ASAM Regional Meeting Japan 2020

vECU-MBD WG / Co-MBD Application TF Cooperation with ASAM

June 25, 2020

NISSAN MOTOR CO., LTD.
Akira Watanabe

Contents

1. Outline of vECU-MBD WG and cooperation with ASAM
2. Plan for PoC (Proof of Concept)
3. Status of activity

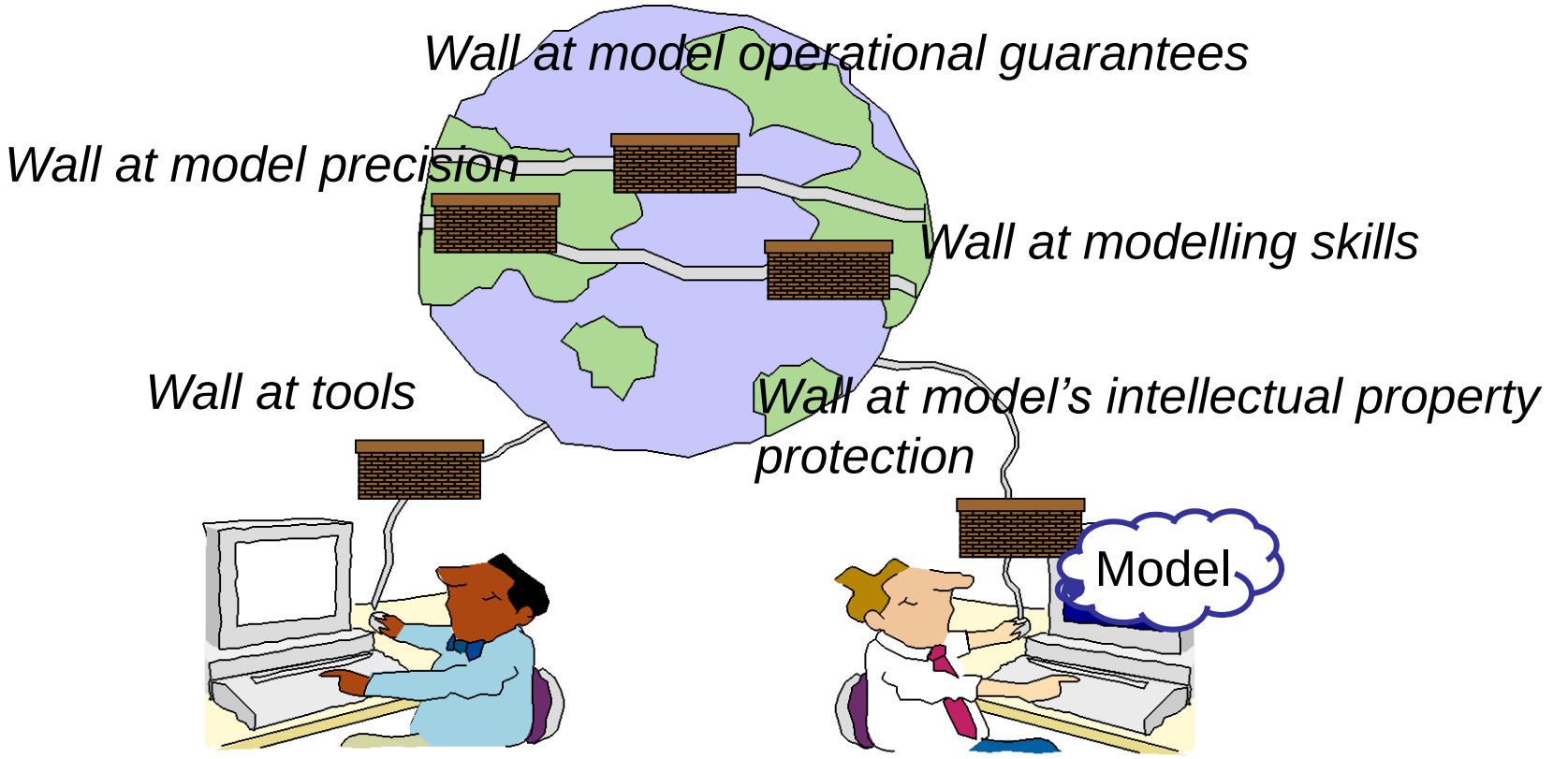
[Notes]
ECU: Electronic Control Unit
vECU: Virtual ECU
MBD: Model Based Development
WG: Working Group

Contents

1. Outline of vECU-MBD WG and cooperation with ASAM
2. Plan for PoC (Proof of Concept)
3. Status of activity

[Notes]
ECU: Electronic Control Unit
vECU: Virtual ECU
MBD: Model Based Development
WG: Working Group

Challenges for utilization of virtual ECUs

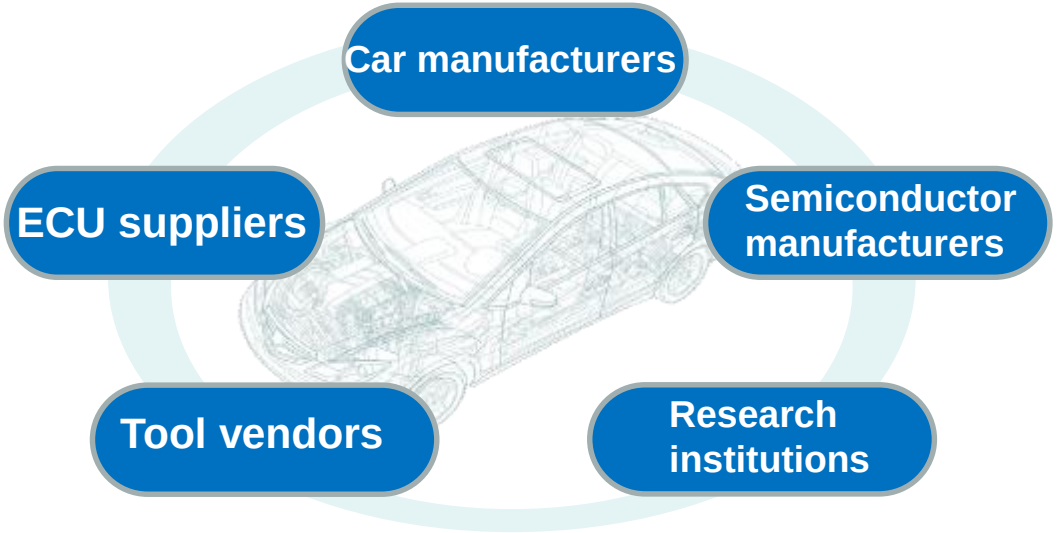


A cross domain organization involves car manufacturers, supplier, semiconductor companies, tool companies is required.

vECU-MBD Working Group

- **Objective:** Promote use of MBD using virtual ECUs
- **Feature:** Collaborative activities cross domain industries those relate to automotive ECUs
- **Activity started:** from 2010/April
- **Home page:** http://www.vecu-mbd.org/en/
- **Working group members:** 31 organizations (as of 2019/June)

