

SCDL introduction

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SCN-SG
Shuhei YAMASHITA (DNV GL)

Plot

- Background of SCDL
- Examples of SCDL expression
- Today's status of SCDL
- ➔ Real application in a project

Background of SCDL

ISO 26262

- Safety design guideline for automotive E/E system.
- The first edition was released in 2011 and revision was made in the end of 2018.
- Commonly used globally in the automotive domain.
- Providing safety architecture oriented approach driven by SR/SC
- Recommending usage of a semiformal notation for SR/SC.

SR : Safety Requirement
SC : Safety Concept
FFI : Freedom From Interference

Semiformal Notation for SR/SC?

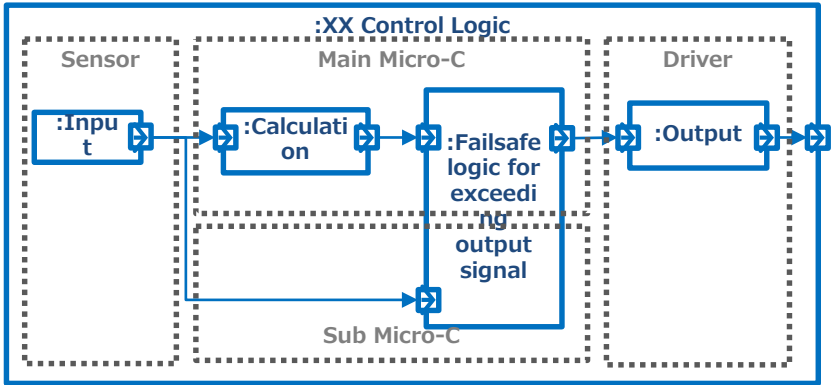
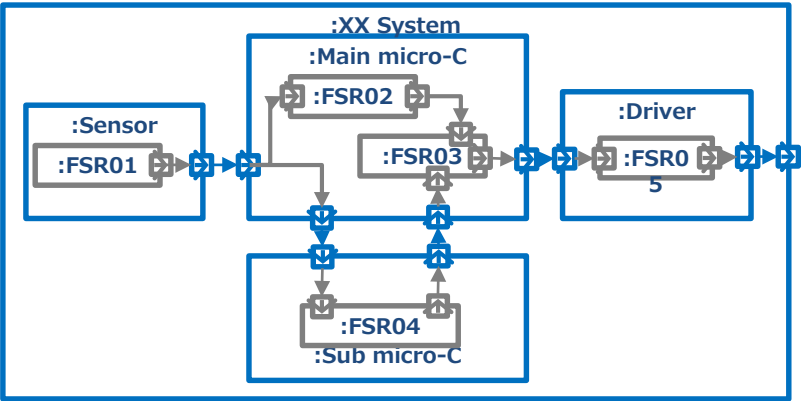
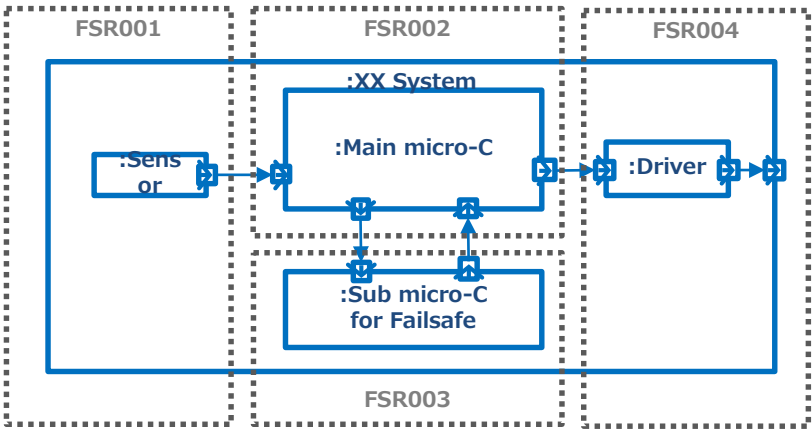
- As the result, many safety engineers have been trying to use SysML or other existing general purpose languages.
- Consequences were unfortunate : usage of general purpose languages creates various expression even for very simple concept.
- This forces many safety engineers to tolerate unnecessary additional work load.

