



System Architecture creation using System Composer

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Mercedes-Benz
The best or nothing.



Agenda

1. Introduction
2. Problem statement
3. Solution
 - a. System Composer – Introduction
 - b. How can System Composer solve the problem?
4. Tools used
5. Demonstration
6. How did System Composer help us improve?
7. Conclusion

Introduction



Sudeep Kulkarni

- 5+ years of experience in Automotive Industry.
- Software Development for the following functions in Powertrain topics:
 - Front axle Manual transmission (FSG)
 - Speed control and coordination
- Currently a part of software development for functional safety of Transmission software

Problem Statement

- The process we follow in requirement based software development, lacks the standard process of creating requirement specifications
- Currently, the requirement specifications used by the developer for software development might be in the form of flow diagram, doors requirements, hand drawing etc.
- In order to achieve full V-Cycle with respect to software development, the process for analyzing the requirement and creating a system architecture that can be used for software development is necessary

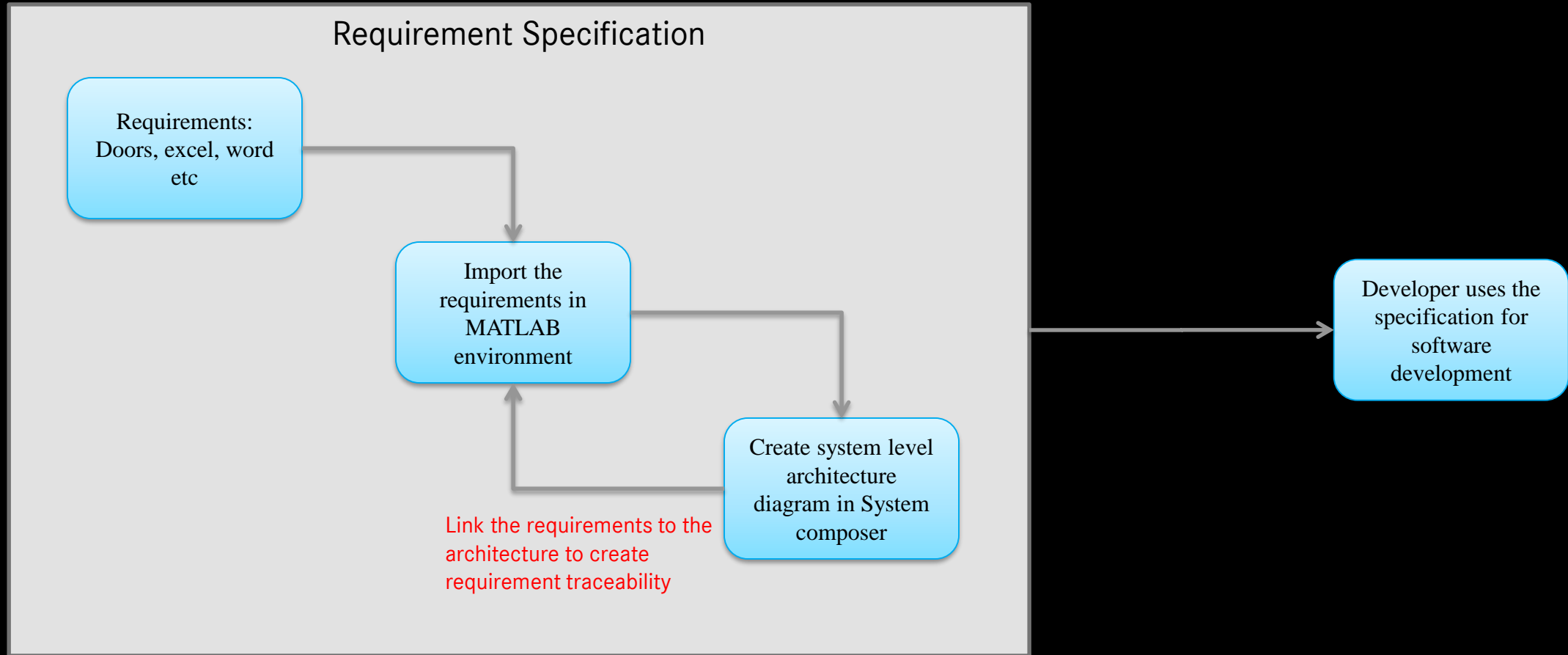
Solution

- To address this void, Architecture based software development shall be adopted with minimal changes in the conventional process
- With System Composer, this void could be addressed, as it is a toolbox in MATLAB family, the conventional process is not altered much

System Composer

- A MathWorks toolbox inside MATLAB family
- Import/create requirements using Simulink Requirements toolbox
- Enables user to create system level architecture
- Link requirements to the Architecture for better traceability
- Define stereotypes
- Create custom views
- Import Simulink model for system architecture creation
- And many more..