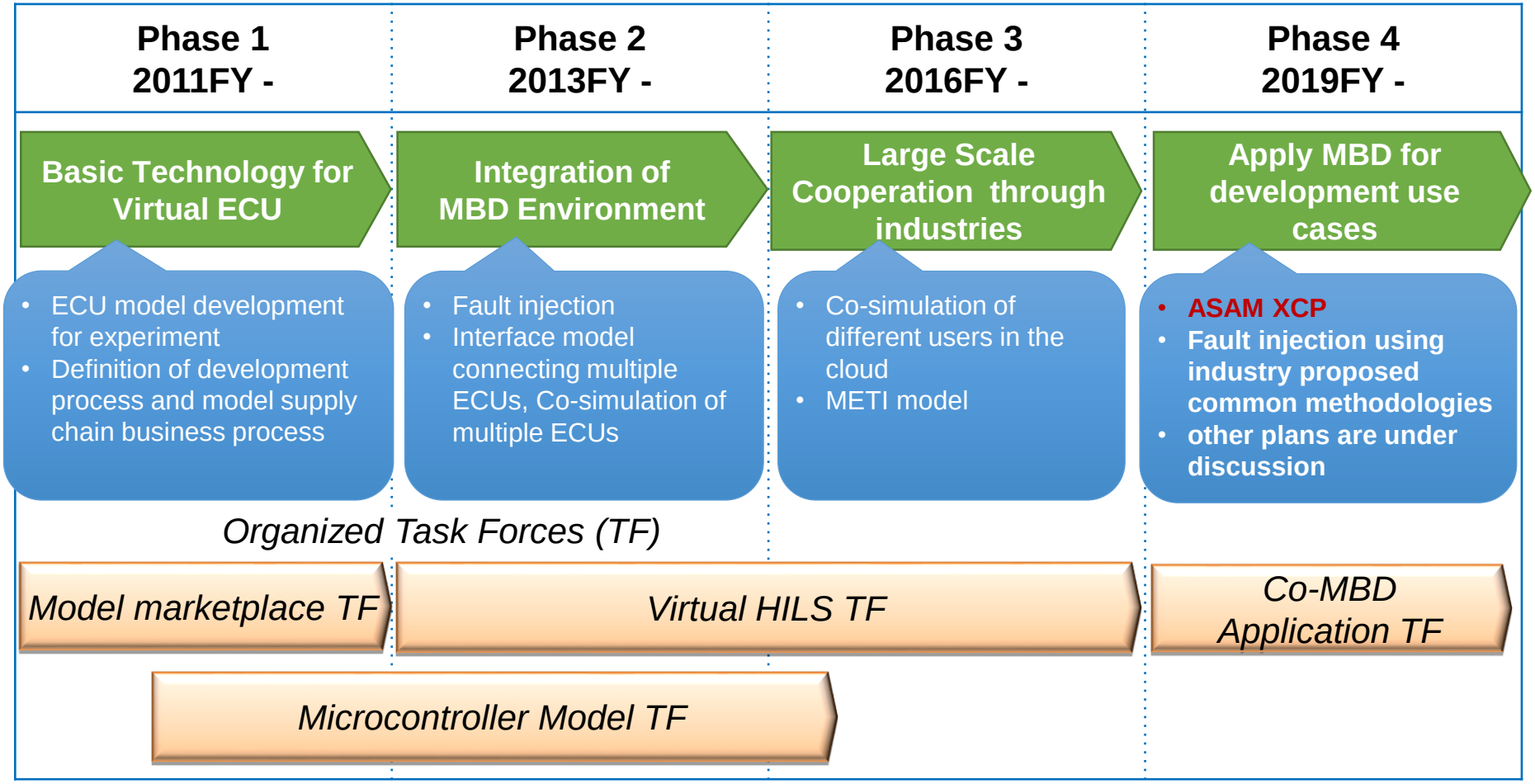
Aisin Seiki Co., Ltd., ETAS K.K., InterBuddy Inc., VITS INC., Australian Semiconductor Technology Company K.K., OMRON Automotive Electronics Co., GAIO TECHNOLOGY Co., Ltd., Calsonic Kansei Corporation, Institute of Systems, Information Technologies and Nanotechnologies（ISIT）, Cypress Innovates Ltd., Sumitomo Wiring Systems, Ltd., Zerosoft Assist Technology Co., Ltd., Team AIBOD Ltd., dSPACE Japan K.K., TOSHIBA CORPORATION, Toyota Technical Development Corporation, Nissan Motor Co., Ltd., Cadence Design Systems, Japan, Nihon Synopsys G.K., NSK corporation, Japan Automobile Research Institute（JARI）, Hitachi Automotive Systems, Ltd., Hitachi Industry & Control Solutions, Ltd., Hitachi, Ltd., Denso Ten Ltd., Bosch Corporation, Board Planning Co., Ltd., Honda R&D Co., Ltd., Mazda Motor Corporation, Mitsubishi Electric Corporation, Renesas Electronics Corporation [in no particular order]



- **Main achievements of the activities**
  - Publication of guide document, "*User support guide to consider introduction of virtual ECU" and "Model procurement / integration guide*".
  - Publication of the specification of CAN bus model to be used in MBD.
  - Proof-of-concept experiment for typical use cases of the virtual ECU.
    Major activity themes:
    (1) Multiple ECUs, (2) Fault injection test, (3) Co-simulation of different users in the cloud

Roadmap of the Working Group

By considering importance and difficulties, 4 phases of activities have been planned.



PoC experiments by WG

1. **Multiple ECU system using SPILS (Simulated-Processor In the Loop Simulation).**
   - Binary-code of the micro-controllers of multiple ECUs are executed using Simulink and microcontroller-simulator co-simulation.

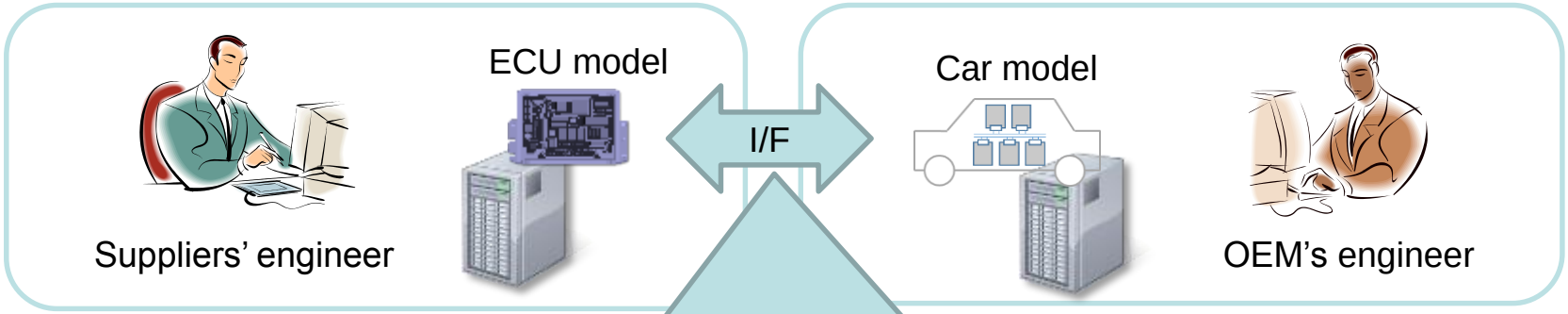
2. **Fault injection using SPILS**
   - Behaviors of binary level of S/W are verified under H/W or memory fault cases.
   - Proposal of a fault injection methodology.

3. **Co-simulation by different users in the cloud.**
   - Use case for different users (ie, OEM's engineer and supplier's engineer) work cooperatively using each others' models without passing model itsself.
   - Proposal of a development methodology called **Co-MBD (Collaborative MBD)**.

