    - Flow specs the diagram doesn't tell you what's inside the port on the diagram, but nested ports gives you a way to show that

- Traditional SysML modeling way
    - Flow Properties
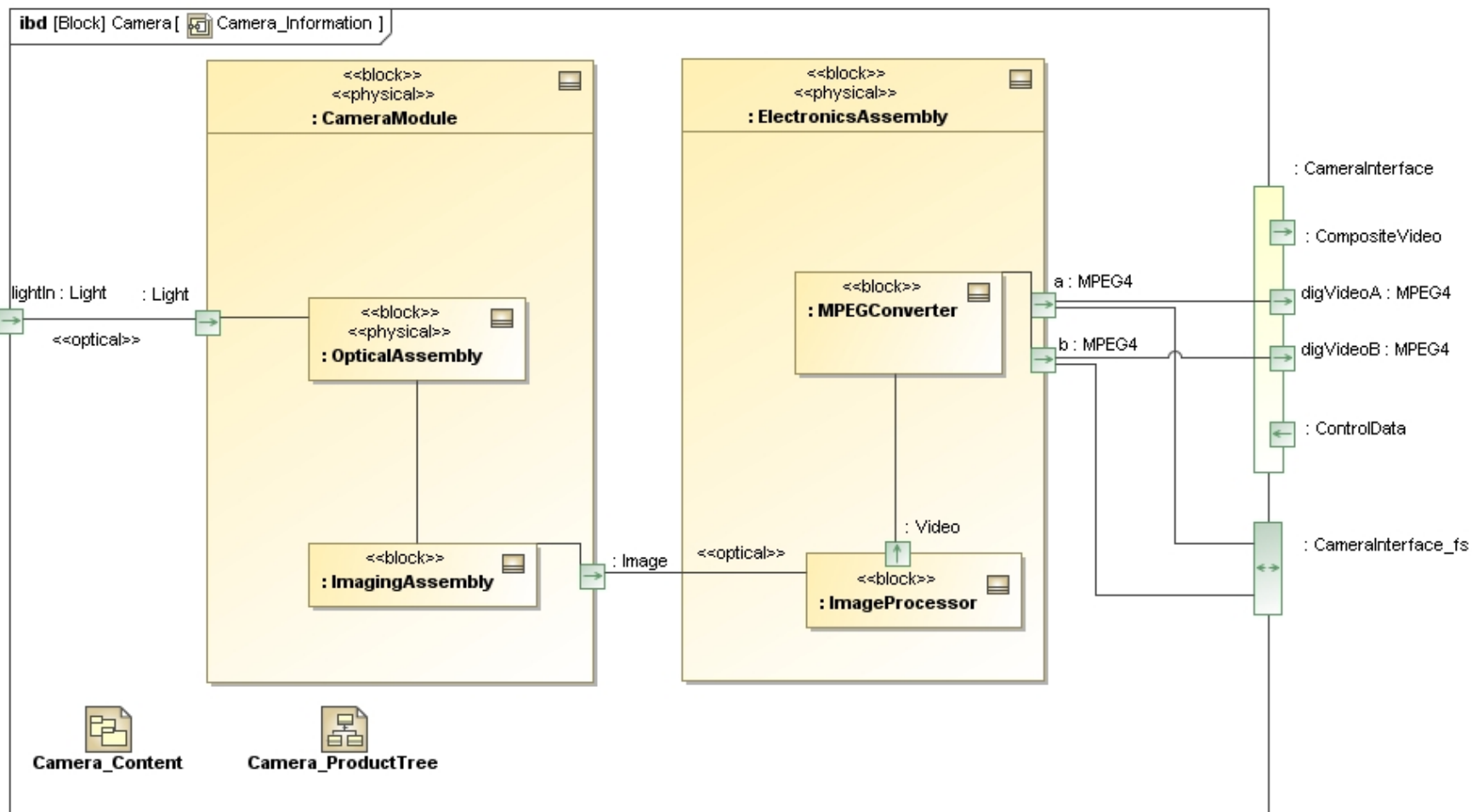
- Limits of nested ports
    - None

Connecting Flow Properties in IBDs Example 1/3

bdd [Package] Camera_Structure [🗃 Camera_ProductTree1]

<<block>>
<<physical>>
Camera

parts
: ProtectiveHousing
ma : MountAssembly
: ElectronicsAssembly
: CameraModule
: MechanicalPowerSubsystem
: DistributionHarness

: CameraInterface

: CameraInterface_fs

: Problematic_fs

<<FlowSpecification>>
CameraInterface_fs

<<FlowProperty>>
analogVideo : CompositeVideo{direction = out}
control : ControlData{readOnly,direction = in}
digVideoA : MPEG4{direction = out}
digVideoB : MPEG4{direction = out}

<<block>>
<<portgroup>>
CameraInterface

<<FlowPort>>digVideoA : MPEG4{direction = out, isAtomic}
<<FlowPort>>digVideoB : MPEG4{direction = out, isAtomic}
<<FlowPort>> : ControlData{direction = in, isAtomic}
<<FlowPort>> : CompositeVideo{direction = out, isAtomic}
<<FlowPort>> : Problematic_fs{direction = inout, isAtomic = false, isConjugated}