System Composer workflow - Proposed

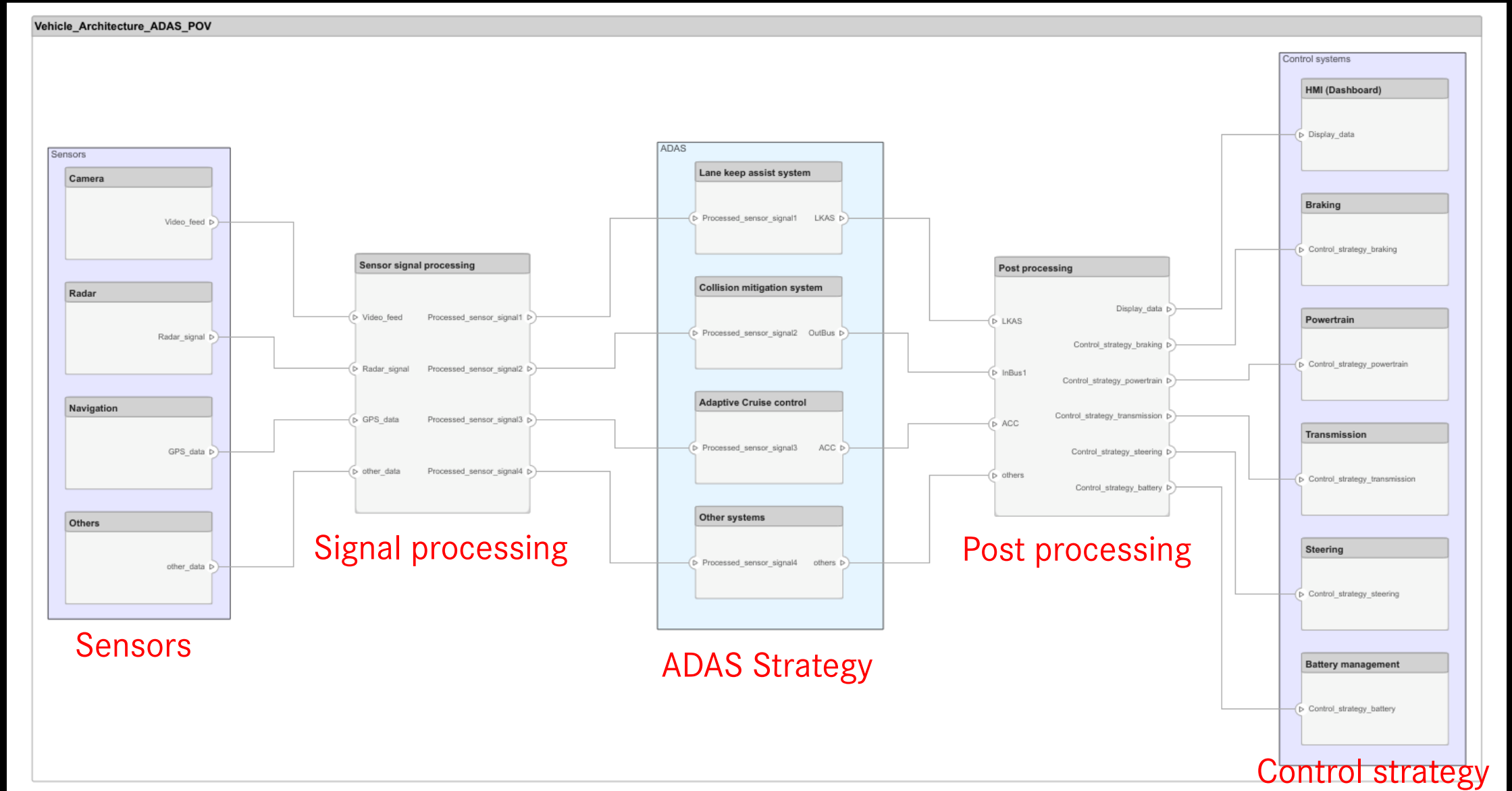


Tools used

- Doors, excel, word etc – Requirements analysis
- Requirements import/export – Simulink Requirements Toolbox
- MATLAB 2020a System Composer Toolbox – System Architecture creation
- Other tools for software development

Demonstration of the tool

Vehicle Architecture from ADAS POV



Requirements Editor

The screenshot displays the Requirements Editor application window. The interface is divided into several sections:

- Menu Bar:** File, Edit, Display, Analysis, Report, Help.
- Toolbar:** Contains icons for file operations (Open, Save, Print, Copy, Paste, Undo, Redo) and a search box.
- View:** A dropdown menu set to 'Requirements'.
- Requirements List:** A table with columns 'Index', 'ID', and 'Summary'. The selected requirement is 1.1, REQ_ID_1, with the summary 'Sensor signal processing'. Other requirements include sample requirements 1-14, ADAS, Lane keep assist system, and Adaptive cruise control.
- Properties Panel:** Located on the right, it shows details for the selected requirement:
 - Type: Functional
 - Index: 1.1
 - Custom ID: REQ_ID_1
 - Summary: Sensor signal processing
- Description Editor:** A rich text editor with a toolbar (font face: Arial, size: 10, bold, italic, underline, text color) and a text area containing the text 'Sensor signal processing'.
- Keywords:** A text input field.
- Revision information:** A section with a collapse arrow.
- Links:** A section with a collapse arrow.
- Comments:** A section with a collapse arrow.

Requirements

Requirements Editor

File Edit Display Analysis Report Help

View: Requirements Search

Index	ID	Summary
1	Requirements!Sheet1	References to Requirements.xlsx (Sheet1)
1.1	REQ_ID_1	Sensor signal processing
1.2	REQ_ID_1_1	sample requirement 1
1.3	REQ_ID_1_2	sample requirement 2
1.4	REQ_ID_1_3	sample requirement 3
1.5	REQ_ID_1_4	sample requirement 4
1.6	REQ_ID_1_5	sample requirement 5
1.7	REQ_ID_1_6	sample requirement 6
1.8	REQ_ID_1_7	sample requirement 7
1.9	REQ_ID_1_8	sample requirement 8
1.10	REQ_ID_1_9	sample requirement 9
1.11	REQ_ID_1_10	sample requirement 10
1.12	REQ_ID_1_11	sample requirement 11
1.13	REQ_ID_1_12	sample requirement 12
1.14	REQ_ID_1_13	sample requirement 13
1.15	REQ_ID_1_14	sample requirement 14
1.16	REQ_ID_2	ADAS
1.17	REQ_ID_2_1_1	Lane keep assist system
1.18	REQ_ID_2_1_2	sample requirement 1
1.19	REQ_ID_2_1_3	sample requirement 2
1.20	REQ_ID_2_1_4	sample requirement 3
1.21	REQ_ID_2_1_5	sample requirement 4
1.22	REQ_ID_2_2_1	Collision mitigation system
1.23	REQ_ID_2_2_2	sample requirement 1
1.24	REQ_ID_2_2_3	sample requirement 2
1.25	REQ_ID_2_2_4	sample requirement 3
1.26	REQ_ID_2_2_5	sample requirement 4
1.27	REQ_ID_2_3_1	Adaptive cruise control
1.28	REQ_ID_2_3_2	sample requirement 1
1.29	REQ_ID_2_3_3	sample requirement 2
1.30	REQ_ID_2_3_4	sample requirement 3
1.31	REQ_ID_2_3_5	sample requirement 4
1.32	REQ_ID_2_4_1	Others
1.33	REQ_ID_2_4_2	sample requirement 1
1.34	REQ_ID_2_4_3	sample requirement 2
1.35	REQ_ID_2_4_4	sample requirement 3
1.36	REQ_ID_2_4_5	sample requirement 4

Properties

Type: Functional

Index: 1.1

Custom ID: REQ_ID_1

Summary: Sensor signal processing

Description Rationale

Arial 10

Sensor signal processing

Keywords:

Revision information:

Links

Comments

Requirements ID

The screenshot displays the Requirements Editor application. The main window is divided into three sections:

- Left Panel (Requirements List):** A tree view showing a hierarchy of requirements. The root is 'Requirements', followed by '1', and then a list of requirements from 1.1 to 1.36. Requirement 1.1 is expanded, showing a list of sub-requirements. Requirement 1.1.1 is highlighted with a red arrow pointing to its ID 'REQ_ID_1' and description 'Sensor signal processing'.
- Center Panel (Table):** A table with columns for Index, ID, and Summary. The selected requirement 1.1.1 is visible in the table.
- Right Panel (Properties):** A detailed view of the selected requirement. It includes fields for Type (Functional), Index (1.1), Custom ID (REQ_ID_1), and Summary (Sensor signal processing). Below these are tabs for Description and Rationale. The Description tab is active, showing a text area with the text 'Sensor signal processing'. There are also fields for Keywords, Revision information, Links, and Comments.

