

# **COMPSAC 2011 Panel**

## **Opportunities and Challenges in Software Engineering for the Next Generation Automotive**

**Moderator: Mikio Aoyama (Nanzan University, Japan)**

**Panelists:**

**Manfred Broy (Technical University of München, Germany)**

**Karl-Josef Kuhn (Siemens, Germany)**

**Thomas Stauner (BMW, Germany)**

**July 21, 2011**

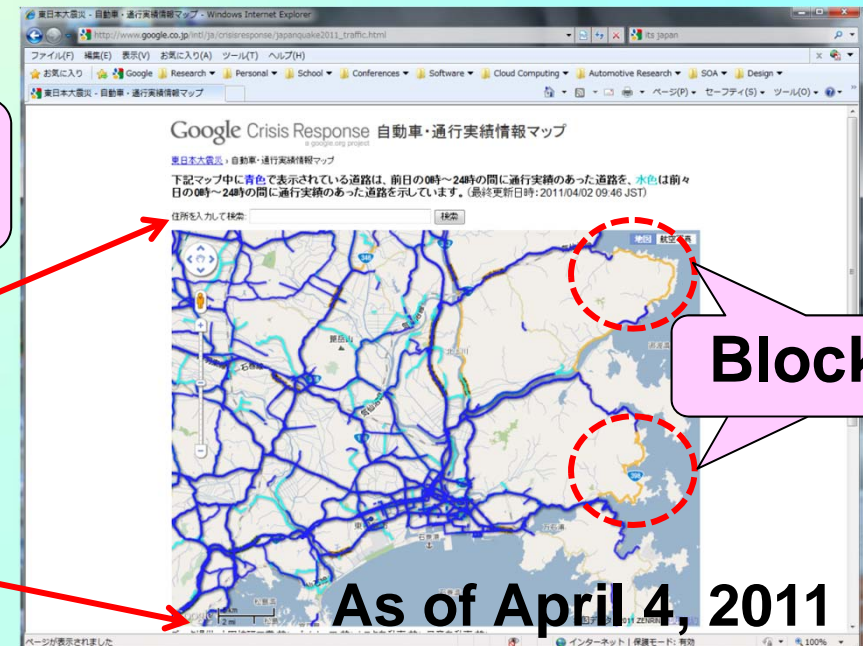
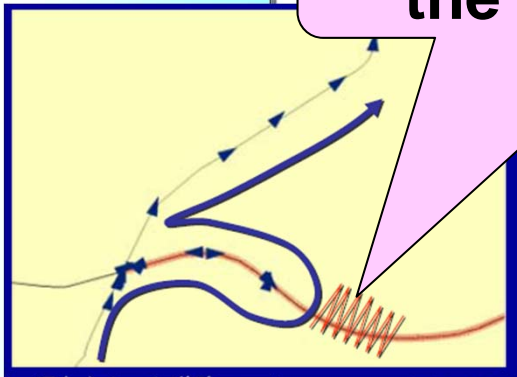
**München, Germany**

# Innovation in Automotive Software

## A Good News from Tsunami Disaster on March 11

- 👉 A Prove Car System Originally Developed and Operated by HONDA on Its Navi System since 2007
- 👉 Tsunami Pushed HONDA, TOYOTA, NISSAN and Google Work Together to Provided Road Information on Google Maps since March 19
- 👉 Car is the Most Effective Way to Collect Information on Availability of Roads

**U-turn of a Car Indicates the Road is Blocked**



# Innovation in Automotive Software

## Software Enables Major Innovations toward 2020

### ➔ Source of Innovation Toward 2020

➔ 1. Software

How can we assist  
the occupants?

➔ 2. Electrical Systems

➔ 3. Engine and Auxiliary Systems

How will the Vehicle  
be Powered?

➔ 4. Power-train

➔ 5. Body Structure (Frame)

What is

➔ 6. Interior

De-Emphasized?