Only major PoC experiments are shown

Co-MBD (Collaborative MBD)

Co-MBD:
A proposed development methodology to achieve collaborative development without passing models each other. Engineers can use other company's models as a service in the cloud.



A case for supplier's engineer utilize OEM's car model.

Model/tool/machine I/F
- ***D-EIPF*** *(Design Electric Integrated Platform)*

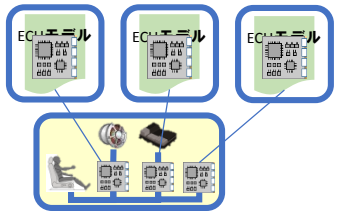
How to provide models
- Models are provided as a service. Models are executed in providers' machine and only result are passed to model users.
- Files of the models are kept in models' providers.

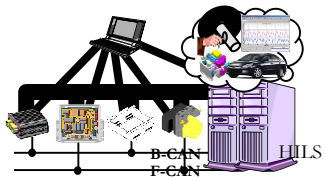
Merit
- For model providers :
  - Can keep model's Confidentiality or IP.
- For model users :
  - Do not have to do model's maintenance.
  - Can utilize computing resource from cloud.

Co-MBD using virtual-HILS on Cloud

by External Working Group “vECU MBD WG”

As-Is



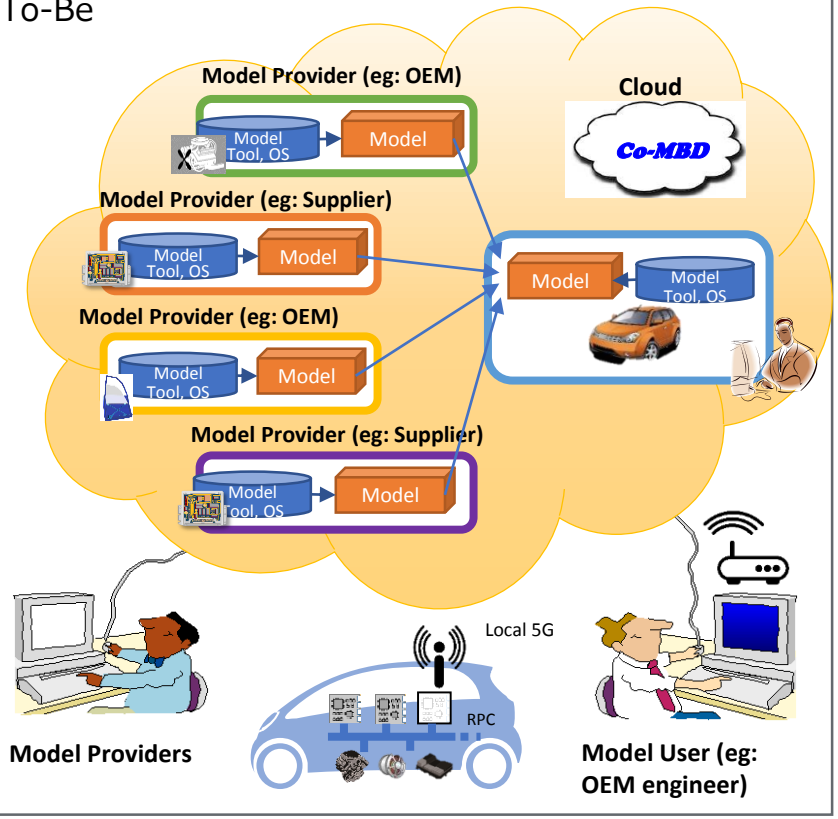


Enabler

MODaaS

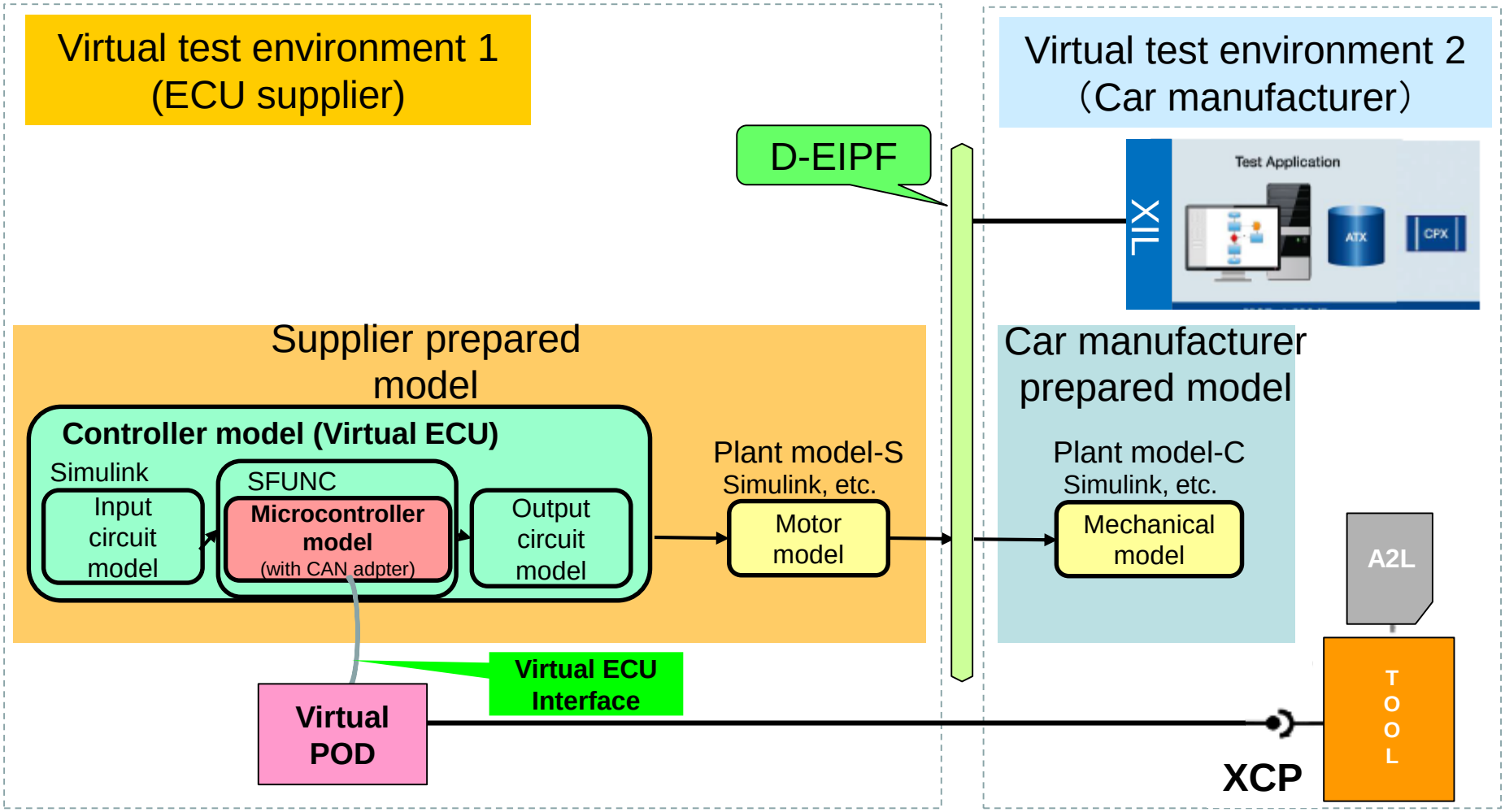
(MODel as a Service)