Requirements Properties

The screenshot displays the Requirements Editor interface. On the left, a tree view shows a list of requirements under the 'Requirements' folder. The selected requirement is '1.1 REQ_ID_1 Sensor signal processing'. A red arrow points from this requirement to the Properties panel on the right.

Index	ID	Summary
1.1	REQ_ID_1	Sensor signal processing
1.2	REQ_ID_1_1	sample requirement 1
1.3	REQ_ID_1_2	sample requirement 2
1.4	REQ_ID_1_3	sample requirement 3
1.5	REQ_ID_1_4	sample requirement 4
1.6	REQ_ID_1_5	sample requirement 5
1.7	REQ_ID_1_6	sample requirement 6
1.8	REQ_ID_1_7	sample requirement 7
1.9	REQ_ID_1_8	sample requirement 8
1.10	REQ_ID_1_9	sample requirement 9
1.11	REQ_ID_1_10	sample requirement 10
1.12	REQ_ID_1_11	sample requirement 11
1.13	REQ_ID_1_12	sample requirement 12
1.14	REQ_ID_1_13	sample requirement 13
1.15	REQ_ID_1_14	sample requirement 14
1.16	REQ_ID_2	ADAS
1.17	REQ_ID_2_1_1	Lane keep assist system
1.18	REQ_ID_2_1_2	sample requirement 1
1.19	REQ_ID_2_1_3	sample requirement 2
1.20	REQ_ID_2_1_4	sample requirement 3
1.21	REQ_ID_2_1_5	sample requirement 4
1.22	REQ_ID_2_2_1	Collision mitigation system
1.23	REQ_ID_2_2_2	sample requirement 1
1.24	REQ_ID_2_2_3	sample requirement 2
1.25	REQ_ID_2_2_4	sample requirement 3
1.26	REQ_ID_2_2_5	sample requirement 4
1.27	REQ_ID_2_3_1	Adaptive cruise control
1.28	REQ_ID_2_3_2	sample requirement 1
1.29	REQ_ID_2_3_3	sample requirement 2
1.30	REQ_ID_2_3_4	sample requirement 3
1.31	REQ_ID_2_3_5	sample requirement 4
1.32	REQ_ID_2_4_1	Others
1.33	REQ_ID_2_4_2	sample requirement 1
1.34	REQ_ID_2_4_3	sample requirement 2
1.35	REQ_ID_2_4_4	sample requirement 3
1.36	REQ_ID_2_4_5	sample requirement 4

The Properties panel for the selected requirement shows the following details:

- Type: Functional
- Index: 1.1
- Custom ID: REQ_ID_1
- Summary: Sensor signal processing

The Description tab is active, showing the text 'Sensor signal processing' in a rich text editor with a font of Arial and size 10. Below the description are fields for Keywords, Revision information, Links, and Comments.

Requirements after linking to Architecture

The screenshot shows the Requirements Editor interface. The main window displays a table of requirements with columns for Index, ID, Summary, and Implemented. A red box highlights the 'Implemented' column, which contains blue progress bars for each requirement, indicating their linking status to the architecture. Requirement 1.4 (REQ_ID_1_3) is highlighted in blue. The right-hand side of the interface shows the Properties panel for the selected requirement, including fields for Type, Index, Custom ID, Summary, Description, and Rationale.

Index	ID	Summary	Implemented
1	Requirements\Sheet1	References to Requirements.xlsx (Sheet1)	
1.1	REQ_ID_1	Sensor signal processing	████████████████████
1.2	REQ_ID_1_1	sample requirement 1	████████████████████
1.3	REQ_ID_1_2	sample requirement 2	████████████████████
1.4	REQ_ID_1_3	sample requirement 3	████████████████████
1.5	REQ_ID_1_4	sample requirement 4	████████████████████
1.6	REQ_ID_1_5	sample requirement 5	████████████████████
1.7	REQ_ID_1_6	sample requirement 6	████████████████████
1.8	REQ_ID_1_7	sample requirement 7	████████████████████
1.9	REQ_ID_1_8	sample requirement 8	████████████████████
1.10	REQ_ID_1_9	sample requirement 9	████████████████████
1.11	REQ_ID_1_10	sample requirement 10	████████████████████
1.12	REQ_ID_1_11	sample requirement 11	████████████████████
1.13	REQ_ID_1_12	sample requirement 12	████████████████████
1.14	REQ_ID_1_13	sample requirement 13	████████████████████
1.15	REQ_ID_1_14	sample requirement 14	████████████████████
1.16	REQ_ID_2	ADAS	████████████████████
1.17	REQ_ID_2_1_1	Lane keep assist system	████████████████████
1.18	REQ_ID_2_1_2	sample requirement 1	████████████████████
1.19	REQ_ID_2_1_3	sample requirement 2	████████████████████
1.20	REQ_ID_2_1_4	sample requirement 3	████████████████████
1.21	REQ_ID_2_1_5	sample requirement 4	████████████████████
1.22	REQ_ID_2_2_1	Collision mitigation system	████████████████████
1.23	REQ_ID_2_2_2	sample requirement 1	████████████████████
1.24	REQ_ID_2_2_3	sample requirement 2	████████████████████
1.25	REQ_ID_2_2_4	sample requirement 3	████████████████████
1.26	REQ_ID_2_2_5	sample requirement 4	████████████████████
1.27	REQ_ID_2_3_1	Adaptive cruise control	████████████████████
1.28	REQ_ID_2_3_2	sample requirement 1	████████████████████
1.29	REQ_ID_2_3_3	sample requirement 2	████████████████████
1.30	REQ_ID_2_3_4	sample requirement 3	████████████████████
1.31	REQ_ID_2_3_5	sample requirement 4	████████████████████
1.32	REQ_ID_2_4_1	Others	████████████████████
1.33	REQ_ID_2_4_2	sample requirement 1	████████████████████
1.34	REQ_ID_2_4_3	sample requirement 2	████████████████████
1.35	REQ_ID_2_4_4	sample requirement 3	████████████████████
1.36	REQ_ID_2_4_5	sample requirement 4	████████████████████

Linking status

Requirements after linking to architecture

The screenshot displays the Simulink Requirements tool interface. The main workspace shows a block diagram of a vehicle architecture with several interconnected components:

- Sensors:** Camera, Radar, Navigation, and Others.
- Sensor signal processing:** Receives signals from the sensors and outputs processed signals.
- ADAS (Active Driving Assistance) Systems:** Lane keep assist system, Collision mitigation system, Adaptive Cruise control, and Other systems.
- Post processing:** Receives data from the ADAS systems and outputs various signals.
- Control systems:** HMI (Dashboard), Powertrain, Transmission, Steering, and Battery management.

