Use Model-Based Design to Develop SOA Application Running on In-vehicle OS

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Background

- **SOA Trend**
  - Software defines a vehicle
  - Growing function demand

- **Next EEA**
  - Centralized domain architecture
  - Providing hardware to support the software boom

- **In-vehicle OS**
  - Distributed operating system developed by OEM
  - Support SOA
Challenges

▪ Coding Difficulty
  – Handwritten C++ language puts forward high requirements not only on the programmer's ability but also on the accompanying tool chain

▪ System Complexity
  – Many software architecture design and management tools on the market are not compatible with non-standard In-vehicle OS
Solution Outline

▪ How to Model the Software Behavior
  – SOA Behavior Modeling
  – SIMULINK New Features
  – Wrapper Code Generator

▪ How to Maintain Complex Software Clusters
  – Software Architecture Engineering
  – System Composer(Deeply Customized)
PART I
How to Model the Software Behavior
Comparison Between Different Modeling Environments

- SWC
  - Code
  - RTE Interface
    - AUTOSAR CP

- Application
  - Code
  - Middleware
    - In-vehicle OS

- RPC
- Message
Typical MBD Process on AUTOSAR Workflow
How to Model on In-vehicle OS

Application

Code

Middleware

In-vehicle OS

Application

Code

SWC.slx

? 

Middleware

CHIP
How to Model on In-vehicle OS

**New Features**
- Support SOA Behavior

**New Modeling Principle**
- Specific rules based on practice

**Wrapper Code Generator**
- Link Simulink side and OS side

**Deployment**
- Deployed just like normal application
How to Model on In-vehicle OS

New Style!
Example in Real Case

Android → Cloud → HPC → MCU → Actuator

Application
- Simulink Generated Code
- Wrapper Code

Application
- Simulink Generated Code
- Wrapper Code

SWC
- Simulink Generated Code
- RTE Interface
- AUTOSAR CP

Middleware
In-vehicle OS
Example in Real Case

Software Architecture

Generator

Merge

HPC

Simulink Generated Code

Wrapper Code
PART II
How to Maintain Complex Software Clusters
What does Software Architecture do

Functional Architecture

Software Architecture

Services Definition

Service
Service
Service

Application
Service Provider

Application
Service Provider

Application
Service Consumer

Application
Service Consumer

In-vehicle OS
Software Management Dilemma

AUTOSAR

Functional Architecture → Software Architecture → SW-C (Data Type)

AUTOSAR Standard!

Software Architecture

Data Type

PREvision
System Weaver
Davinci Developer
Enterprise Architect
Software Management Dilemma

In-vehicle OS

Functional Architecture → Software Architecture → SW-C → Data Type

?
Model-Based Systems Engineering

- MBSE
  - Engineers use model-based systems engineering (MBSE) to manage system complexity, improve communication, and produce optimized systems.
  - MATLAB®, Simulink®, and System Composer™ together create a single environment for creating descriptive architecture models that seamlessly bridge into detailed implementation models.

Build Our Own Software Architecture Tool

**SOMOC**
- SOA Model Composer
- Made specifically for MBD on In-vehicle OS

**System Composer**
- Model-based systems engineering
- Architectural design elements
- Powerful visualization
- Support for customization

**MATLAB**
- Powerful programming language
- Support object oriented programming
- Rich product API

**APP Designer**
- Customized desktop applications
- Simple and easy to use
Different Software Architecture Level on SOMOC

**Architecture Level**
- Whole view of specific system

**Process Level**
- Minimum interaction unit
- Consists of multiple SW-Cs
- Independent applications
- Communication via middleware

**SW-C Level**
- Minimum development unit
- Consists of multiple services
- Contains software logic and implementation

**Service Level**
- Service interface description
- Imported from upstream service design

Reflected by System Composer Model (Enhanced by Profile)

Reference Component...
Enhance System Composer Model by Profile

- **Profile**
  - Give custom property to different architecture elements
  - Enhance system composer to fit specific system requirement
Link Different Level Elements by Reference Component

- Reference Component
  - Link to an architectural definition
  - Simulate the operation of integrating low level elements into high level elements
  - System Composer models carry whole information of an software architecture
SOMOC Workflow
SOMOC GUI

**Architecture Tree**
- Tree view of different level components
- Context menu for different kind of tree nodes

**Component Composer Interface**
- Simplified operation of a component
- Add or remove elements in a component

**Export Shell Model**
- Automatically export shell model according to component interface definition
- Transferred downstream for Simulink model detail design
Conclusion

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  - SOA Behavior Modeling
  - SIMULINK New Features
  - Wrapper Code Generator

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  - System Composer(Deeply Customized)
Thank you