➔ 7. Chasis

➔ 8. Body Exterior (Skin)

### ➔ From Interviews to 125 Executives in 15 Countries

Source: IBM Global Business Services, Automotive 2020, Aug. 2008,  
<http://www-03.ibm.com/industries/automotive/us/detail/resource/U291660E06389058.html>.

# Challenges for Smart and Social Automotive Aspects of Automotive Software

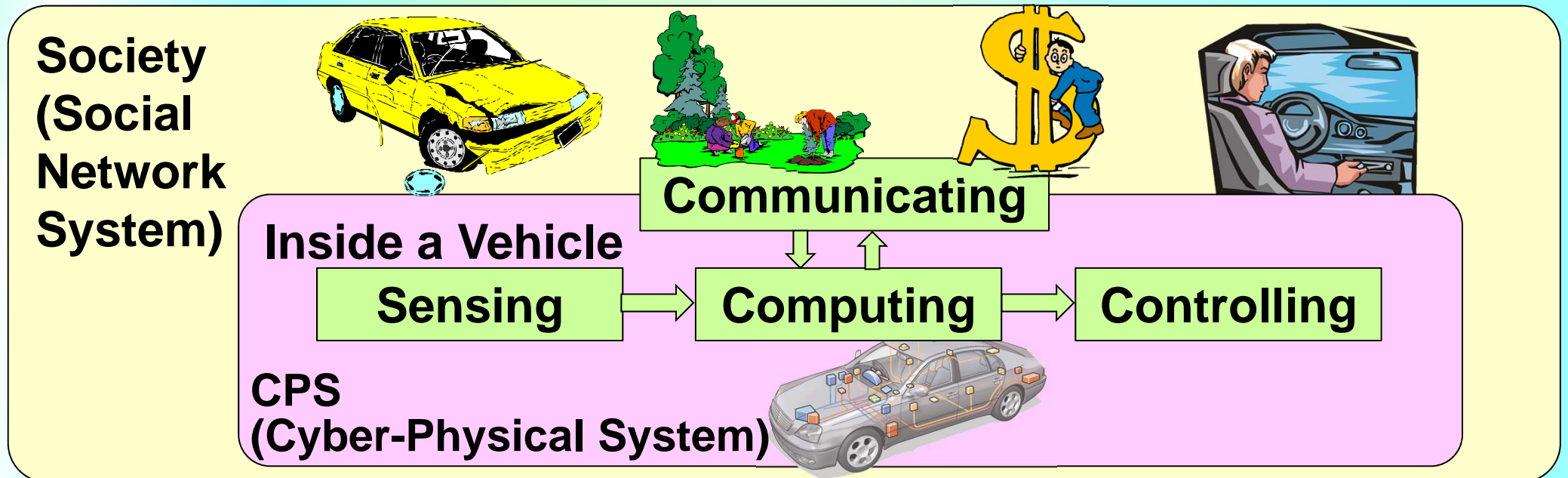
## 👉 Four Aspects of Automotive Software: A Kind of CPS

👉 Sensing, Computing, Controlling, and Communicating

## 👉 Two Scopes of Impact

👉 Inside a Vehicle and Outside Society

👉 Vehicle is Social Product: Traffic Network and Social Network for Better Safety, Environment, Economy, and Experience