The 'Lane keep assist system' block is highlighted with a red box. A red arrow points from this block to the requirements table on the right. The table lists requirements for the 'Lane keep assist system' and other components.

Index	ID	Summary
1.6	REQ_ID_1_5	sample requirement 5
1.7	REQ_ID_1_6	sample requirement 6
1.8	REQ_ID_1_7	sample requirement 7
1.9	REQ_ID_1_8	sample requirement 8
1.10	REQ_ID_1_9	sample requirement 9
1.11	REQ_ID_1_10	sample requirement 10
1.12	REQ_ID_1_11	sample requirement 11
1.13	REQ_ID_1_12	sample requirement 12
1.14	REQ_ID_1_13	sample requirement 13
1.15	REQ_ID_1_14	sample requirement 14
1.16	REQ_ID_2_1	ADAS
1.17	REQ_ID_2_1_1	Lane keep assist system
1.18	REQ_ID_2_1_2	sample requirement 1
1.19	REQ_ID_2_1_3	sample requirement 2
1.20	REQ_ID_2_1_4	sample requirement 3
1.21	REQ_ID_2_1_5	sample requirement 4
1.22	REQ_ID_2_2_1	Collision mitigation system
1.23	REQ_ID_2_2_2	sample requirement 1
1.24	REQ_ID_2_2_3	sample requirement 2
1.25	REQ_ID_2_2_4	sample requirement 3
1.26	REQ_ID_2_2_5	sample requirement 4
1.27	REQ_ID_2_3_1	Adaptive cruise control
1.28	REQ_ID_2_3_2	sample requirement 1
1.29	REQ_ID_2_3_3	sample requirement 2
1.30	REQ_ID_2_3_4	sample requirement 3
1.31	REQ_ID_2_3_5	sample requirement 4
1.32	REQ_ID_2_4_1	Others
1.33	REQ_ID_2_4_2	sample requirement 1
1.34	REQ_ID_2_4_3	sample requirement 2
1.35	REQ_ID_2_4_4	sample requirement 3
1.36	REQ_ID_2_4_5	sample requirement 4
1.37	REQ_ID_3	Post processing
1.38	REQ_ID_3_1	sample requirement 1

Requirements after linking to architecture

The screenshot displays the Simulink Requirements tool interface for a project named 'Vehicle_Architecture_ADAS_POV'. The main workspace shows a system architecture diagram with several interconnected blocks:

- Sensors:** Camera, Radar, Navigation, and Others.
- ADAS:** Lane keep assist system, Collision mitigation system, Adaptive Cruise control, and Other systems.
- Post processing:** A central block receiving data from the ADAS systems.
- Control systems:** HMI (Dashboard), Braking, Powertrain, Transmission, Steering, and Battery management.

The 'Sensor signal processing' block is highlighted with a red box. A red arrow points from this block to the 'Requirements' list on the right. The list shows a hierarchy of requirements, with the top-level requirement '1.1 REQ_ID_1 Sensor signal processing' also highlighted in red. Below it are 14 sample requirements (REQ_ID_1_1 to REQ_ID_1_14) and a final requirement '1.16 REQ_ID_2 ADAS'. A red arrow points from the top-level requirement back to the 'Sensor signal processing' block in the architecture diagram.

ID	Summary
1.1 REQ_ID_1	Sensor signal processing
1.2 REQ_ID_1_1	sample requirement 1
1.3 REQ_ID_1_2	sample requirement 2
1.4 REQ_ID_1_3	sample requirement 3
1.5 REQ_ID_1_4	sample requirement 4
1.6 REQ_ID_1_5	sample requirement 5
1.7 REQ_ID_1_6	sample requirement 6
1.8 REQ_ID_1_7	sample requirement 7
1.9 REQ_ID_1_8	sample requirement 8
1.10 REQ_ID_1_9	sample requirement 9
1.11 REQ_ID_1_10	sample requirement 10
1.12 REQ_ID_1_11	sample requirement 11
1.13 REQ_ID_1_12	sample requirement 12
1.14 REQ_ID_1_13	sample requirement 13
1.15 REQ_ID_1_14	sample requirement 14
1.16 REQ_ID_2	ADAS

Requirements when updated at source

The screenshot displays the 'Requirements Editor' application window. The main area contains a table of requirements with columns for Index, ID, Summary, and Implemented. The 'Implemented' column shows blue progress bars for most items, while some are empty. A right-hand sidebar is open, showing the 'Requirement Interchange' section with buttons for 'Update', 'Export', and 'Unlock all'. A red arrow points to the 'Update' button. Below the buttons, the status reads 'Status: This document is up-to-date.' and there are expandable sections for 'Properties', 'Attribute Mapping', 'Links', and 'Comments'.

Index	ID	Summary	Implemented
1	REQ_ID_1	Sensor signal processing	<input checked="" type="checkbox"/>
2	REQ_ID_1_1	sample requirement 1	<input checked="" type="checkbox"/>
3	REQ_ID_1_2	sample requirement 2	<input checked="" type="checkbox"/>
4	REQ_ID_1_3	sample requirement 3	<input checked="" type="checkbox"/>
5	REQ_ID_1_4	sample requirement 4	<input checked="" type="checkbox"/>
6	REQ_ID_1_5	sample requirement 5	<input checked="" type="checkbox"/>
7	REQ_ID_1_6	SAMPLE REQUIREMENTS	<input checked="" type="checkbox"/>
8	REQ_ID_1_7	sample requirement 7	<input checked="" type="checkbox"/>
9	REQ_ID_1_8	sample requirement 8	<input checked="" type="checkbox"/>
10	REQ_ID_1_9	sample requirement 9	<input checked="" type="checkbox"/>
11	REQ_ID_1_10	sample requirement 10	<input checked="" type="checkbox"/>
12	REQ_ID_1_11	sample requirement 11	<input checked="" type="checkbox"/>
13	REQ_ID_1_12	sample requirement 12	<input checked="" type="checkbox"/>
14	REQ_ID_1_13	sample requirement 13	<input checked="" type="checkbox"/>
15	REQ_ID_1_14	sample requirement 14	<input checked="" type="checkbox"/>
16	REQ_ID_2	ADAS	<input type="checkbox"/>
17	REQ_ID_2_1_1	Lane keep assist system	<input checked="" type="checkbox"/>
18	REQ_ID_2_1_2	sample requirement 1	<input checked="" type="checkbox"/>
19	REQ_ID_2_1_3	sample requirement 2	<input checked="" type="checkbox"/>
20	REQ_ID_2_1_4	sample requirement 3	<input checked="" type="checkbox"/>
21	REQ_ID_2_1_5	sample requirement 4	<input checked="" type="checkbox"/>
22	REQ_ID_2_2_1	Collision mitigation system	<input checked="" type="checkbox"/>
23	REQ_ID_2_2_2	sample requirement 1	<input checked="" type="checkbox"/>
24	REQ_ID_2_2_3	sample requirement 2	<input checked="" type="checkbox"/>
25	REQ_ID_2_2_4	sample requirement 3	<input checked="" type="checkbox"/>
26	REQ_ID_2_2_5	sample requirement 4	<input checked="" type="checkbox"/>
27	REQ_ID_2_3_1	Adaptive cruise control	<input checked="" type="checkbox"/>
28	REQ_ID_2_3_2	sample requirement 1	<input checked="" type="checkbox"/>
29	REQ_ID_2_3_3	sample requirement 2	<input checked="" type="checkbox"/>
30	REQ_ID_2_3_4	sample requirement 3	<input checked="" type="checkbox"/>
31	REQ_ID_2_3_5	sample requirement 4	<input checked="" type="checkbox"/>
32	REQ_ID_2_4_1	Others	<input type="checkbox"/>
33	REQ_ID_2_4_2	sample requirement 1	<input type="checkbox"/>
34	REQ_ID_2_4_3	sample requirement 2	<input type="checkbox"/>
35	REQ_ID_2_4_4	sample requirement 3	<input type="checkbox"/>
36	REQ_ID_2_4_5	sample requirement 4	<input type="checkbox"/>