To-Be



ASAM and Co-MBD

Feasibility study for using ASAM at co-simulation of different users on cloud (Co-MBD)



ASAM XIL : an API standard for the communication between test automation tools and test benches
ASAM MCD-1 XCP : a bus-independent, master-slave communication protocol to connect ECUs with calibration systems
POD : Plug-On Device

Contents

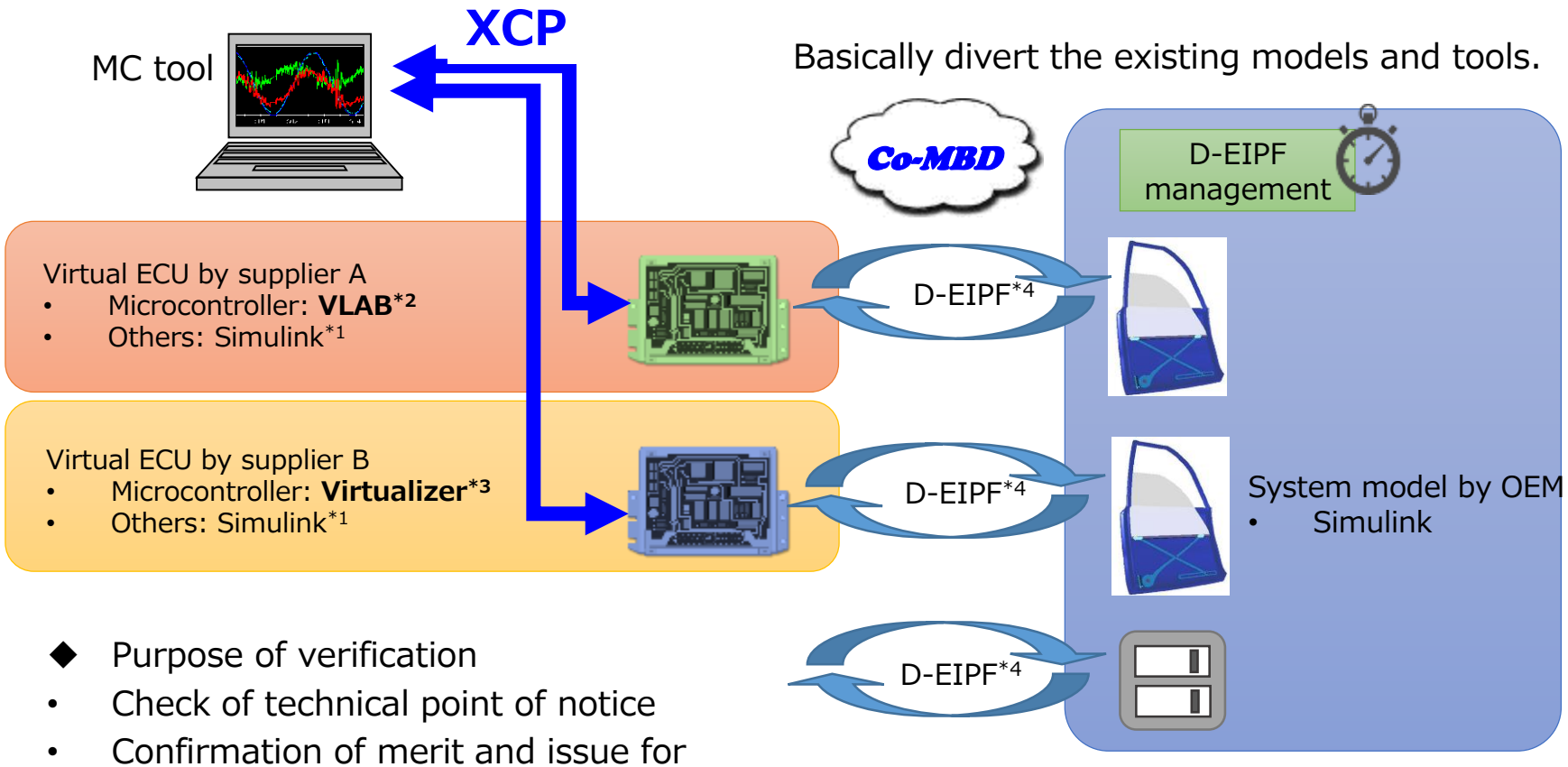
[Notes]
ECU: Electronic Control Unit
vECU: Virtual ECU
MBD: Model Based Development
WG: Working Group

Participants

- Australian Semiconductor Technology Company K.K.
- ETAS K.K.
- GAIO TECHNOLOGY Co., Ltd.
- Nihon Synopsys G.K.
- Nissan Motor Co., Ltd.

* alphabetical sequence

Image of Plan for PoC



◆ Purpose of verification
- Check of technical point of notice
- Confirmation of merit and issue for operation
- **Feedback to ASAM**

◆ Step of verification

Planning from Step0 to Step5.

→ For details please refer next slide.