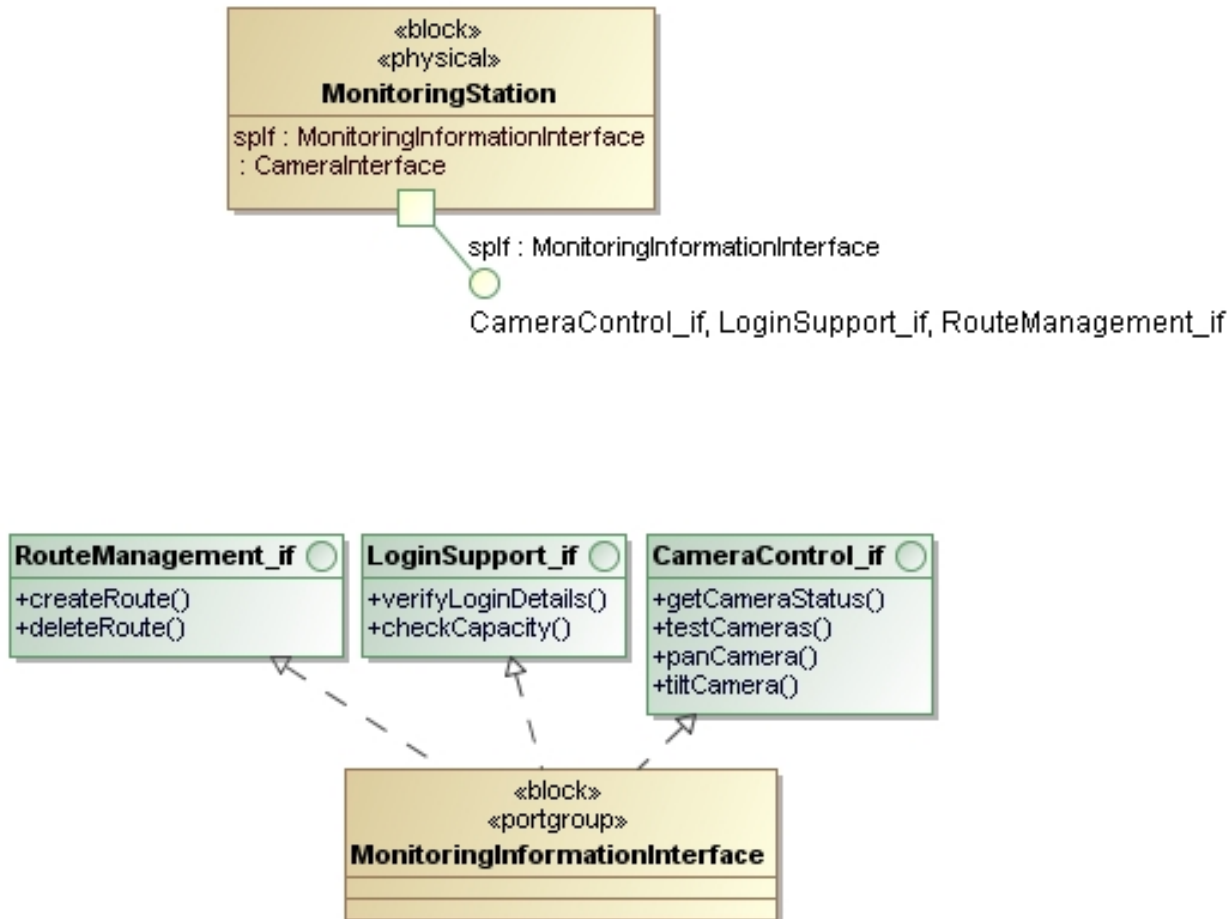# Connecting Flow Properties in IBDs Example 2/3

Grouping of Ports

- Aim of the modeling aspect
    - Group similar interfaces, e.g. information, electrical, optical

- Benefit of nested port usage
    - Re-use easier because it is a type
    - Nested Ports make it easier to query sets of relationships because they are grouped

- Traditional SysML modeling way
    - Many different, unrelated flow or standard ports
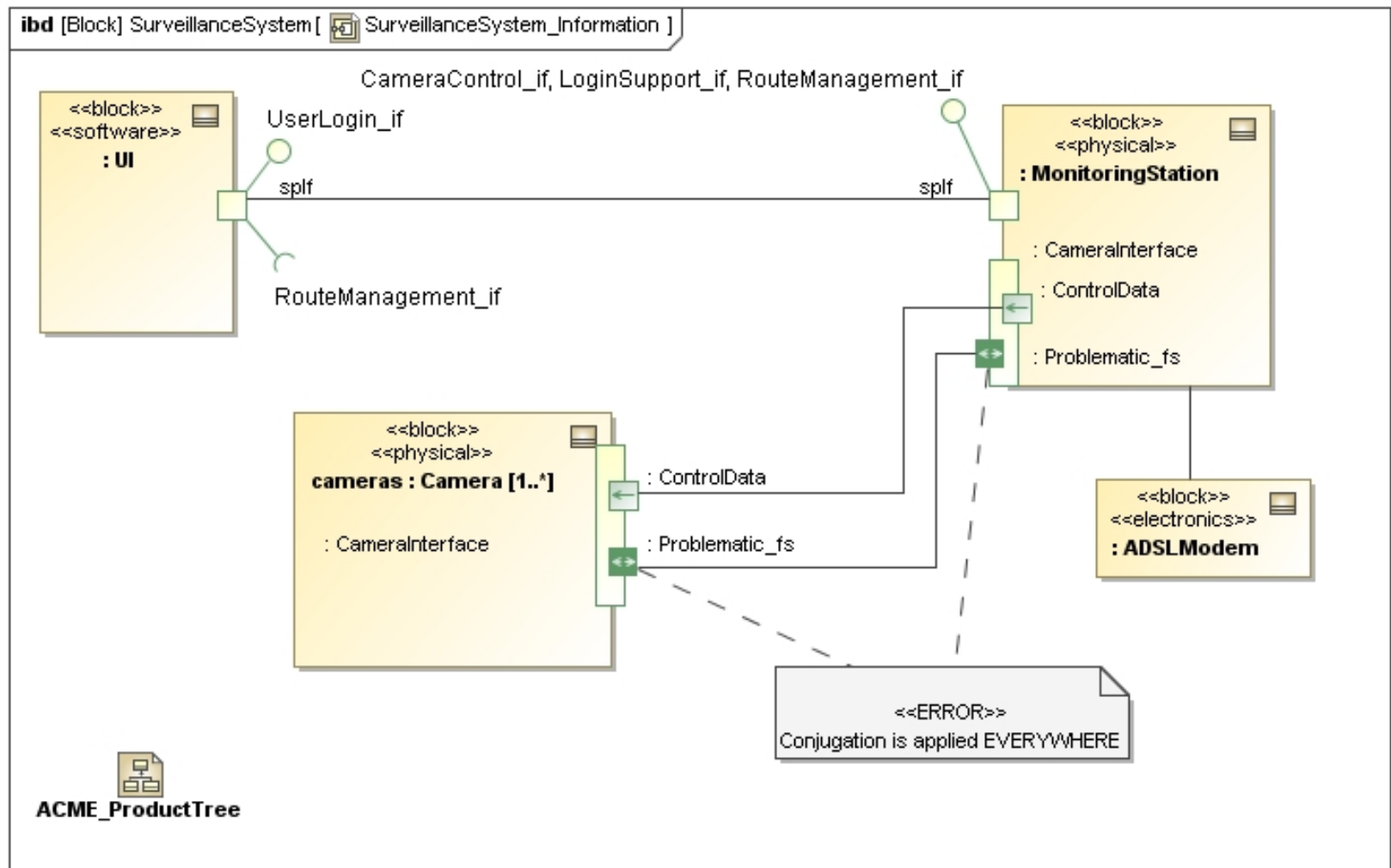
- Limits of nested ports
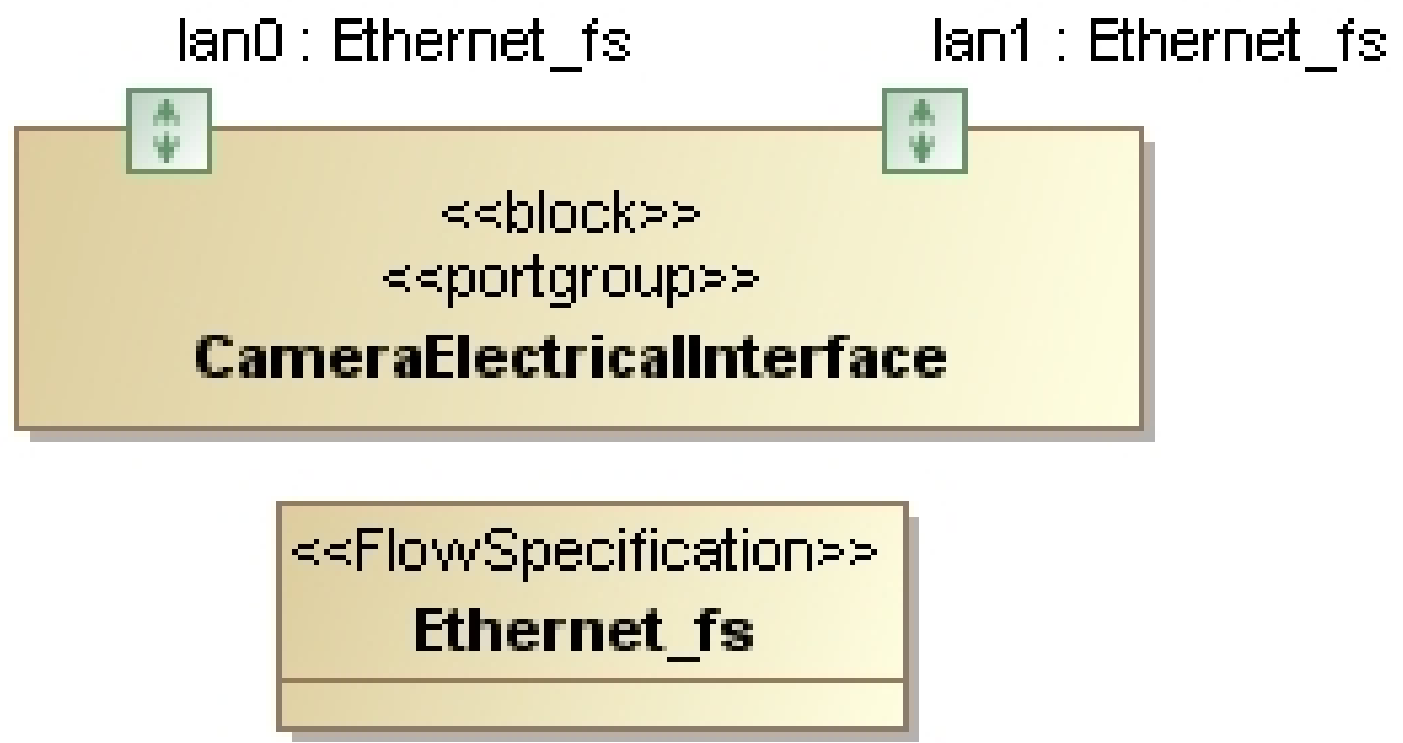   - Conjugation fails