Requirements when updated at source

The screenshot shows the Requirements Editor interface. The main table displays a list of requirements with columns for Index, ID, Summary, and Implemented. Row 3 is highlighted in red, and a red arrow points to it from the text "Requirements get highlighted when changed at source".

Index	ID	Summary	Implemented
1	REQ_ID_1	Sensor signal processing	<input type="checkbox"/>
2	REQ_ID_1_1	sample requirement 1	<input type="checkbox"/>
3	REQ_ID_1_2	sample requirement 2	<input type="checkbox"/>
4	REQ_ID_1_3	sample requirement 3	<input type="checkbox"/>
5	REQ_ID_1_4	sample requirement 4	<input type="checkbox"/>
6	REQ_ID_1_5	sample requirement 5	<input type="checkbox"/>
7	REQ_ID_1_6	SAMPLE REQUIREMENTS	<input type="checkbox"/>
8	REQ_ID_1_7	sample requirement 7	<input type="checkbox"/>
9	REQ_ID_1_8	sample requirement 8	<input type="checkbox"/>
10	REQ_ID_1_9	sample requirement 9	<input type="checkbox"/>
11	REQ_ID_1_10	sample requirement 10	<input type="checkbox"/>
12	REQ_ID_1_11	sample requirement 11	<input type="checkbox"/>
13	REQ_ID_1_12	sample requirement 12	<input type="checkbox"/>
14	REQ_ID_1_13	sample requirement 13	<input type="checkbox"/>
15	REQ_ID_1_14	sample requirement 14	<input type="checkbox"/>
16	REQ_ID_2	ADAS	<input type="checkbox"/>
17	REQ_ID_2_1_1	Lane keep assist system	<input type="checkbox"/>
18	REQ_ID_2_1_2	sample requirement 1	<input type="checkbox"/>
19	REQ_ID_2_1_3	sample requirement 2	<input type="checkbox"/>
20	REQ_ID_2_1_4	sample requirement 3	<input type="checkbox"/>
21	REQ_ID_2_1_5	sample requirement 4	<input type="checkbox"/>
22	REQ_ID_2_2_1	Collision mitigation system	<input type="checkbox"/>
23	REQ_ID_2_2_2	sample requirement 1	<input type="checkbox"/>
24	REQ_ID_2_2_3	sample requirement 2	<input type="checkbox"/>
25	REQ_ID_2_2_4	sample requirement 3	<input type="checkbox"/>
26	REQ_ID_2_2_5	sample requirement 4	<input type="checkbox"/>
27	REQ_ID_2_3_1	Adaptive cruise control	<input type="checkbox"/>
28	REQ_ID_2_3_2	sample requirement 1	<input type="checkbox"/>
29	REQ_ID_2_3_3	sample requirement 2	<input type="checkbox"/>
30	REQ_ID_2_3_4	sample requirement 3	<input type="checkbox"/>
31	REQ_ID_2_3_5	sample requirement 4	<input type="checkbox"/>
32	REQ_ID_2_4_1	Others	<input type="checkbox"/>
33	REQ_ID_2_4_2	sample requirement 1	<input type="checkbox"/>
34	REQ_ID_2_4_3	sample requirement 2	<input type="checkbox"/>
35	REQ_ID_2_4_4	sample requirement 3	<input type="checkbox"/>
36	REQ_ID_2_4_5	sample requirement 4	<input type="checkbox"/>

Requirements get highlighted when changed at source

Requirements when updated at source

The screenshot displays the Simulink Requirements tool interface. The main workspace shows a system architecture diagram for 'Vehicle_Architecture_ADAS_POV'. The diagram is organized into several functional blocks: Sensors (Camera, Radar, Navigation, Others), Sensor signal processing, ADAS (Lane keep assist system, Collision mitigation system, Adaptive Cruise control, Other systems), Post processing, and Control systems (HMI, Braking, Powertrain, Transmission, Steering, Battery management). Two red arrows point from the 'Requirements' table on the right to the 'Collision mitigation system' and 'Post processing' blocks in the architecture diagram, indicating that these components are highlighted when requirements are updated at source.

Requirements - Vehicle_Architecture_ADAS_POV

Index	ID	Summary
20	REQ_ID_2_1_4	sample requirement 3
21	REQ_ID_2_1_5	sample requirement 4
22	REQ_ID_2_2_1	Collision mitigation system
23	REQ_ID_2_2_2	sample requirement 1
24	REQ_ID_2_2_3	sample requirement 2
25	REQ_ID_2_2_4	sample requirement 3
26	REQ_ID_2_2_5	sample requirement 4
27	REQ_ID_2_3_1	Adaptive cruise control
28	REQ_ID_2_3_2	sample requirement 1
29	REQ_ID_2_3_3	sample requirement 2
30	REQ_ID_2_3_4	sample requirement 3
31	REQ_ID_2_3_5	sample requirement 4
32	REQ_ID_2_4_1	Others
33	REQ_ID_2_4_2	sample requirement 1
34	REQ_ID_2_4_3	sample requirement 2
35	REQ_ID_2_4_4	sample requirement 3
36	REQ_ID_2_4_5	sample requirement 4
37	REQ_ID_3	Post processing
38	REQ_ID_3_1	sample requirement 1
39	REQ_ID_3_2	sample requirement 2
40	REQ_ID_3_3	sample requirement 3
41	REQ_ID_3_4	sample requirement 4
42	REQ_ID_3_5	sample requirement 5
43	REQ_ID_3_6	sample requirement 6
44	REQ_ID_3_7	sample requirement 7
45	REQ_ID_3_8	sample requirement 8
46	REQ_ID_3_9	sample requirement 9
47	REQ_ID_3_10	sample requirement 10
48	REQ_ID_3_11	sample requirement 11
49	REQ_ID_3_12	sample requirement 12
50	REQ_ID_3_13	sample requirement 13
51	REQ_ID_3_14	sample requirement 14