*1: MathWorks
*2: ASTC
*3: Synopsys
*4: Nissan

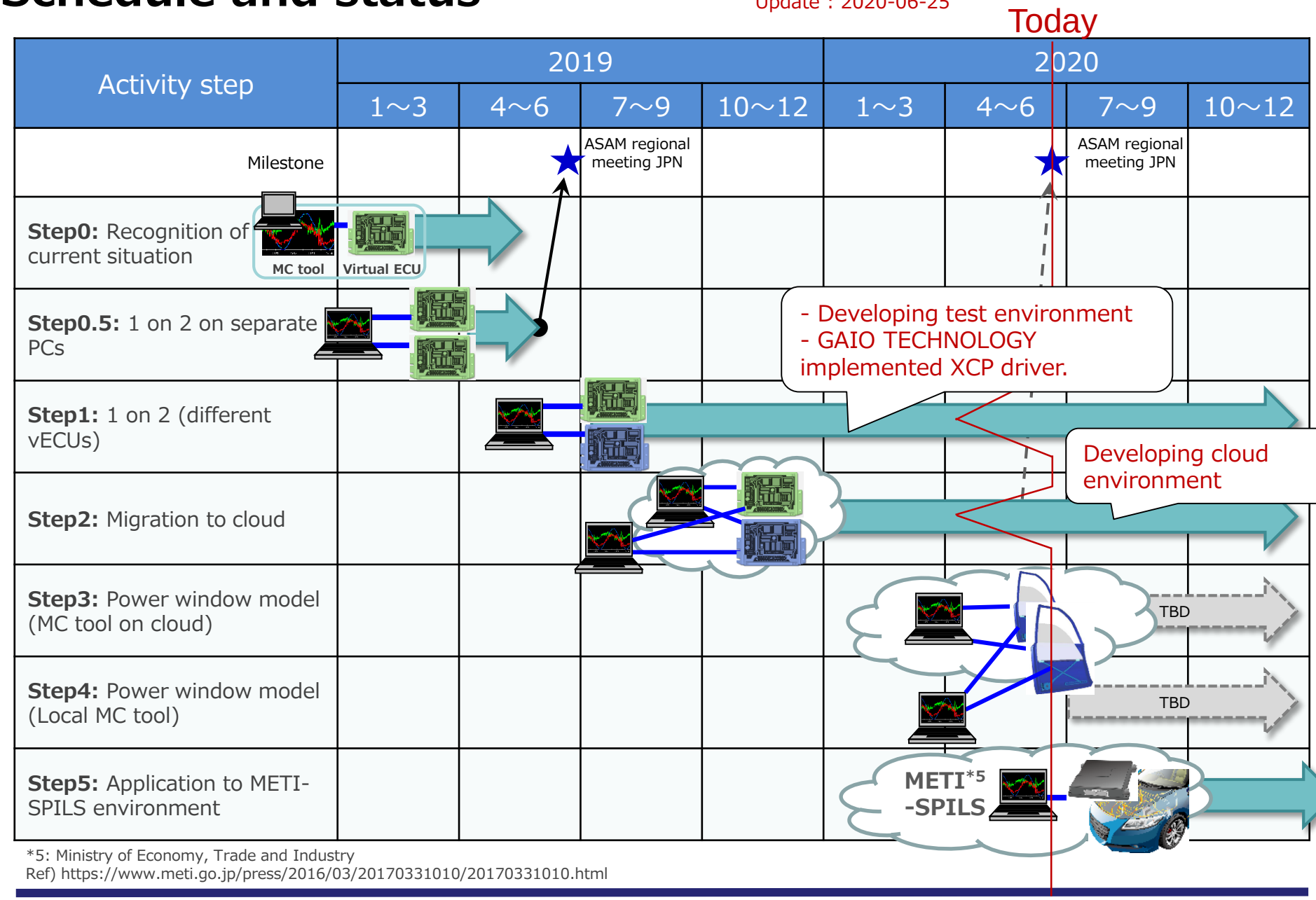
Contents

1. Outline of vECU-MBD WG and cooperation with ASAM
2. Plan for Plan for PoC (Proof of Concept)
3. Status of activity

[Notes]
ECU: Electronic Control Unit
vECU: Virtual ECU
MBD: Model Based Development
WG: Working Group

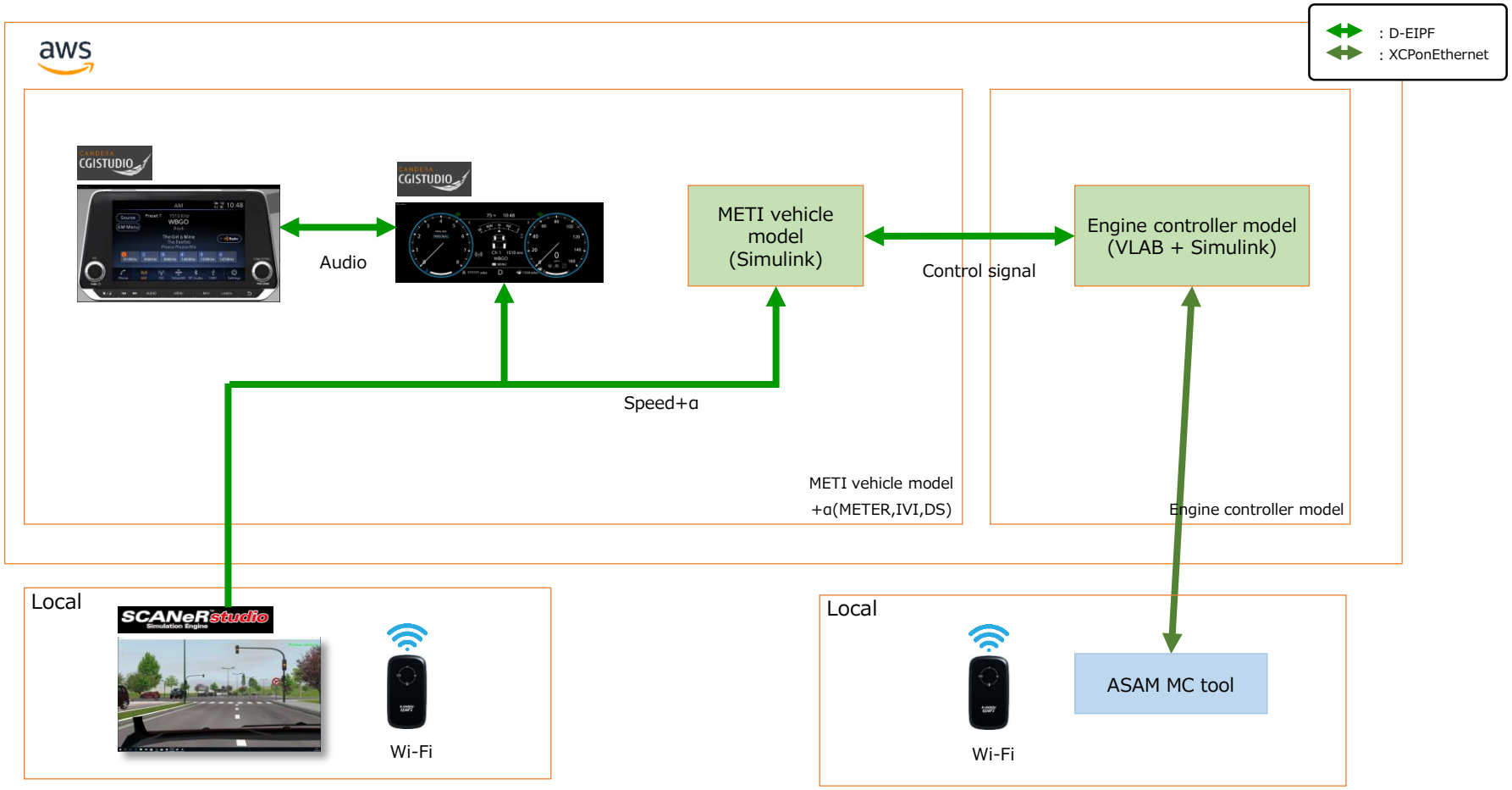
Schedule and status

Reminder: ASAM Regional Meeting Japan / June 27, 2019
Update : 2020-06-25



*5: Ministry of Economy, Trade and Industry
Ref) https://www.meti.go.jp/press/2016/03/20170331010/20170331010.html

A GOAL IMAGE AT STEP5



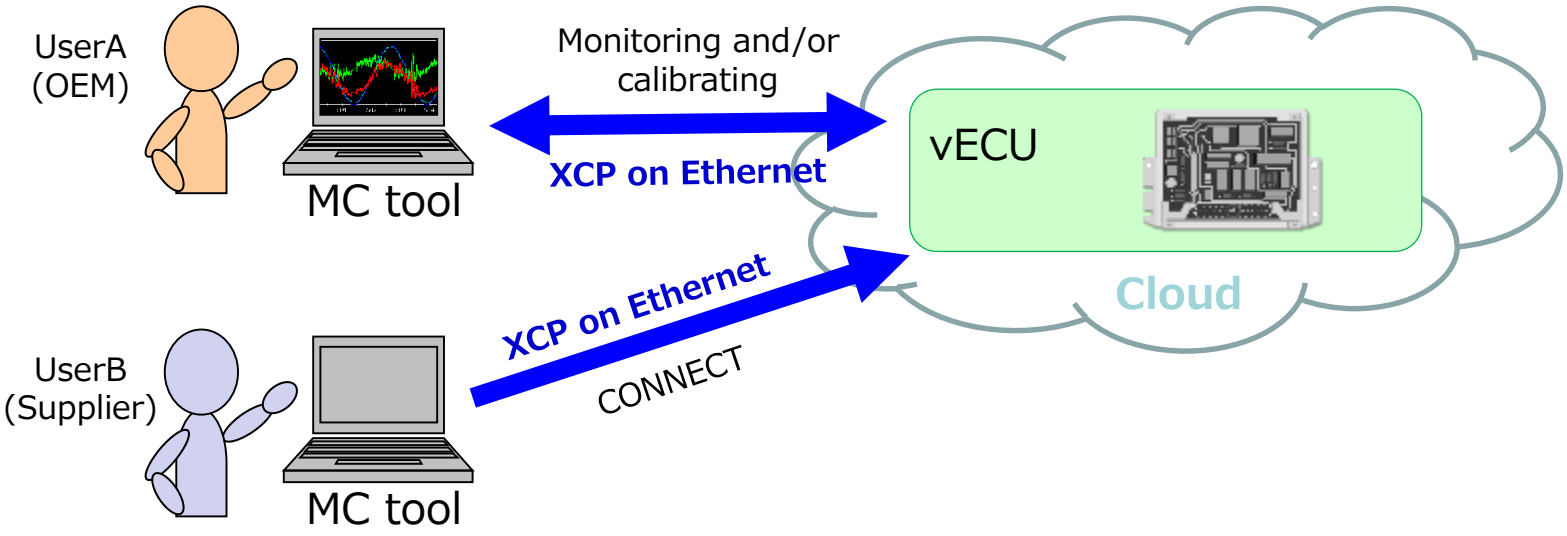
Concerns and Issues to realize MC on virtual environment