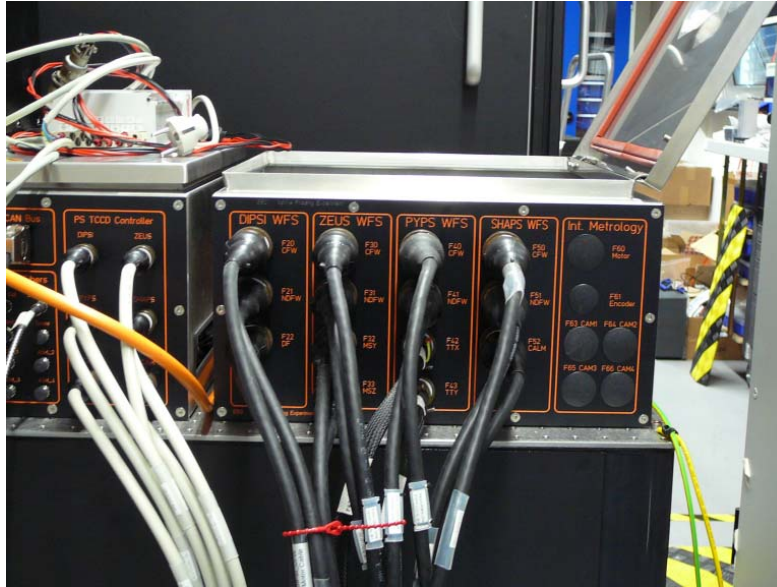## Grouping of Ports - Example 1/5

Grouping of Ports Example 2/5

Grouping of Ports Example 3/5

lan0 : Ethernet_fs   lan1 : Ethernet_fs

<<block>>
<<portgroup>>
CameraElectricalInterface

<<FlowSpecification>>
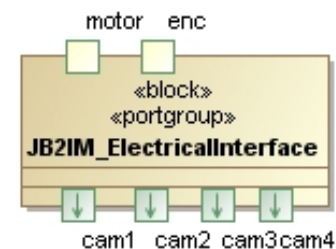**Ethernet_fs**

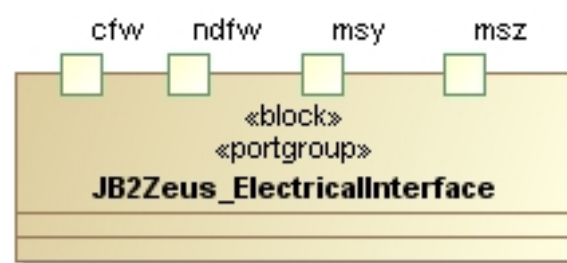## Grouping of Ports APE Junction box Example 4/5