SysML : System Modeling Language

Variety of SC expression

NOT really efficient for
effective Functional
Safety development

SC : Safety Concept



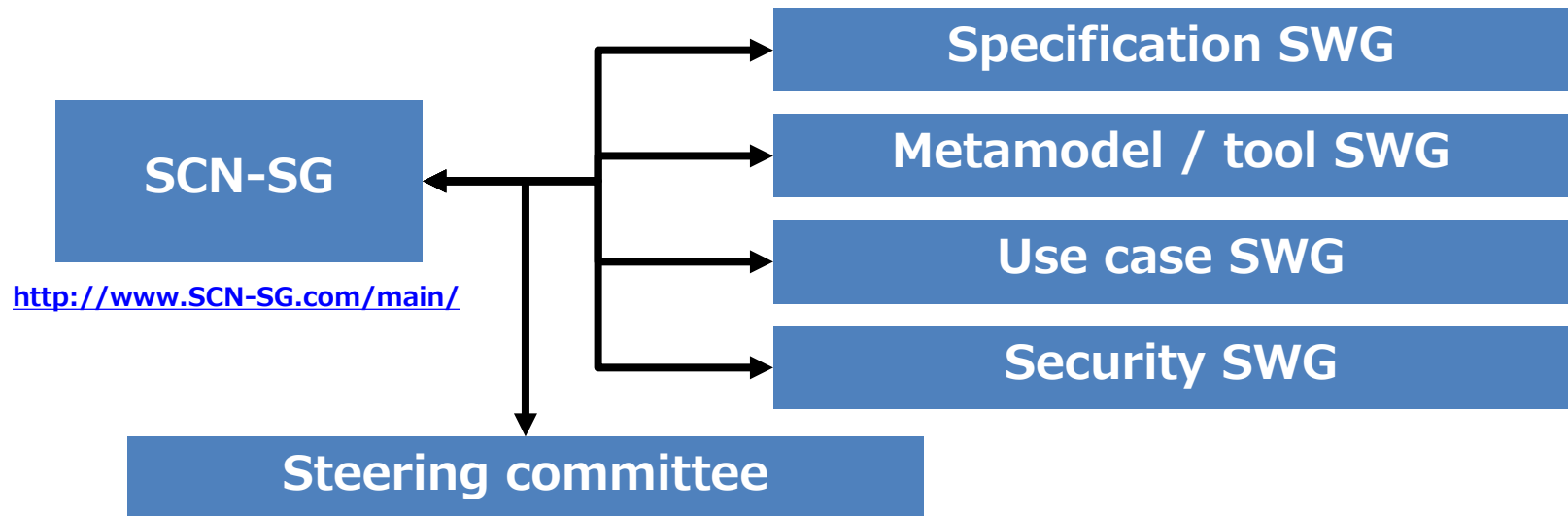
Birth of SCDL

- Came up with an idea of safety concept oriented language which can help effective and efficient functional safety development.
 - following ISO 26262 original intention
 - considering context and semantics of the standard
- Especially focusing on key factors such as SR, SC, Element, ASIL, dependency and interaction between SRs, decomposition, FFI and so on.
- Characterized with function block diagram base graphical expression

SR : Safety Requirement
SC : Safety Concept
ASIL : Automotive Safety Integrity Level
FFI : Freedom From Interference

SCDL created by SCN-SG

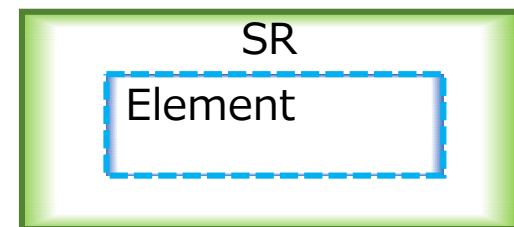
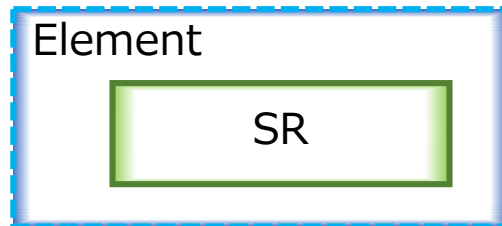
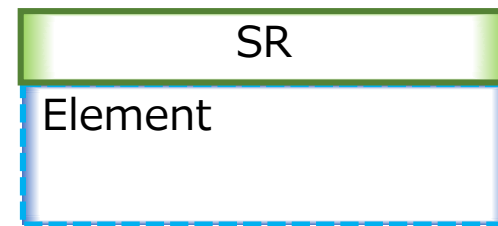
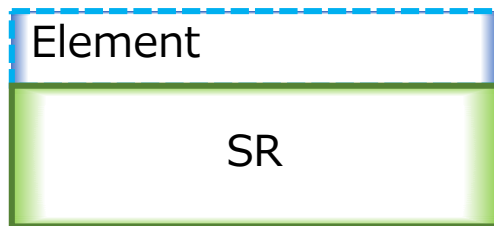
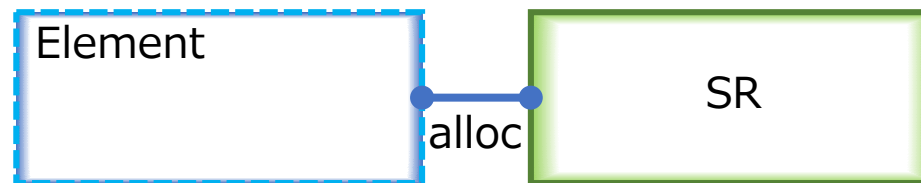
- SCDL specification is open to public on the SCN-SG web site.
- SCN-SG has been studying grammar of SCDL, it's use-cases, meta-models and other topics on a voluntary basis since 2015.



Examples of SCDL expression

Grammar Examples of SCDL

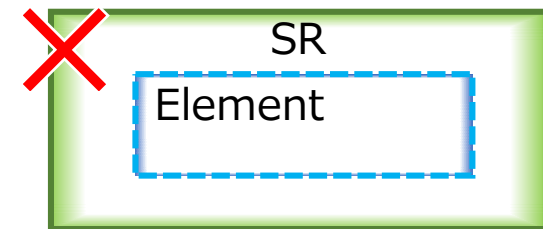
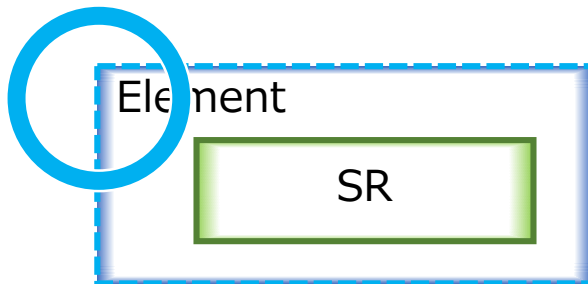
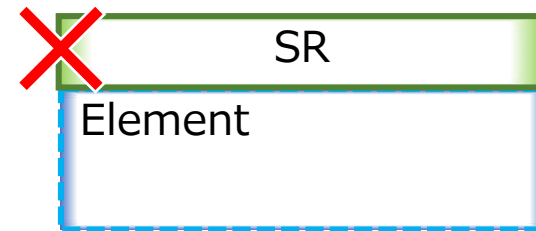
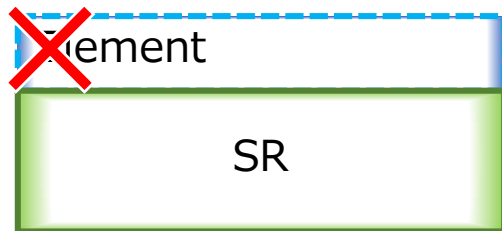
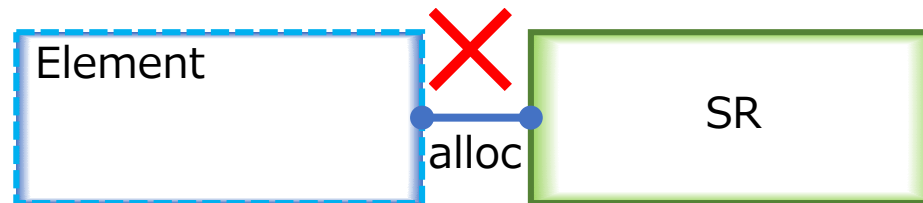
SysML allows following all combinations for 'SR allocation on Element'.