And the same get highlighted in the architecture as well

Some other features of System Composer

Interface data

The screenshot displays the Simulink interface for a vehicle architecture project. The main workspace shows a block diagram titled "Vehicle_Architecture_ADAS_POV". The diagram is organized into several functional blocks:

- Sensors:** Includes Camera (Video_feed), Radar (Radar_signal), Navigation (GPS_data), and Others (other_data).
- Sensor signal processing:** Receives signals from the sensors and outputs Processed_sensor_signal1 through 4.
- ADAS (Advanced Driver Assistance Systems):** Contains Lane keep assist system, Collision mitigation system, Adaptive Cruise control, and Other systems, each receiving processed signals.
- Post processing:** Receives signals from the ADAS blocks and outputs various control strategies like Display_data, Control_strategy_braking, etc.

A red arrow points from the "Radar_signal" port in the Radar block to the "Radar_signal" property in the Property Inspector window on the right. The Property Inspector shows the following details for the selected port:

NAME	VALUE
Main	
Name	Radar_signal
Interface	
Name	<anonymous>
Action	PROVIDE
Type	double
Dimensions	1
Unit	
Complexity	real
Minimum	[]
Maximum	[]
Stereotype	Add..

Stereotypes

The screenshot displays the Simulink Requirements Manager interface for a project named 'Vehicle_Architecture_ADAS_POV'. The main workspace shows a block diagram with several interconnected components:

- Sensors:** A container block containing 'Camera', 'Radar', 'Navigation', and 'Others' sub-blocks. Each sub-block has an output port (e.g., 'Video_feed', 'Radar_signal', 'GPS_data', 'other_data').
- Sensor signal processing:** A central block that receives inputs from the sensors and outputs 'Processed_sensor_signal1' through 'Processed_sensor_signal4'.
- ADAS:** A container block containing 'Lane keep assist system', 'Collision mitigation system', 'Adaptive Cruise control', and 'Other systems' sub-blocks. Each sub-block has an input port for a processed sensor signal.
- Post processing:** A block that receives inputs from the ADAS sub-blocks and outputs various control strategies like 'Display_data', 'Control_strategy_braking', etc.

A red arrow points from the 'Sensor signal processing' block in the diagram to the 'Property Inspector' on the right. The Property Inspector shows the following details for the selected component:

NAME	VALUE
Main	
Name	Sensor signal proces...
Stereotype	Add..
Type	
Sampletime	5 ms

Custom views

VIEW BROWSER

- Sample_time
- Radar
- Post processing
- HMI (Dashboard)
- Lane keep assist system
- Sensor signal processing