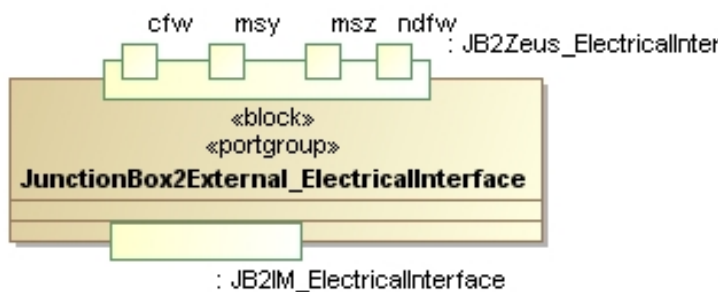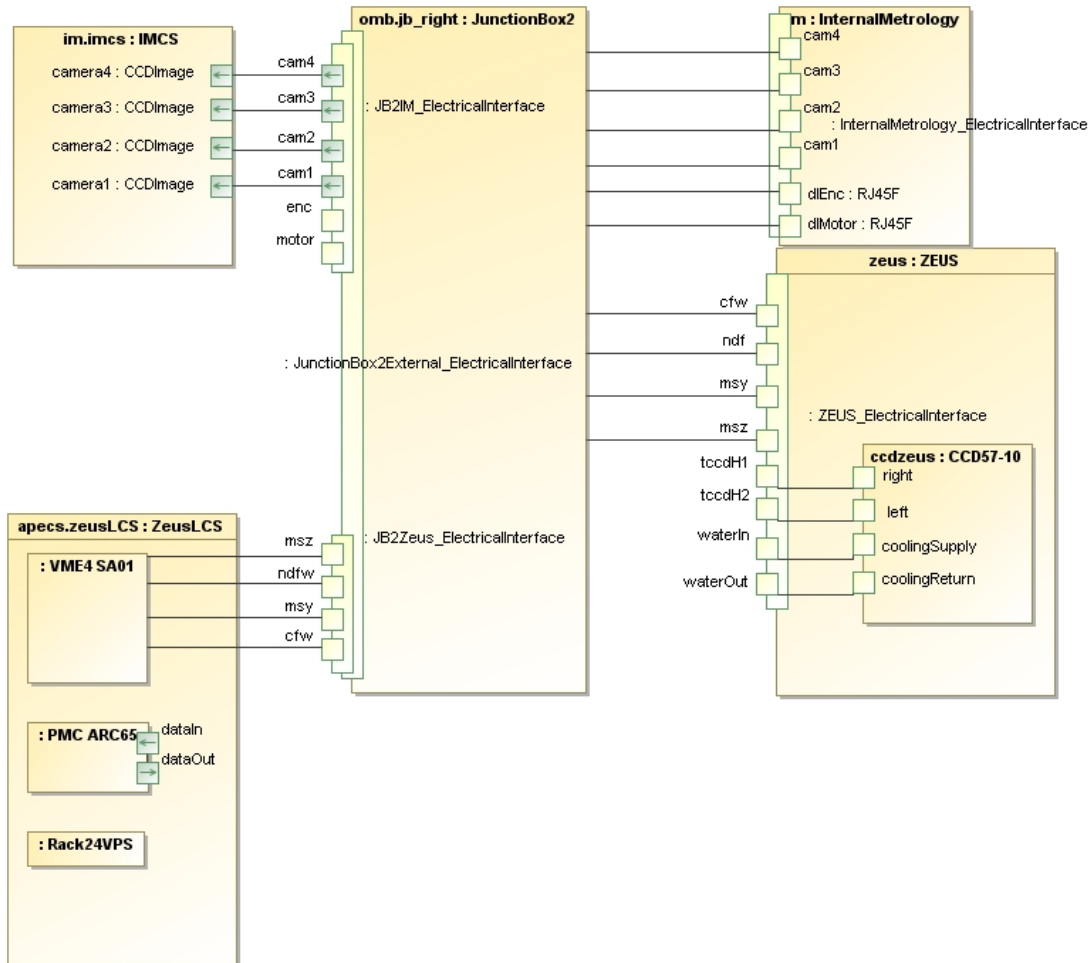

Junction box external interface

Junction box
internal cabling

Junction box internal
interface fanout

# Grouping of Ports APE Junction box Example 5/5

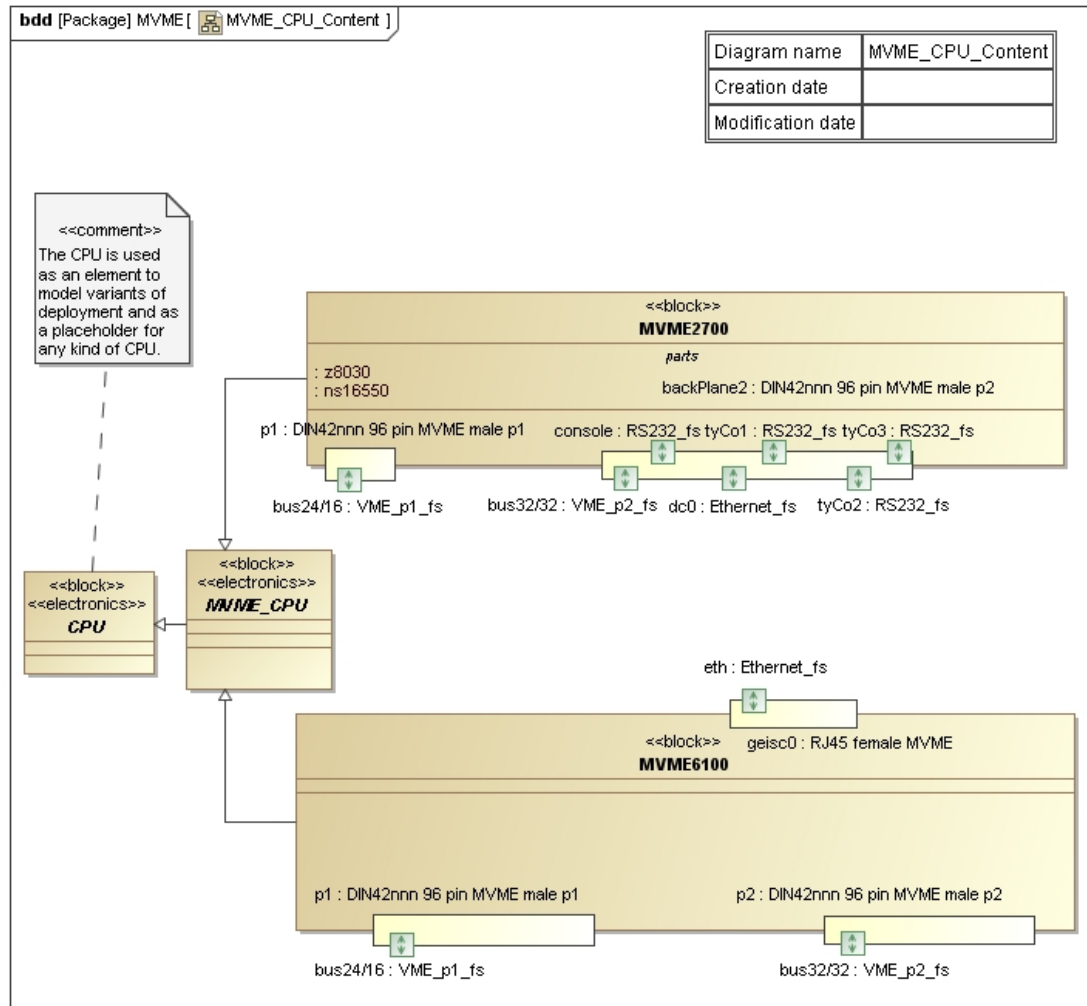## Combining physical connector type and flow

- Aim of the modeling aspect
    - Define physical connector and flow at border of part
    - Hide internals of block
- Benefit of nested port usage
    - A single type is defined for both
    - Re-use
- Traditional SysML modeling way
    - Connect to internal part
    - Need several unrelated ports
- Limits of nested ports
    - Different flows over a connector (e.g. pin assignment) can only be assigned via specialization