Will add when we face any concerns/issues.

No	Item	Description	Countermeasure	Note
1	Startup sequence	If startup sequence is different among vECUs, there is a concern that synchronous measurement is not possible. (e.g. MC tool should be start first, or simulator started first...) Startup sequence of vECU should be flexible and not depend on the specific order.	To be confirmed in future.	
2	Restriction by security mechanism on execution environment	Due to security mechanism on PC which MC tool or vECU is set on, not possible to change configuration of network and firewall. For this MC tool PC and vECU PC cannot be connected.	Use PCs on which the configuration of NW and firewall can be changed.	In the case that device license is needed to install vECU, should be careful for security mechanism of PC.
3	Multi-master connection in cloud environment	ASAM MCD-1 XCP does not allow multi-master topology. On cloud environment there is a possibility that multiple masters connect to a vECU. Ex. During a user is monitoring or calibrating a vECU on cloud, another user may connect to the same vECU.	Implement any exclusive control to vECU. Or, Feedback to ASAM if there is use case multi-master connection is necessary.	Next page for details
4	Seed&Key support	Only an authenticated MC tool should be connected to vECU. Is it possible to support Seed&Key mechanism to vECU? (or already supported?)	To be confirmed in future.	
5	Disconnection control between MC tool and vECU	A mechanism to forcibly disconnect XCP communication is needed. (ex. In the case that no one notices that keep MC tool connecting to vECU)	To be confirmed in future.	
6	MC tool on cloud	Restrictions on MC tool: Is it possible to use MC tool on cloud? What kind of restriction will be? (ex. Any restriction of license)	To be confirmed in future.	
7		Multi user access to MC tool: If MC tool is put on cloud, there is a case multi users will use at the same time. The number of user will be limited?	To be confirmed in future.	
8		Location of A2L file: If MC tool is put on cloud, where should A2L file be put? (Cloud server where MC tool is installed, or use's local PC?)	To be confirmed in future.	

Concern about multi-master connection in cloud environment

Ex. During userA (OEM) is monitoring and/or calibrating of vECU, userB (supplier) connects.



From ASAM Office;

- MCD-1 XCP does not define a behavioral specification of multi-master connection.
- When multiple masters send CONNECT command with the same IP address and port, slave (vECU) cannot identify the user for each commands.
- Slave will respond to CONNECT commands even if multiple times. However, measurement may stop by command sequence error dependent on what command will be sent from users.

→ Need to implement exclusive control mechanism to vECU.
Anyway we will plan to include this case to verification scenario,
and study to give feedback to ASAM if there is use case multi-master connection is necessary

Ex. There might be a case that OEM user would like to share with supplier in real time the transition of variables associated with calibration.

In future

We would like to give feedback about findings gotten through vECU-WG to ASAM standards.

Relevant standards

- MCD-1 POD
- MCD-1 XCP
- MCD-2 MC

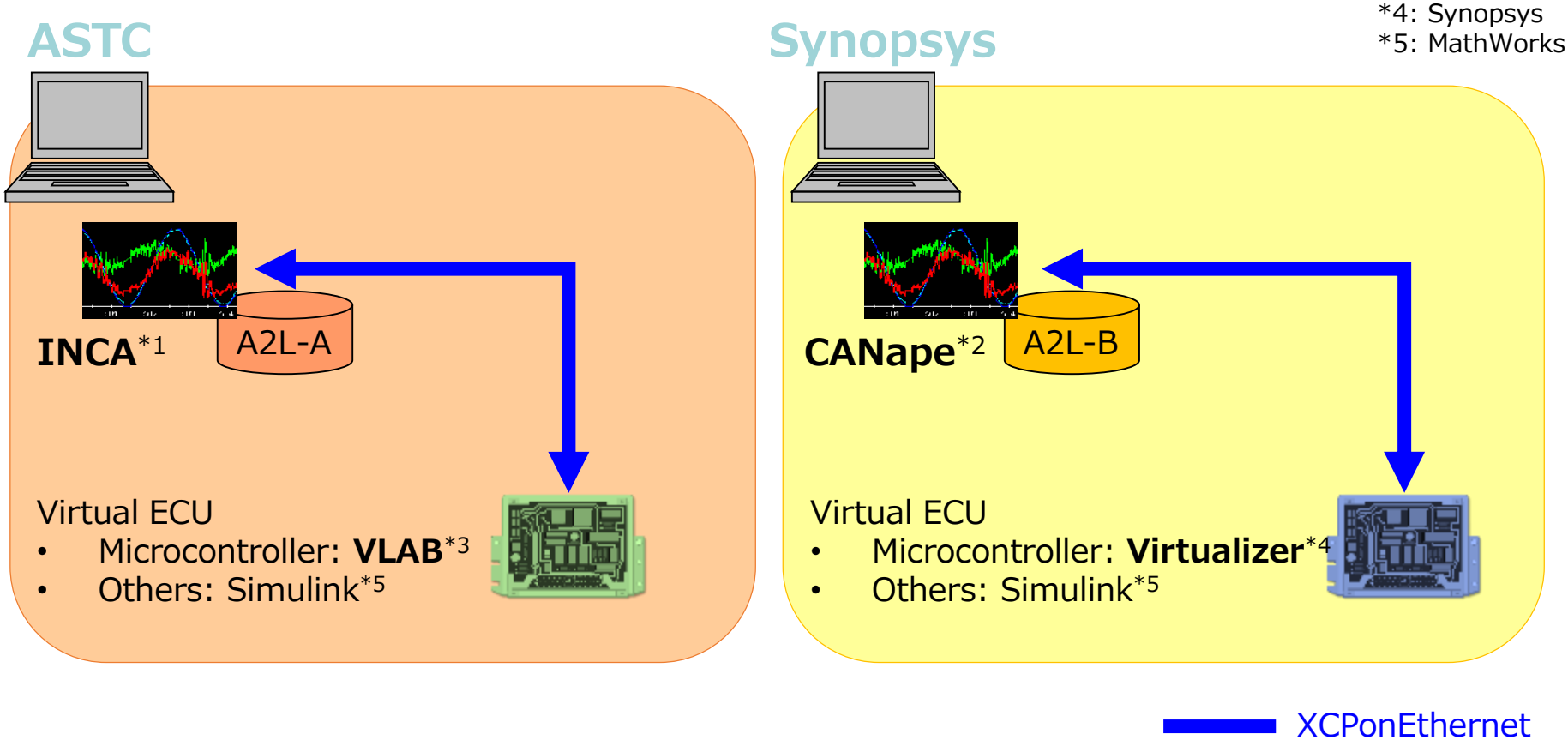
Thank you for your attention.