SysML : System Modeling Language
SR : Safety Requirement

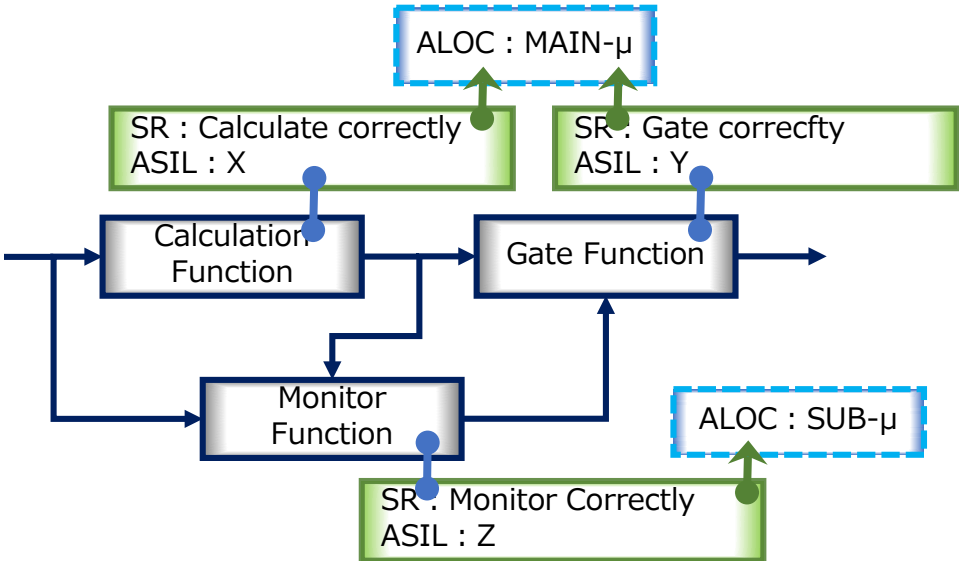
Grammar Examples of SCDL

SCDL chose only one expression for 'SR allocation on Element'.



SR : Safety Requirement

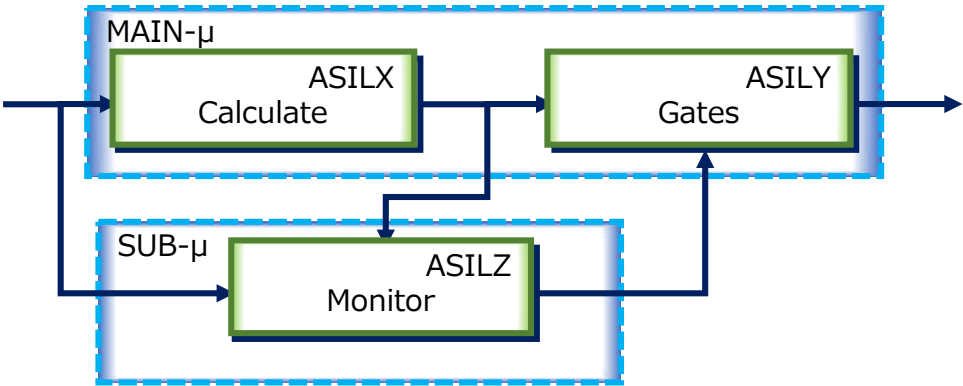
Grammar Examples of SCDL



Typical expression for SC based on Function Block Diagram before SCDL

SCDL could simplify SC expression.