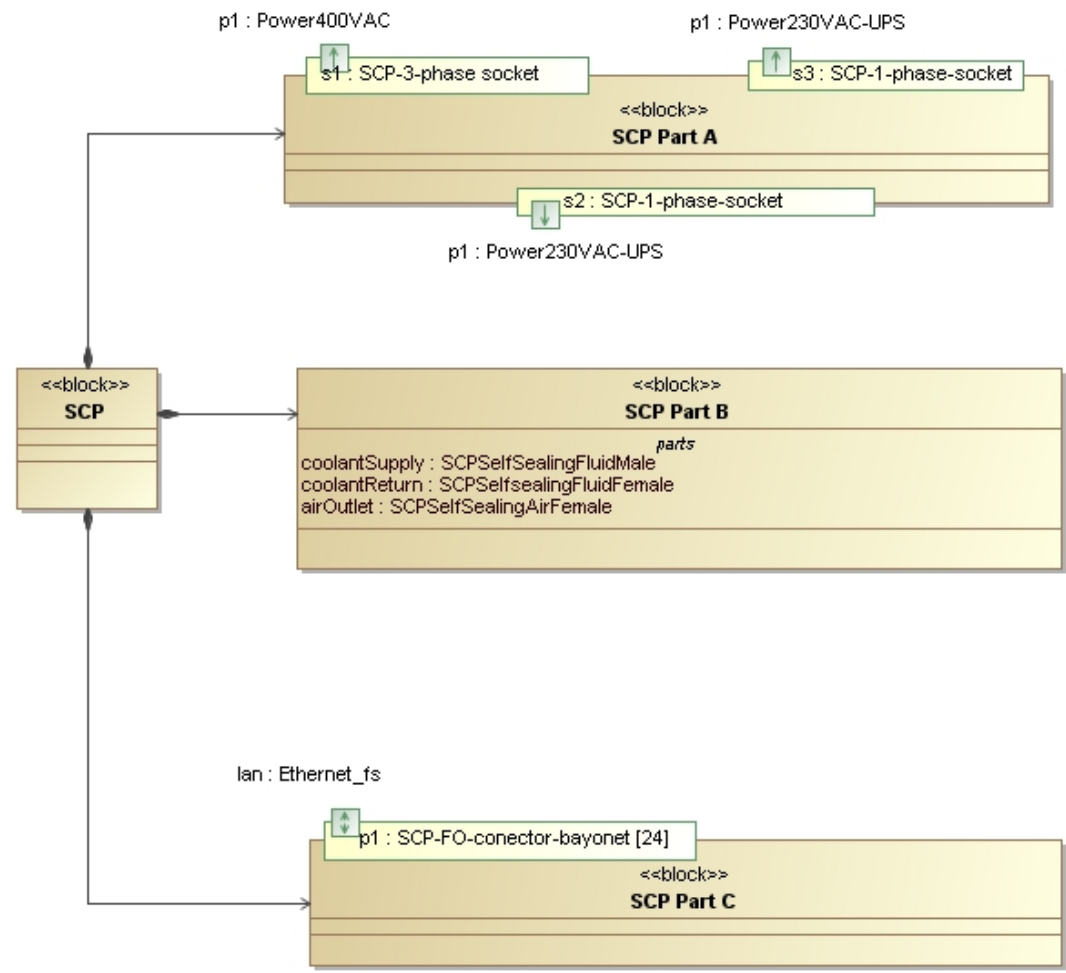## Combining physical connector type and flow Example 1/5
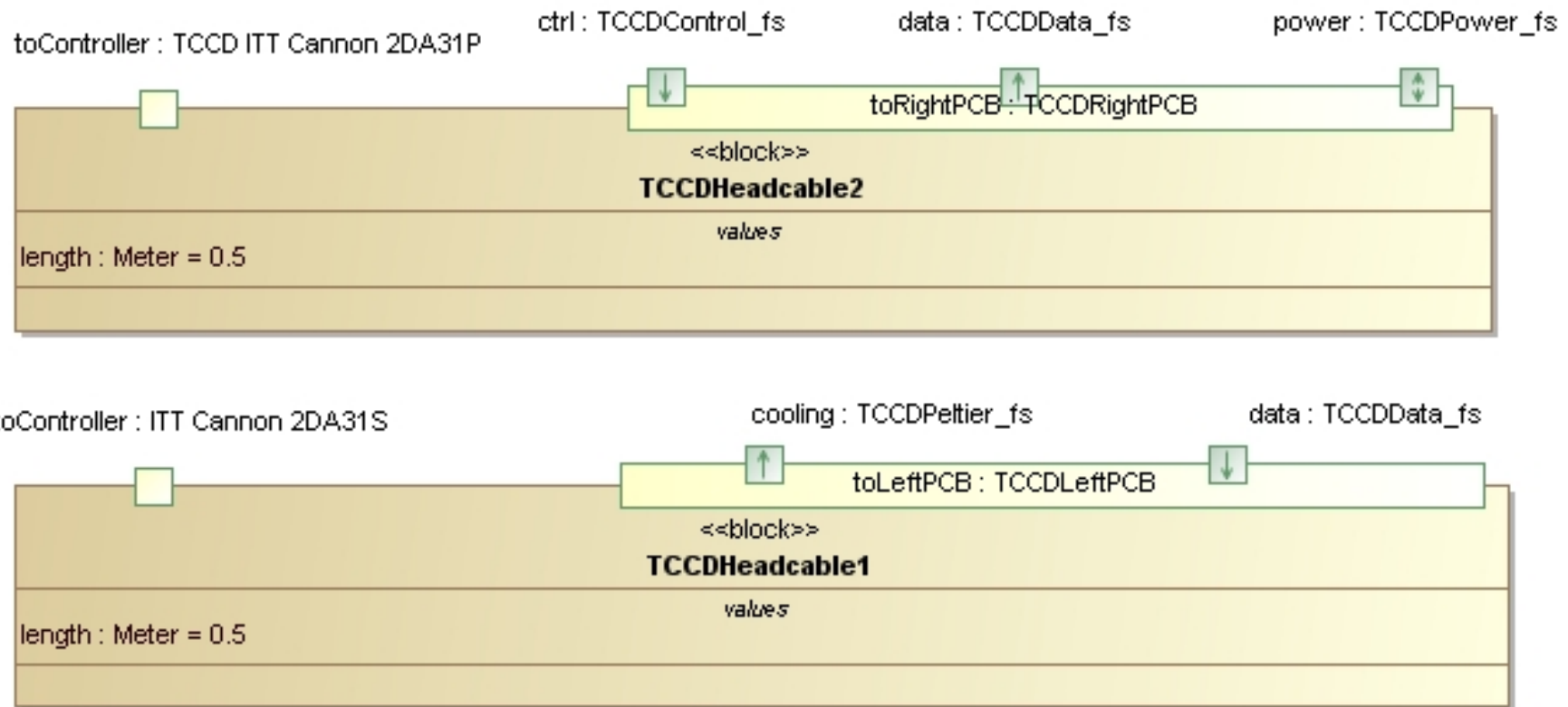
Combining physical connector type and flow Example 2/5