VIEW PROPERTIES

Name	Value
Main	
Name	Sample_time

VIEW PROPERTIES

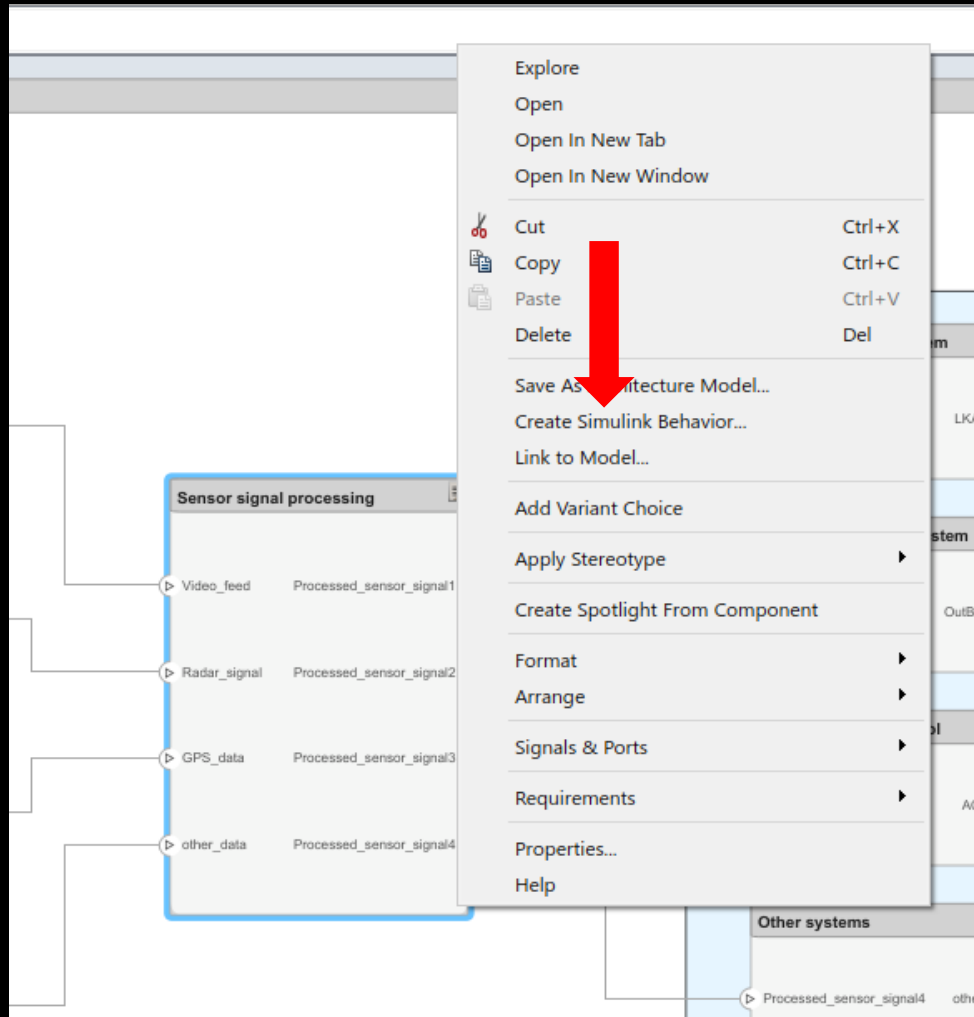
REQUIREMENT LINKS

No links

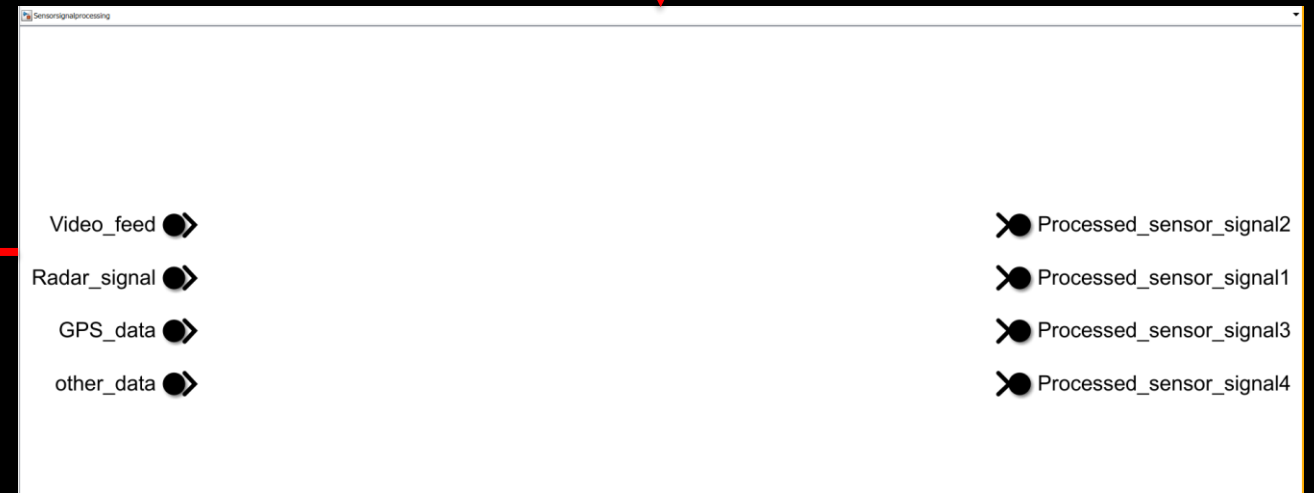
Stereotype set based on sample time

```
graph LR; Radar -- Radar_signal --> SSP; subgraph SSP [Sensor signal processing]; direction TB; SSP1[Video feed] --- SSP2[Processed_sensor_signal1]; SSP3[Radar_signal] --- SSP4[Processed_sensor_signal2]; SSP5[GPS_data] --- SSP6[Processed_sensor_signal3]; SSP7[other_data] --- SSP8[Processed_sensor_signal4]; end; SSP -- Processed_sensor_signal1 --> LKAS; subgraph LKAS [Lane keep assist system]; direction TB; LKAS1[Processed_sensor_signal1] --- LKAS2[LKAS]; end; LKAS -- LKAS --> PP; subgraph PP [Post processing]; direction TB; PP1[LKAS] --- PP2[Display_data]; PP3[Inbus1] --- PP4[Control_strategy_lanekeep]; PP5[ACC] --- PP6[Control_strategy_powertrain]; PP7[other] --- PP8[Control_strategy_transmission]; PP9[other] --- PP10[Control_strategy_steering]; PP11[other] --- PP12[Control_strategy_brake]; end; PP -- Display_data --> HMI; subgraph HMI [HMI Dashboard]; direction TB; HMI1[Display_data]; end;
```


Create a Simulink behavior



System Architecture component



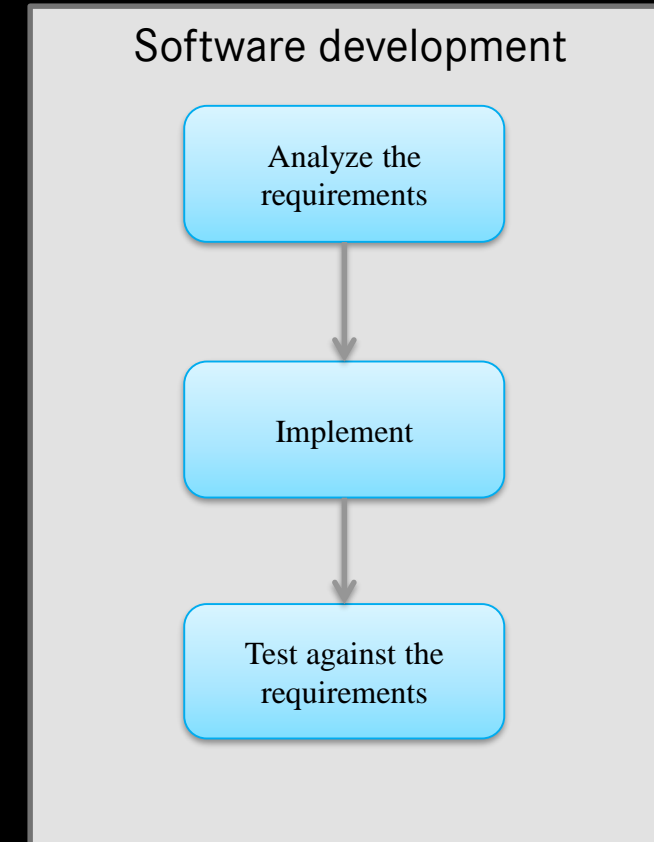
Simulink model

Any component with interfaces can be used to create a Simulink model with the predefined ports in the architecture.