Appendix

Image of Step0

- MC tool and vECU on the same PC.

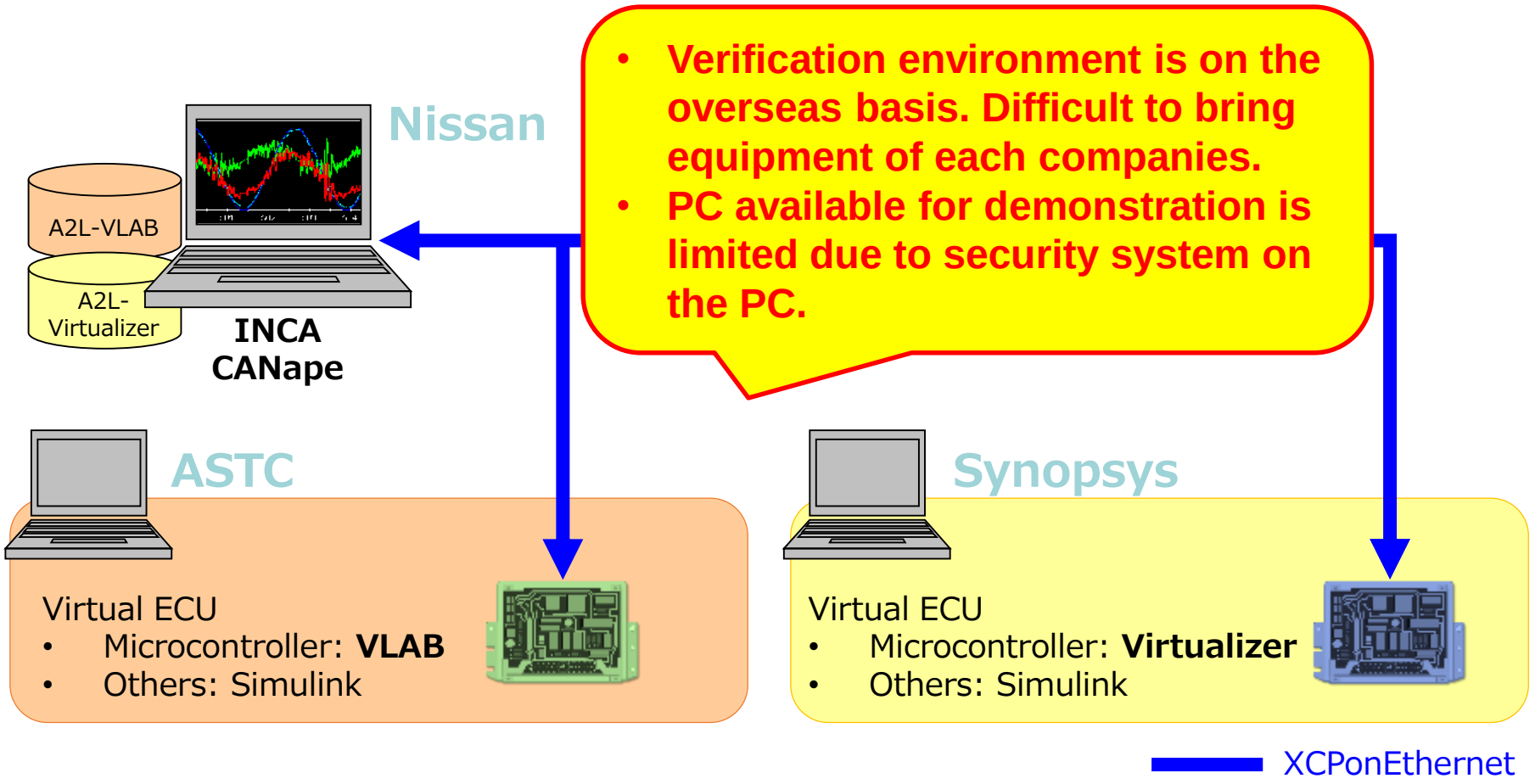
*1: ETAS
*2: Vector
*3: ASTC
*4: Synopsys
*5: MathWorks



- Software of virtual ECU can be any simple or existing one.
- Two virtual ECUs do not have to synchronize.

Image of Step1

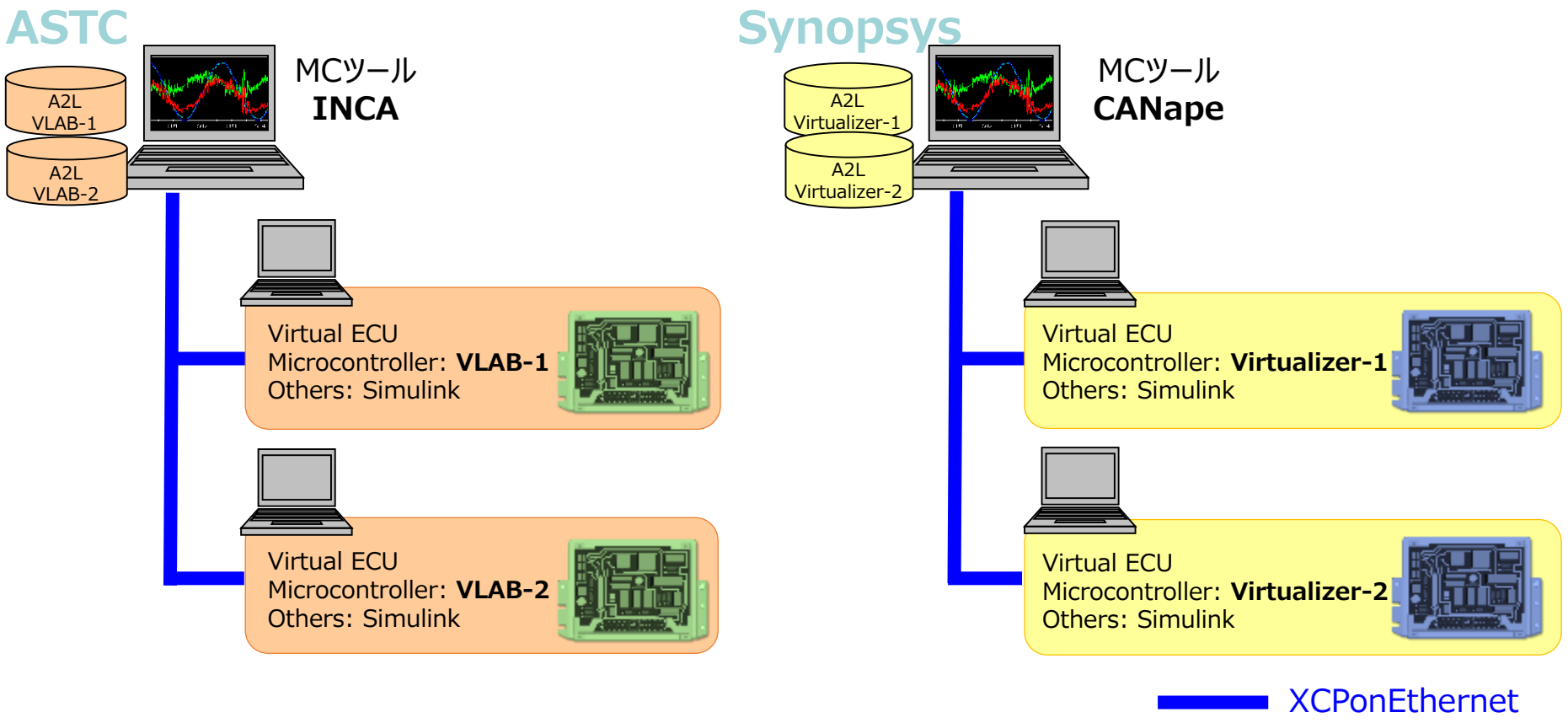
- MC tool and vECU on separate PCs.
- “1 on 2” connection (Synchronous measurement of VLAB and Virtualizer).