Combining physical connector type and flow Example 3/5

Combining physical connector type and flow Example 4/5
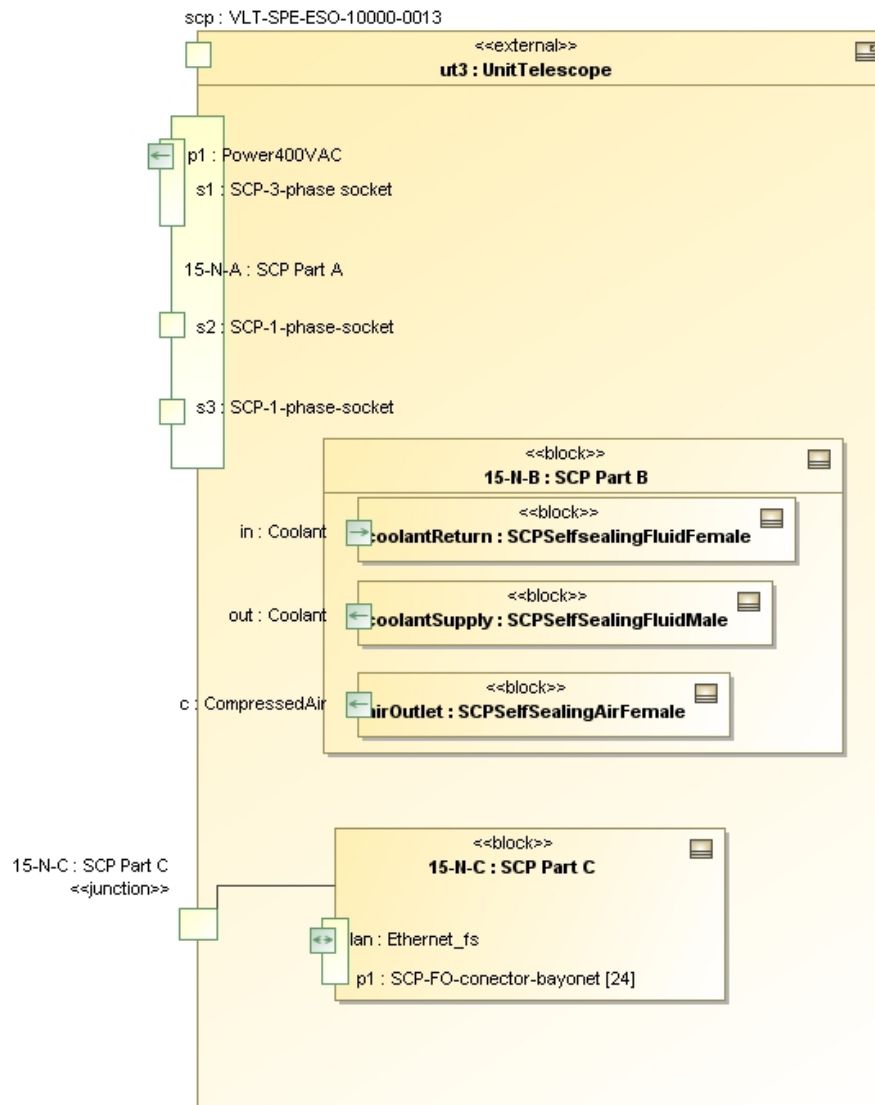
Cable is soldered to the head – no need to have extra block for cable – Example 5/5
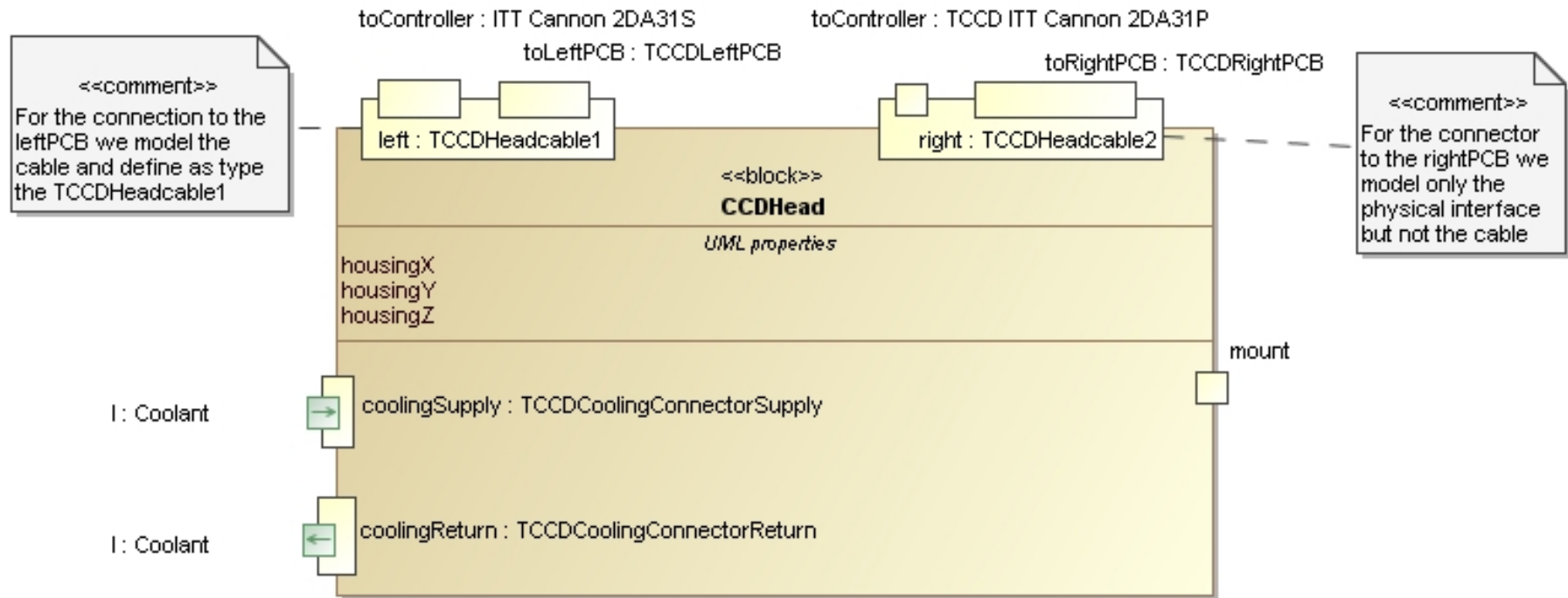
Reusable Data and Command Interfaces

- Aim of the modeling aspect
    - Define Command and Data interfaces in one Block

- Benefit of nested port usage
    - Grouping
    - Re-use
    - Extendibility
    - Consistency