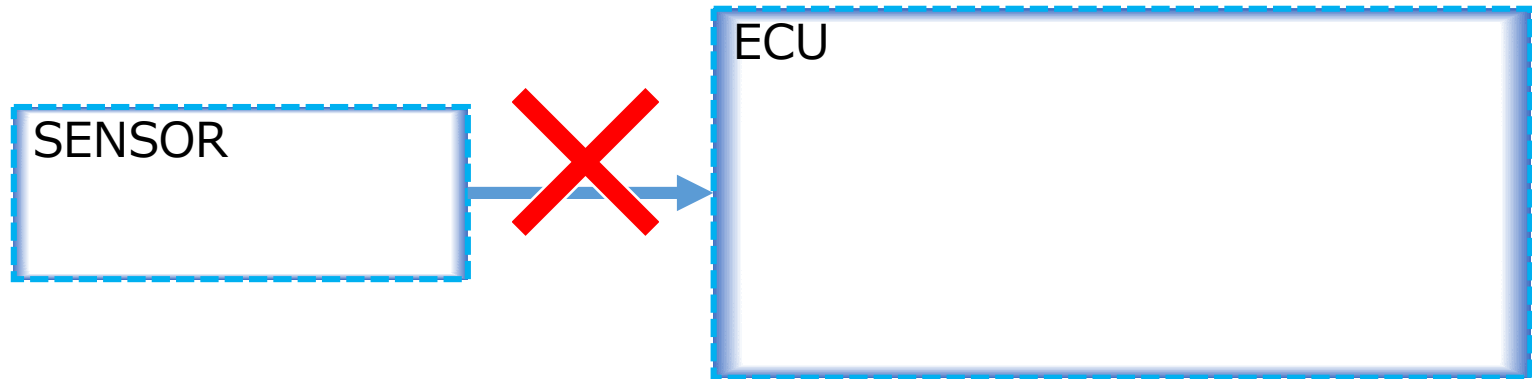
SCDL expression for SC



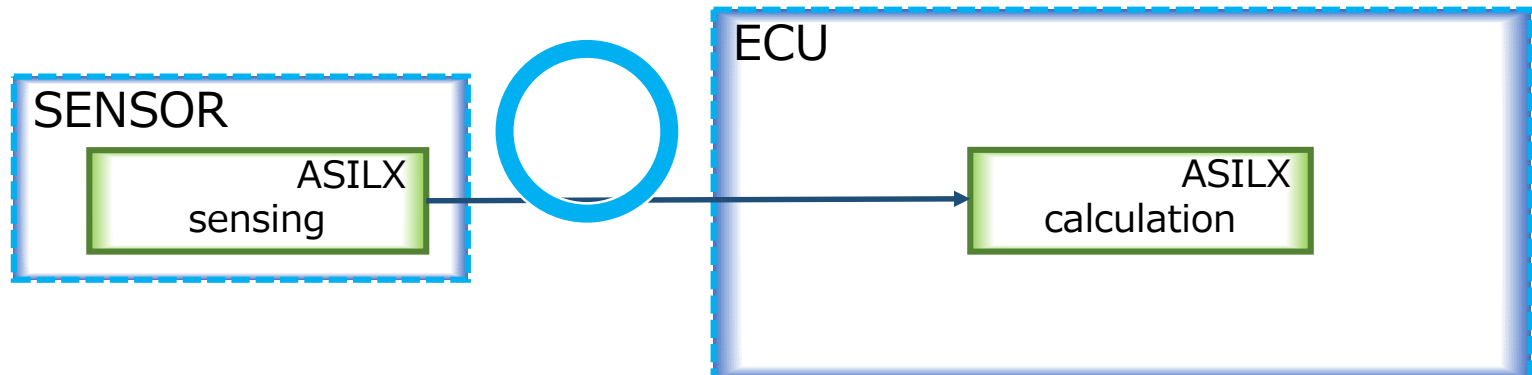
SC : Safety Concept
SR : Safety Requirement

Grammar Examples of SCDL

Do not connect elements each other with an arrow.

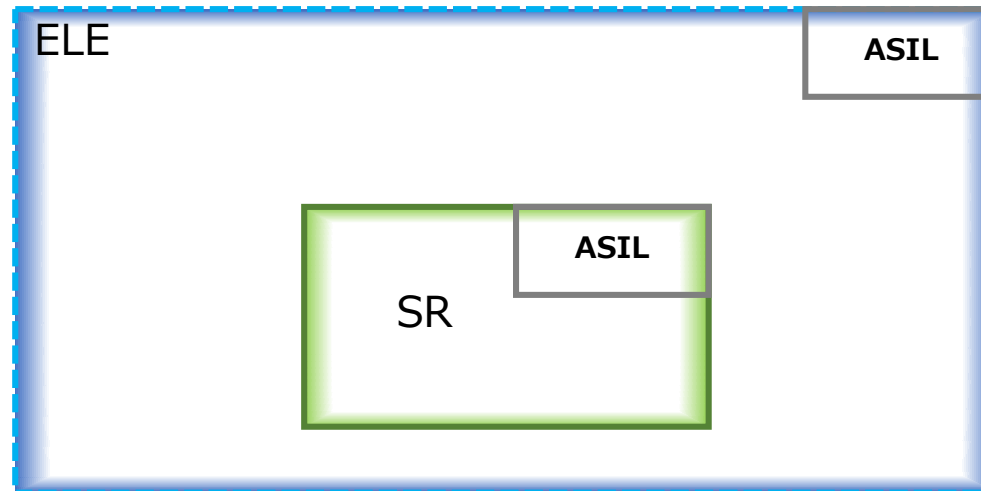


Connect their requirements.



Grammar Examples of SCDL

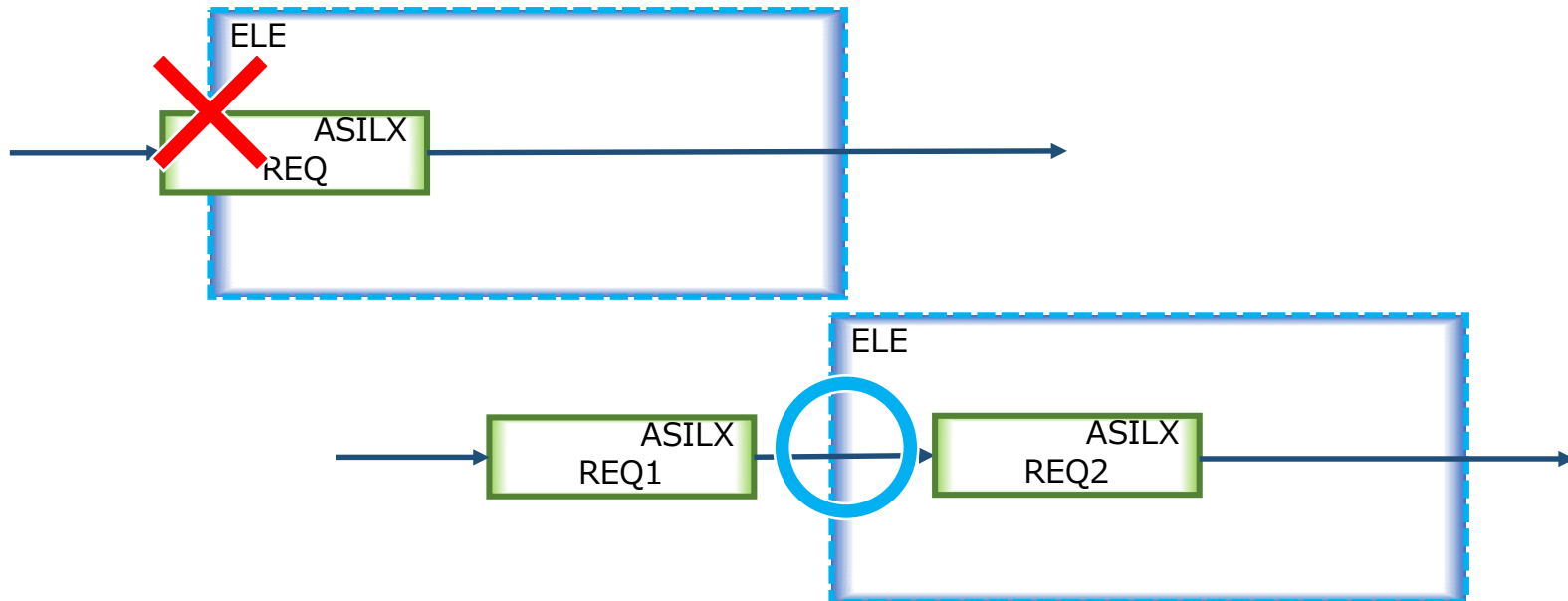
A place holder for ASIL is defined for both Element and SR.