Other way around is also possible

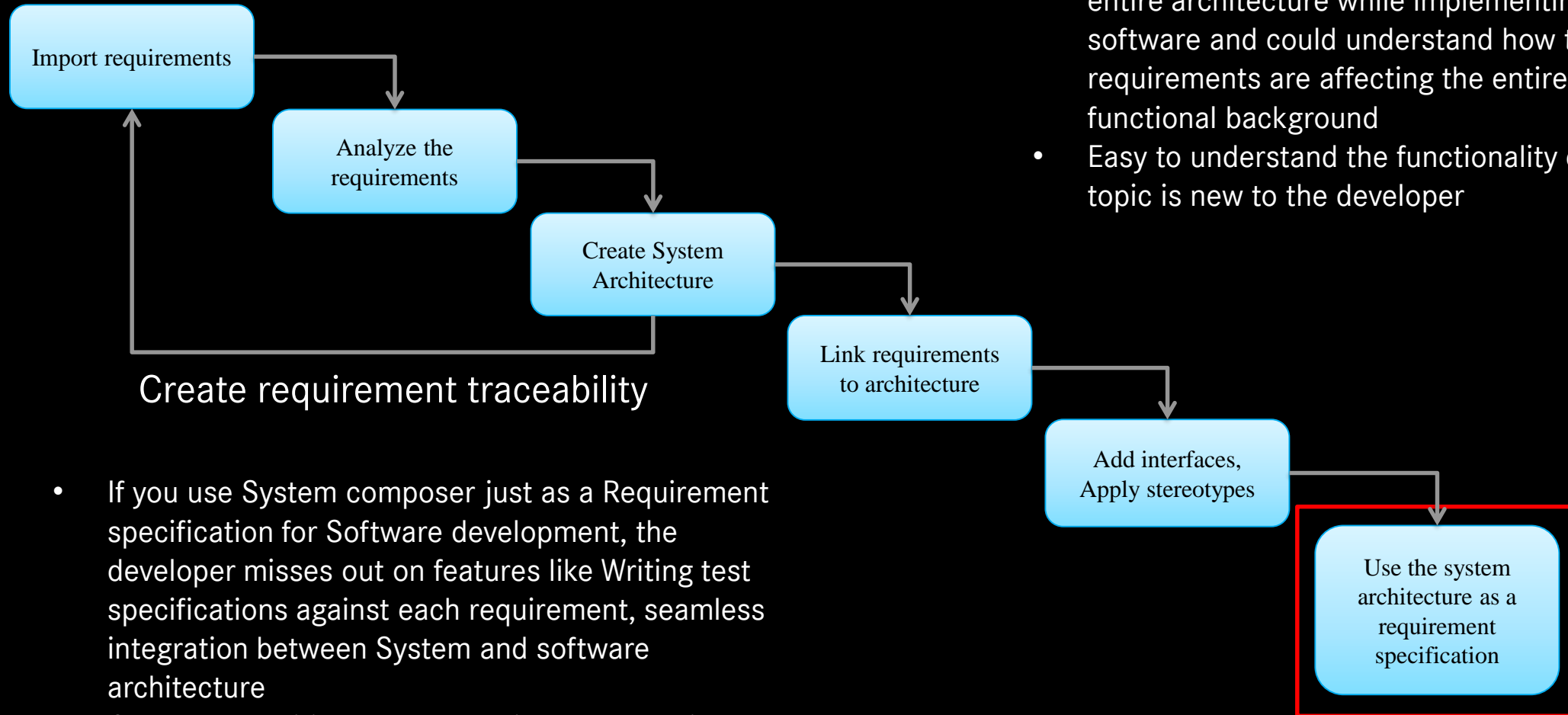
Requirements based Software Development

- The role of a software developer in the V-cycle of a Requirements based software development is limited.
- Mostly, analyzing the requirements, implementing it and performing unit test.
- What's missing here is that the developer won't understand the whole picture of the requirement being implemented on how it is affecting the entire system
- Might miss implementing some of the requirements due to human error
- Difficult to understand the functionality if the topic is new to the developer



Our findings after using System Composer

Process 1b: System to Software Architecture

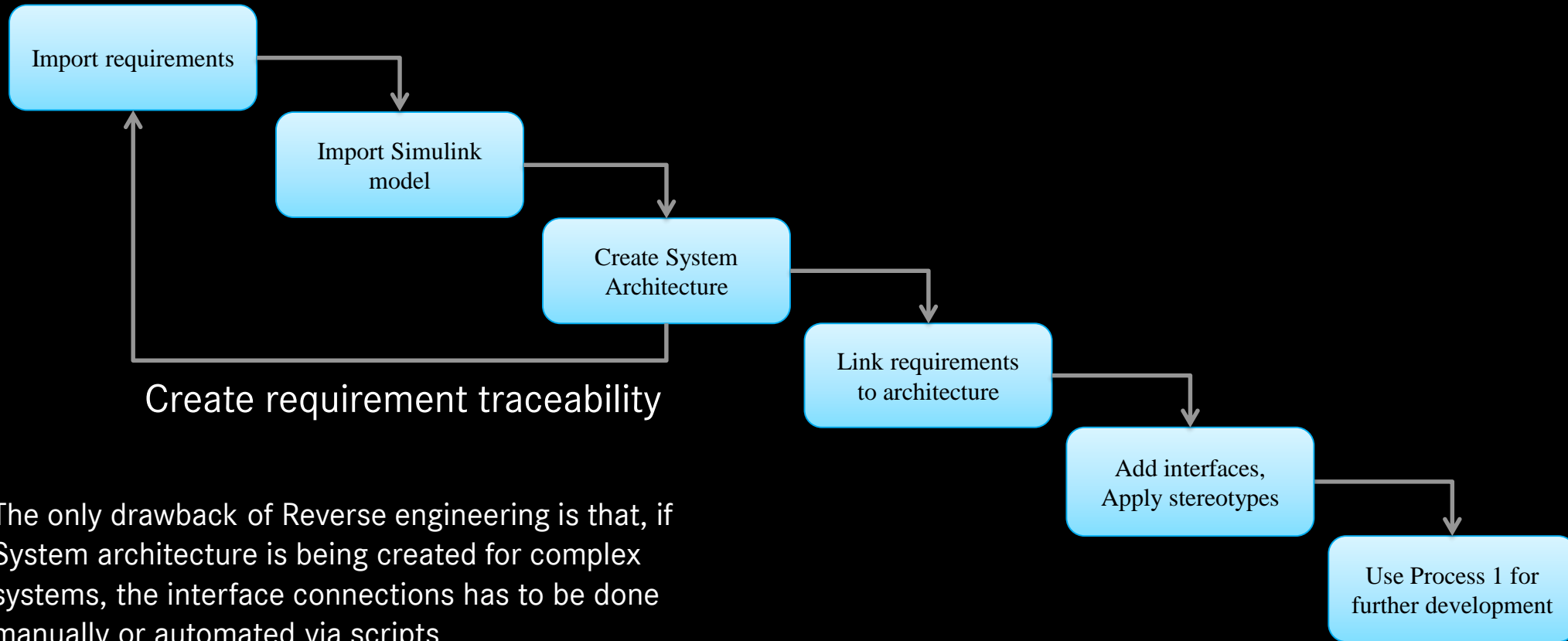


- In this process, the developer has access to the entire architecture while implementing the software and could understand how the requirements are affecting the entire system with functional background
- Easy to understand the functionality even if the topic is new to the developer

- If you use System composer just as a Requirement specification for Software development, the developer misses out on features like Writing test specifications against each requirement, seamless integration between System and software architecture
- One more additional tool to be incorporated in the software development process

Our findings after using System Composer

Process 1c: Software to System Architecture (Reverse engineering)



Conclusion

- Communication between stakeholders and functional developers will be improved
- The tool is assistive in complex system development
- As it is a hierarchical modelling, what and where to implement is pretty clear
- This process facilitates impact analysis of requirements and design changes
- Improves design quality by reducing errors and ambiguity
- Early and on going verification and validation can be done to reduce the risk
- Enhances knowledge on the system

Questions?

Thank you