- Traditional SysML modeling way
    - Several unrelated flow and standard ports

- Limits of nested ports
    - None

Reusable Data and Command Interfaces Example 1/2
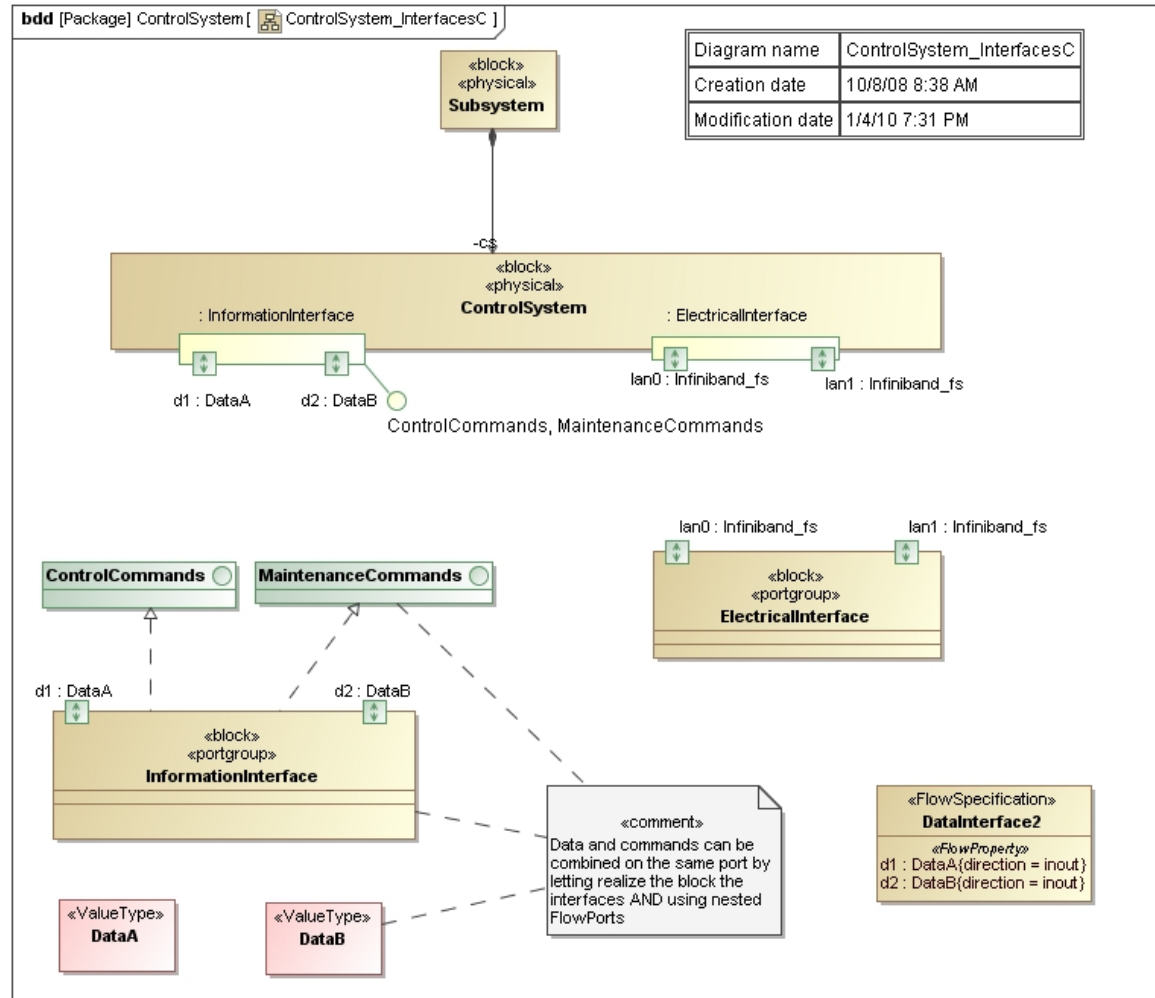
Reusable Data and Command Interfaces Example 2/2
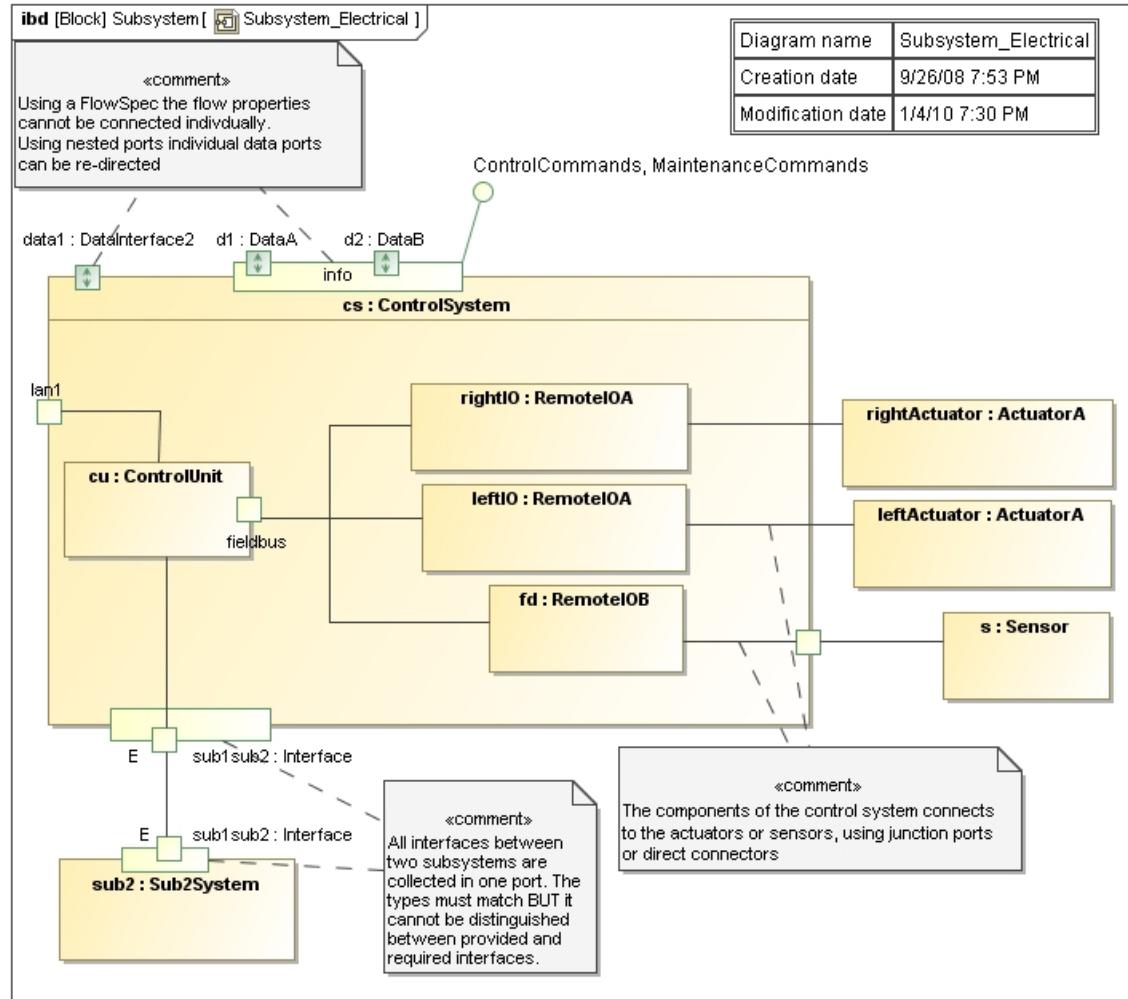
Logical Channels (credit: Darren Kelly)