SR : Safety Requirement

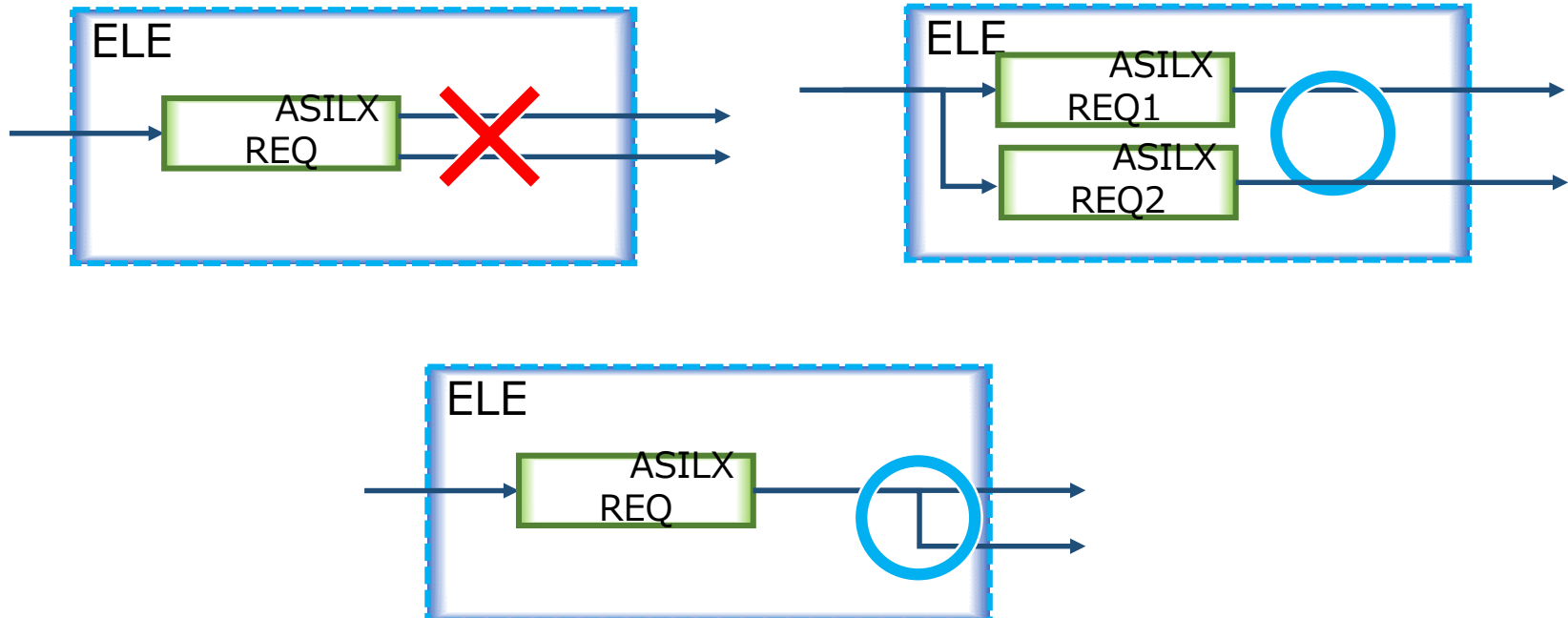
Grammar Examples of SCDL

Do not cross the element boundary with the requirement.
(to keep the requirements' granularity appropriate)



Grammar Examples of SCDL

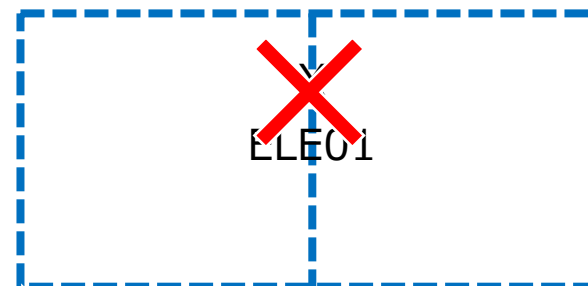
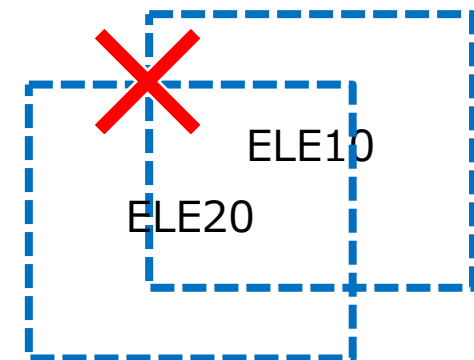
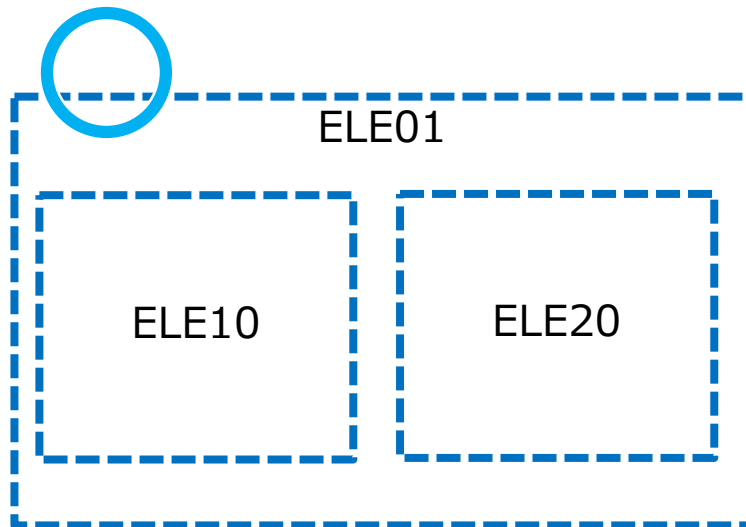
Do not give multiple output to a single requirement.
(to keep the requirements appropriately atomic)



Grammar Examples of SCDL

Do not cross any element boundary line with another Element.