- Software of virtual ECU can be any simple or existing one.
- Two virtual ECUs do not have to synchronize.

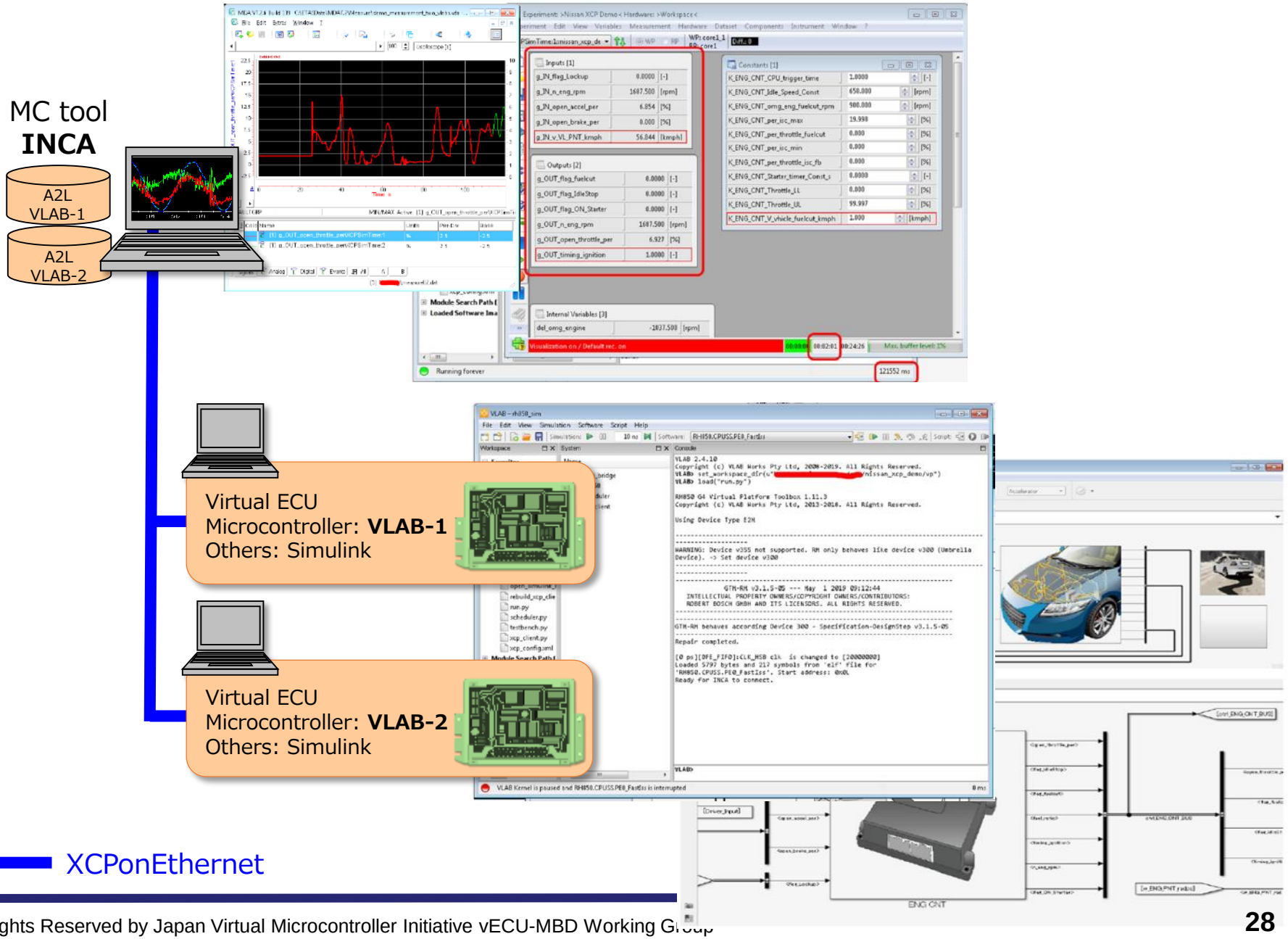
Image of Step0.5

- Because Step1 is not easy to perform due to some restrictions, we set one step as **Step0.5** before Step1.
- vECU vendors prepare two ECU models (software was copy) and set up “1 on 2” connection.



- Software of virtual ECU can be any simple or existing one.
- Two virtual ECUs do not have to synchronize.

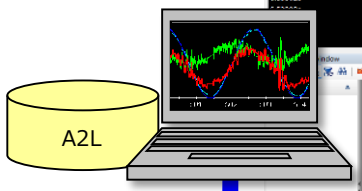
Image of demonstration today (ASTC)

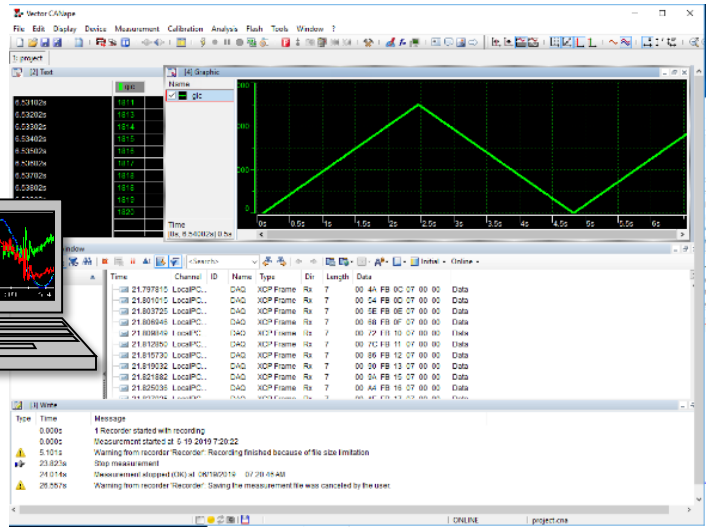


XCPonEthernet

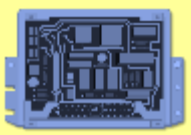
Image of demonstration today (Synopsys)

MC tool
CANape



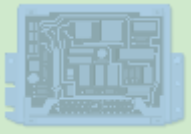


Virtual ECU
Microcontroller: **Virtualizer-1**
Others: Simulink



2nd model under preparation

Virtual ECU
Microcontroller: **Virtualizer-2**
Others: Simulink



XCPonEthernet