- Aim of the modeling aspect
    - Define logical channels

- Benefit of nested port usage
    - Grouping of logical channels which belong together
    - Re-use

- Traditional SysML modeling way
    - Several unrelated flow ports

- Limits of nested ports
    - none

Logical channels Example 1/2

ibd [System] [ObjectMonitoringSystem]

The position and angle of a physical object is sensed using analog sensors and monitored as digitally encoded signals using a digital computer. This example illustrates the possibility of combining standard ports and SyML flowports.
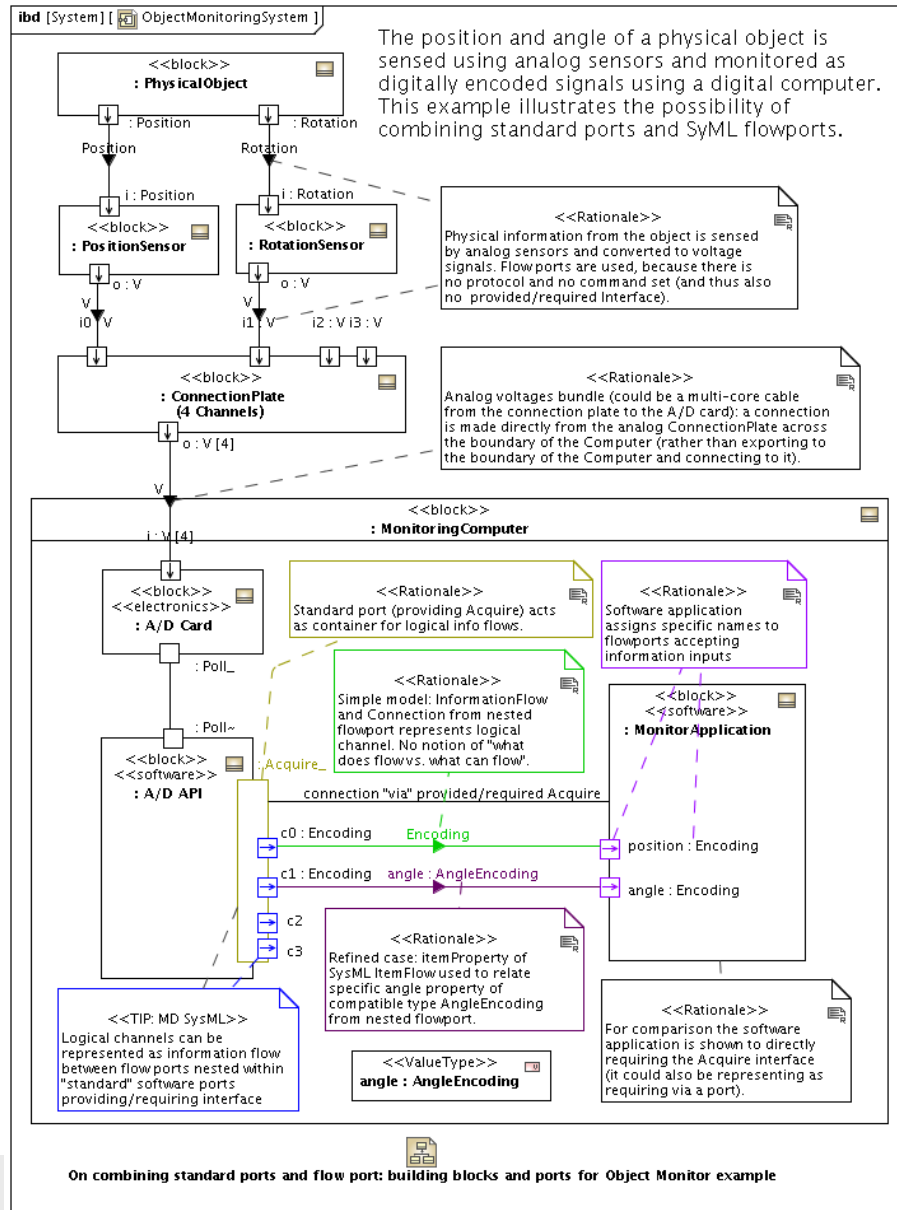
<<block>>
: PhysicalObject

<<block>>
: PositionSensor

<<block>>
: RotationSensor

<<Rationale>>
Physical information from the object is sensed by analog sensors and converted to voltage signals. Flow ports are used, because there is no protocol and no command set (and thus also no provided/required Interface).

<<block>>
: ConnectionPlate
(4 Channels)

<<Rationale>>
Analog voltages bundle (could be a multi-core cable from the connection plate to the A/D card): a connection is made directly from the analog ConnectionPlate across the boundary of the Computer (rather than exporting to the boundary of the Computer and connecting to it).

<<block>>
: MonitoringComputer

<<block>>
<<electronics>>
: A/D Card

<<Rationale>>
Standard port (providing Acquire) acts as container for logical info flows.

<<Rationale>>
Software application assigns specific names to flowports accepting information inputs

<<Rationale>>
Simple model: InformationFlow and Connection from nested flowport represents logical channel. No notion of "what does flow vs. what can flow".

<<block>>
<<software>>
: MonitorApplication

<<block>>
<<software>>
: A/D API

connection "via" provided/required Acquire

c0 : Encoding — Encoding — position : Encoding

c1 : Encoding — angle : AngleEncoding — angle : Encoding

c2
c3

<<Rationale>>
Refined case: itemProperty of SysML ItemFlow used to relate specific angle property of compatible type AngleEncoding from nested flowport.

<<Rationale>>
For comparison the software application is shown to directly requiring the Acquire interface (it could also be representing as requiring via a port).

<<TIP: MD SysML>>
Logical channels can be represented as information flow between flowports nested within "standard" software ports providing/requiring interface

<<ValueType>>
angle : AngleEncoding

On combining standard ports and flow port: building blocks and ports for Object Monitor example

Logical channels Example 2/2

bdd [Model] [On combining standard ports and flow port: building blocks and ports for Object Monitor example]