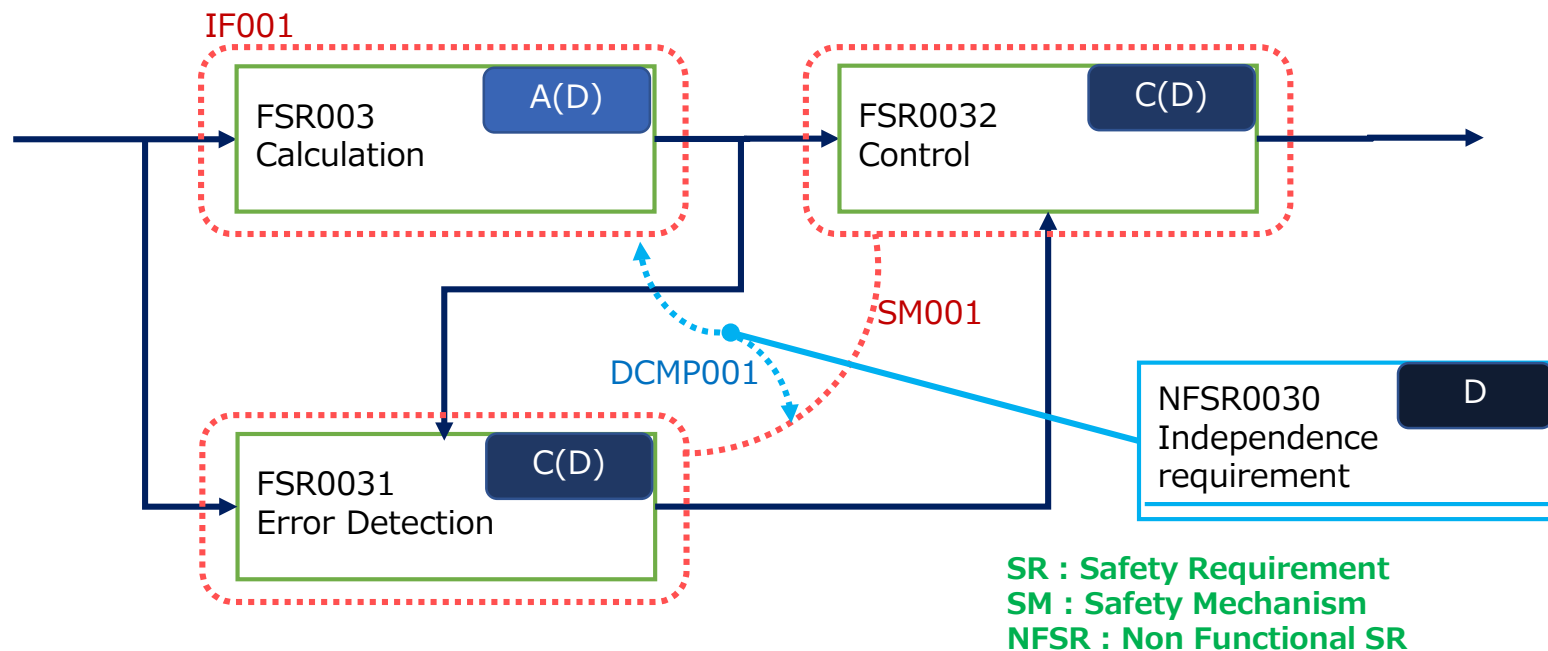
Do not divide one element into multiple elements.



Grammar Examples of SCDL

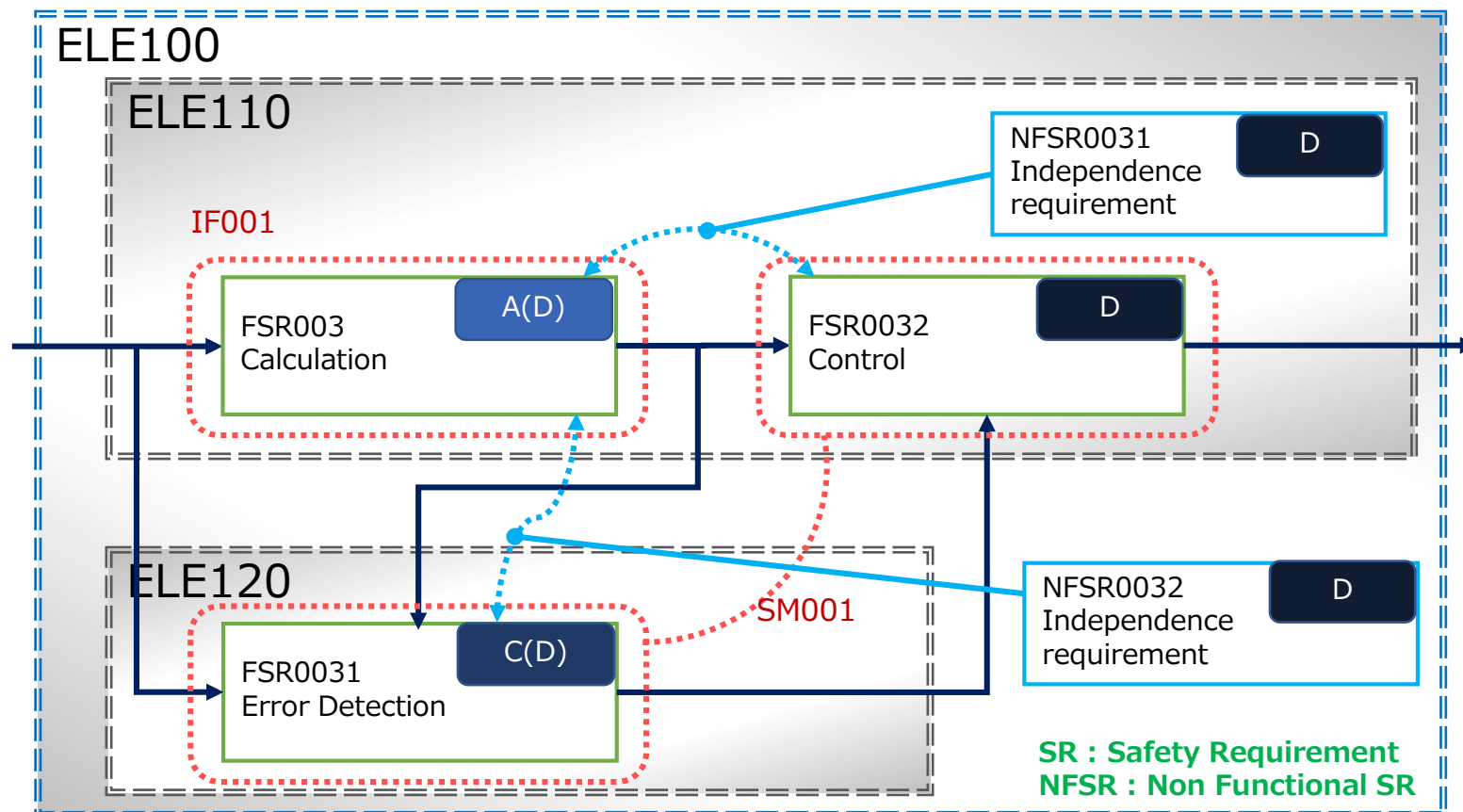
Expression for SR structure of SM is following decomposition logic perfectly :