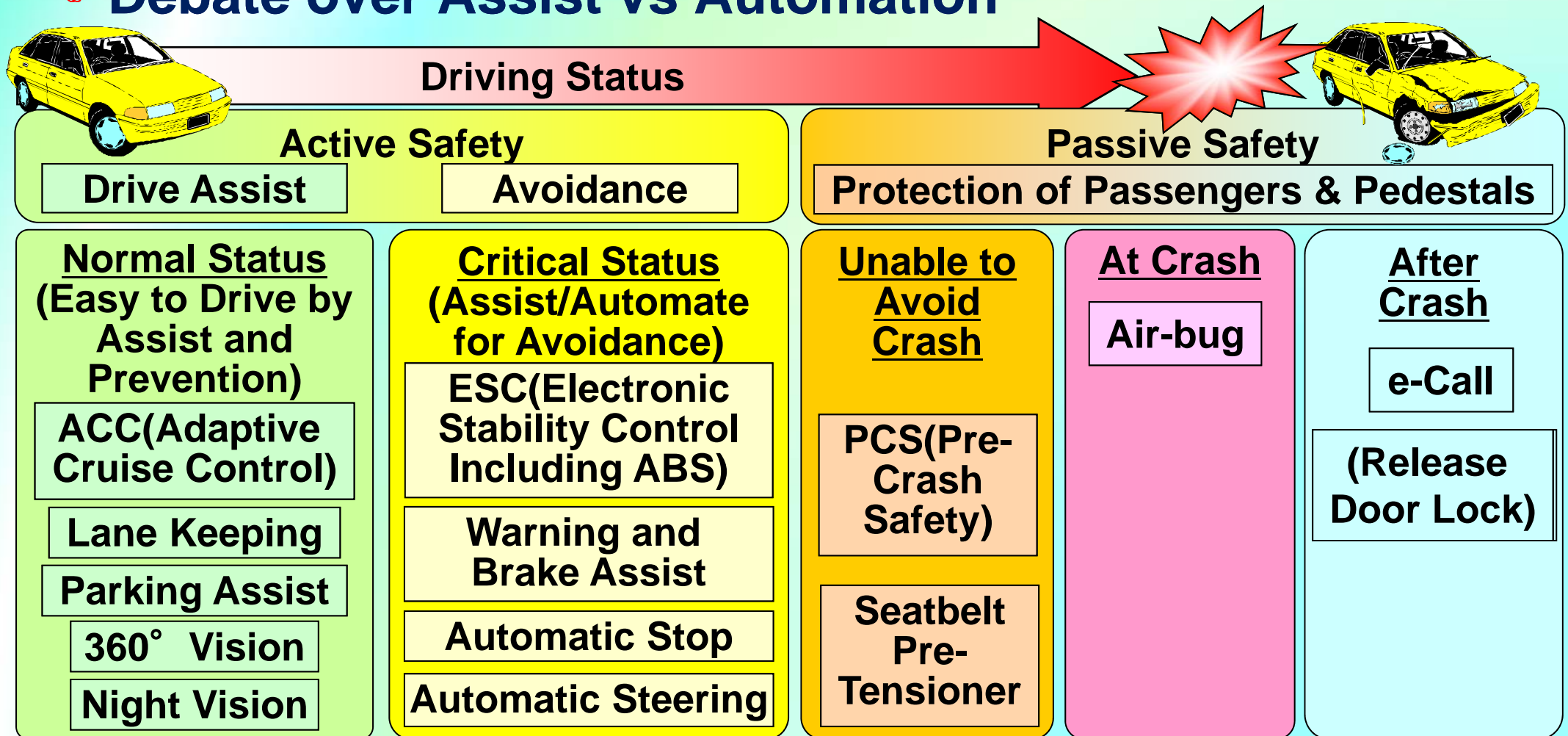
# Challenges for Smart and Social Automotive Technologies to Make Vehicle Smart and Social

## 👉 From a Single Vehicle to a Vehicle for Social Network

|                    | Today   | Tomorrow  |
|--------------------|---|---|
| <b>Sensing</b>     | <b>For inside a Vehicle</b>   | <b>And Sharing with Society</b>   |
| <b>Computing</b>   | <b>For Controlling Vehicle Dynamics</b>   | <b>And Safety, Experience and Value Creation</b>  |
| <b>Controlling</b> | <b>For Actuators inside a Vehicle</b>   | <b>And Information and Energy thru Network</b>  |
| <b>Comm.</b>       | <b>For Distributed Computing over In-Vehicle Network (CAN, FlexRay, MOST, Lin), and for Telematics Services with Low Speed to Outside</b> | <b>And with Other Vehicle, and Social Network Including Cloud Computing, SNS, Smart Phone and Smart Grid with High-Speed (Ethernet)</b> |