- Interactions among SRs (e.g.; Detection & Control)
- Pairs of redundant SR groups (DCMP001 = IF001 + SM001)
- Independence requirements (NFSR0030; floating)



Grammar Examples of SCDL

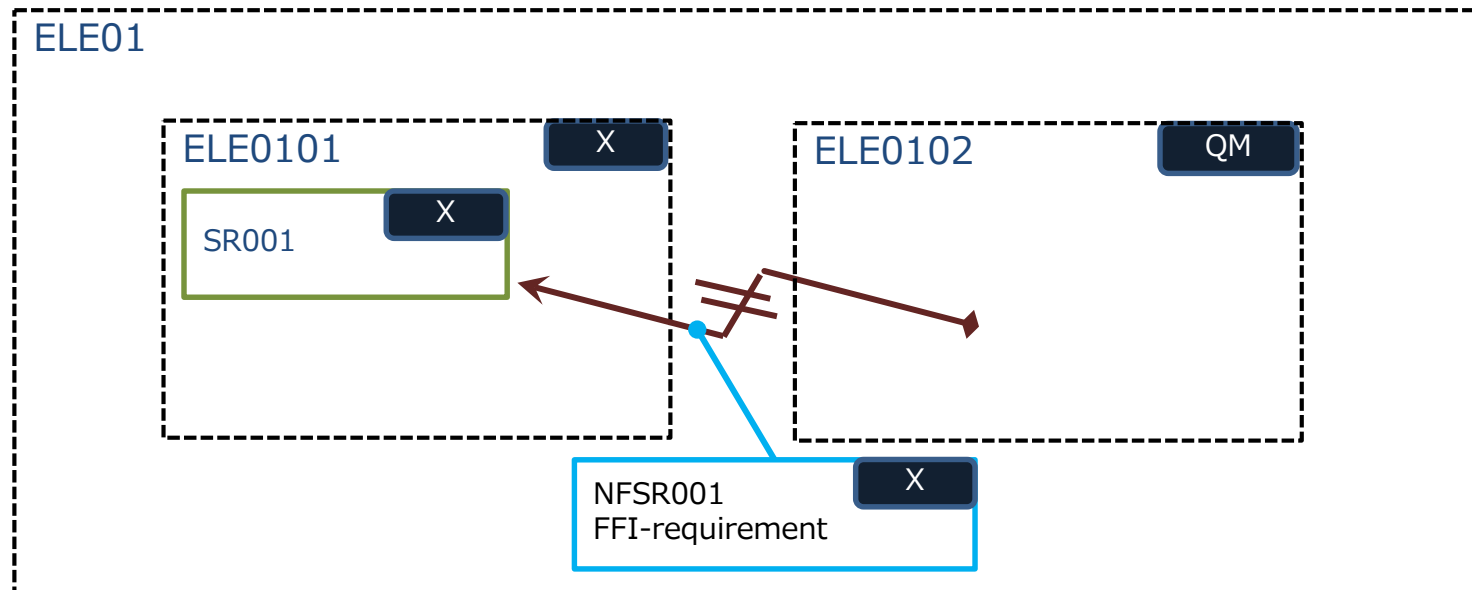
Example of results of decomposition : The diagram indicates SRs allocation on Elements including independence requirement.



Grammar Examples of SCDL

FFI requirement expression following 'Criteria for Coexistence'.

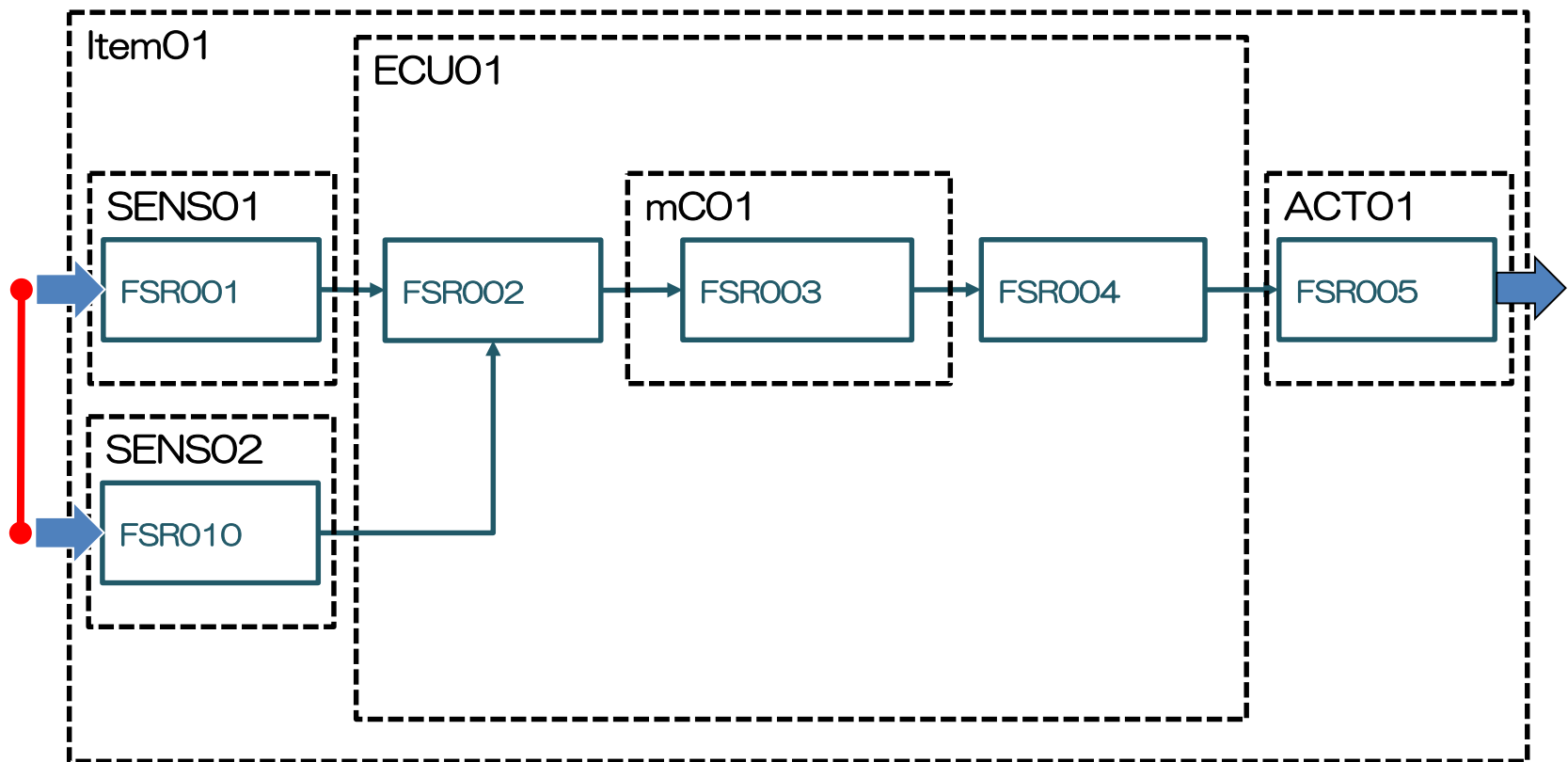
FFI : Freedom From Interference



Grammar Examples of SCDL

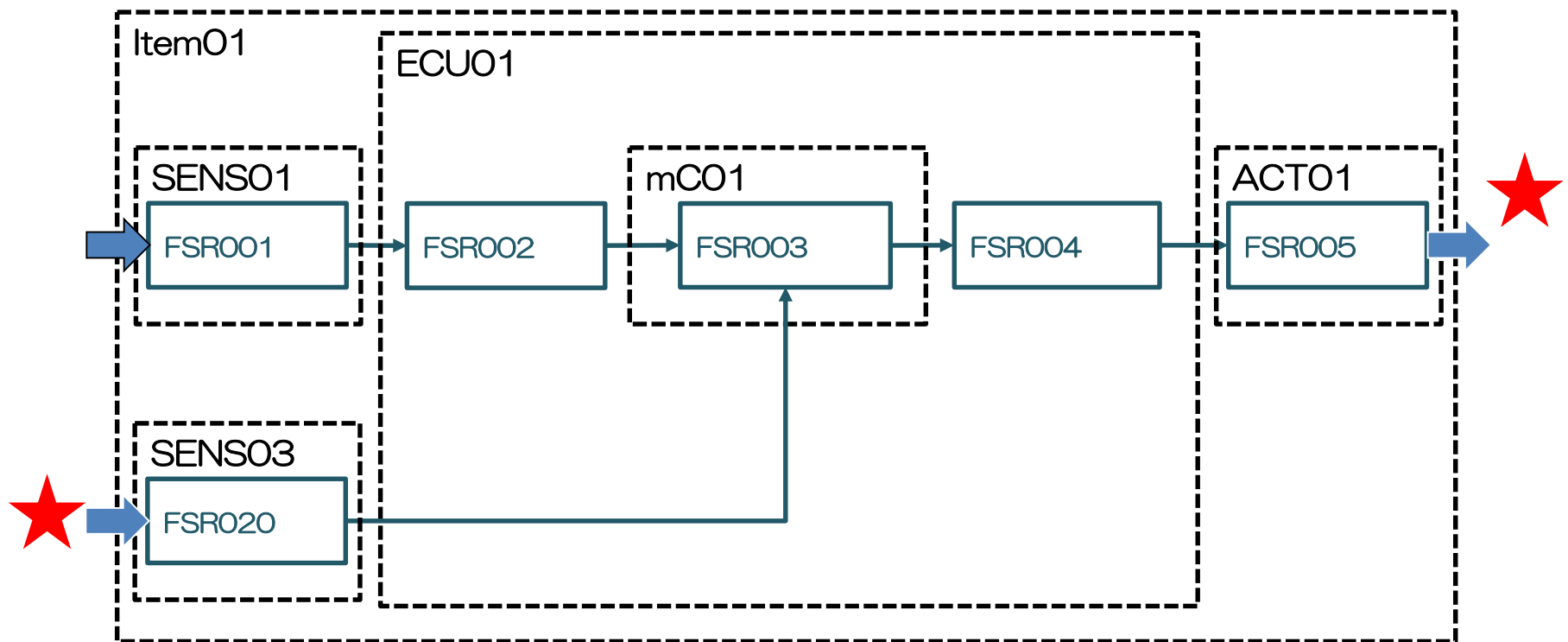
A bridge symbol between two input block arrow stands for OT link.
e.g. a mechanical link for two redundant sensors

OT : Other Technology



Grammar Examples of SCDL

A pair of star symbols is used to stand for 'External Plant'.
e.g. Vehicle, Engine, Motor



Today's status of SCDL

SCDL today's status

- SCDL is quite well spreading in Japanese automotive society in various level of usage.

Usage level		description
1	Illustration	Illustrating ISO26262 basic logics for training purpose
2	System diagram	Drawing system diagrams subject to analysis, further detailing or supplement for specification in SysML or other languages
3	Semiformal Notation	Specifying SR/SC in semiformal notation according to the standard original intention
4	Modeling	Safety architecture modeling that are effective for model verification, generating test vectors or inter-conversion with dynamic models.

SCDL standardization

- Stability and sustainability of SCDL specification are required by the society.
- Data interchangeability among several software tools is also expected by many users.
- Considering SCDL as a common property, it looks relevant to transfer it's specification to a standardization body such as ASAM.

➔ **example of implementation of SCDL in
real development in CALSONIC KANSEI**