# Challenges for Smart and Social Automotive Integrated Safety by Software

- ➡ Real-Time Integrated Control by Software
- ➡ Design for Dependability: ISO26262 (Functional Safety)
- ➡ Debate over Assist vs Automation



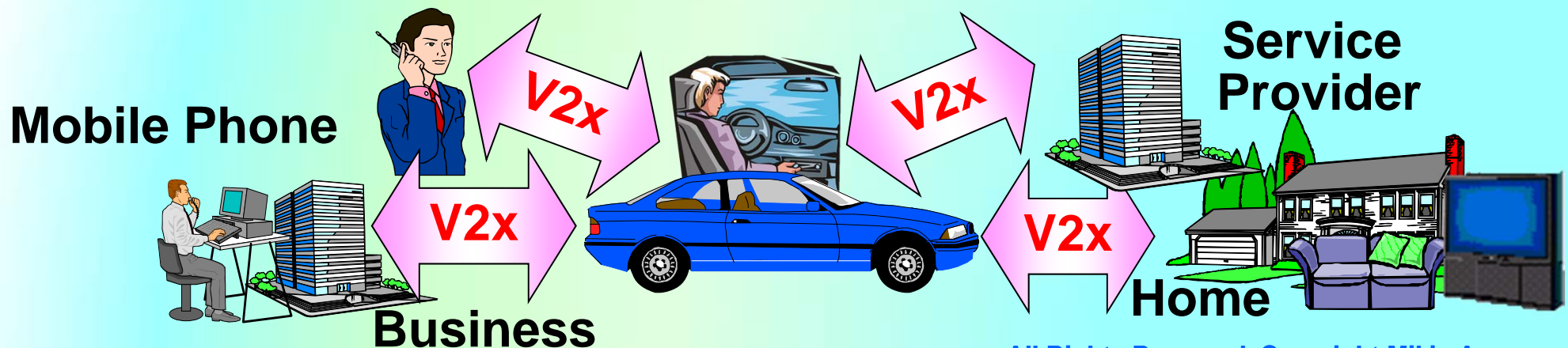
# Challenges for Smart and Social Automotive Issues in Software Engineering within Vehicle

- **Automotive Software within Vehicle**
- **Ultra High Complexity of Distributed Processing**
  - **More than 50 Processors Connected with Multiple In-Vehicle Networks**
- **Large-Scale**
  - **10+ MLOC per Vehicle , and Still Rapidly Evolving**
- **Hard Real-Time at Micro Second Order**
  - **Air-bug, Engine Control, Auto Stop for Avoiding Crash**
- **Safety Critical and High-Dependability**
  - **Recall Due to Software Bug**
- **Wide Variability**
  - **By Market Segment and Country Including Regulation**
  - **By Driver's Persona: Age, Gender, Driving Style and Culture**

# Challenges for Smart and Social Automotive

## New Challenges for Fully Connected Car

- **(Fully) Connected Car**: Anytime at High-Speed
  - Connected to Other Car: Vehicle-to-Vehicle (V2V, C2C)
  - Connected to Transportation Infrastructure and Smart Grid: Vehicle-to-Infrastructure (V2I, C2I)
  - Connected to Home, Business and Other Sources Including Cloud Computing and SNS (V2x, C2x)
- **Providing Services for New Experiences and Values**
- **Social Information Infrastructure: Collective Intelligence**



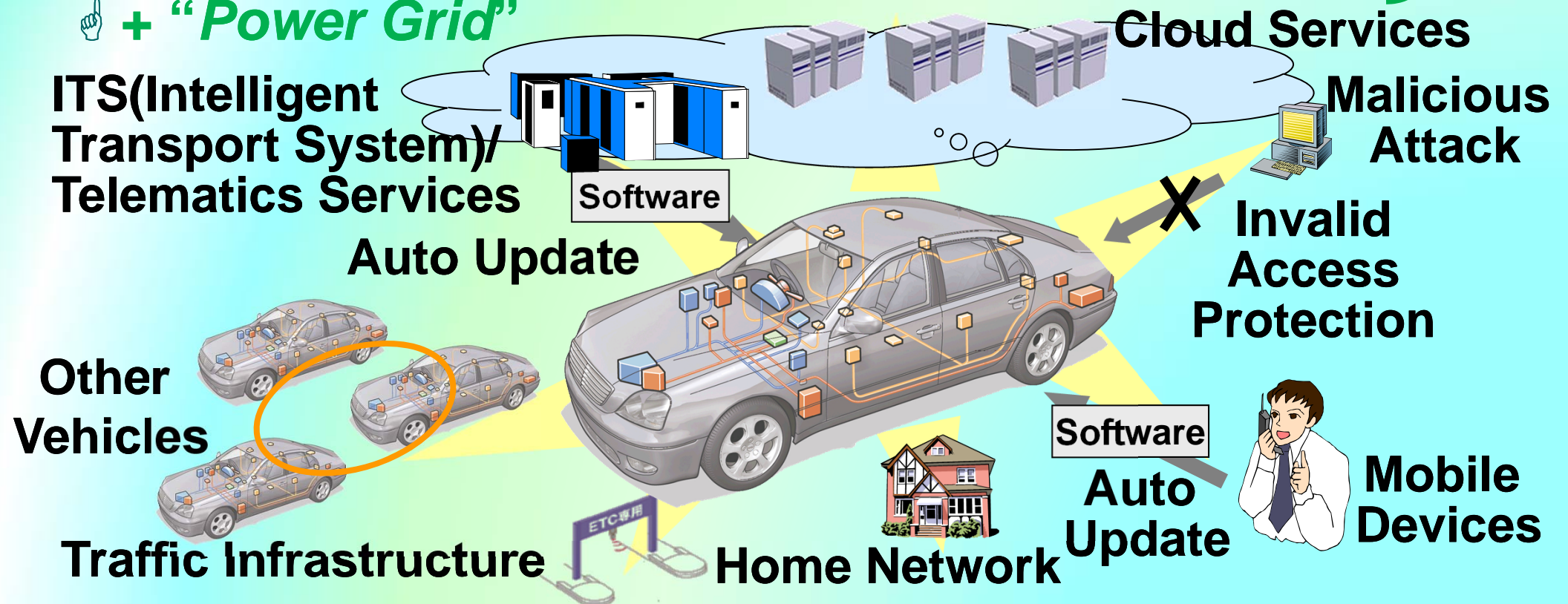


# Challenges for Smart and Social Automotive

## Smart and Social Car

### Automotive Software Makes Car Smart and Social

- 👉 Vehicle and *Traffic Infrastructure*
  - 👉 + “*IT service*”
  - 👉 + “*Power Grid*”
- } ITS, Telematics } Smart Grid



Reference: A. Iwai and M. Aoyama, Automotive Cloud Service Systems Based on Service-Oriented Architecture and Its Evaluation, Proc. IEEE CLOUD 2011, Jul. 2011.

# Challenges for Smart and Social Automotive

## Some Key Questions

### **What Software/Service We Build and Provide**

 **So Much New Requirements**


 **So Broad Scope and Variability**

### **How Software/Service We Build and Provide**

 **Accommodating Unique Nature of Physical System and Mobility**


 **Productivity and Quality for High Complexity and Scale**


 **Design for Safety and Dependability, and Building Trust**


 **Education and Training People**

# Scenario of Panel

## **Position Presentation/Statement [15 min. Each]**

 **Professor Manfred Broy (Technical University of München, Germany)**

 **Dr. Karl-Josef Kuhn (Siemens AG, Germany)**

 **Dr. Thomas Stauner (BMW, Germany)**

## **Open Discussions [30 min.]**

## A Final Remark

 **Automotive  
Software  
Engineering is  
Exciting and  
Challenging  
Area with Fun  
to Study!**

**Photo at Toyota Kaikan Museum  
July, 2011**

