What is a Connected Car

Connected Car System

Big Data M2M/Cloud

3G/4G Broadband
Always Connected
Fixed Rate
Low Cost

Web Server

• E-Mail
• Calendar
• Location
• SNS
• Traffic
• Weather

Network Operator

Internet

Application/Contents Service Providers

Customer Database

Home

Office

• R&D
• Manufacturing
• Dealership Management

VRM *2)

CRM *3)

Definitions of CAN and data formats are slightly different for OEMs and even among vehicle models within a company

Sensor Data
(Preferably, Read Only)

Control Area

Power train CAN
Multimedia CAN

Vehicle CAN

NAVI AV SNS Safety & Security

Service Applications

Human Machine Interface
Generic Operating Systems

Interface, Device Drivers

Generic Car Hardware Parts
(CPU, Chipset, Memory...)

IVA*1) Client

IVI*1) Probe DB

III: In-Vehicle Infotainment

VRM: Car Relationship Management

CRM: Customer Relationship Management

- 1) IVI: In-Vehicle Infotainment
- 2) VRM: Car Relationship Management
- 3) CRM: Customer Relationship Management

- Definitions of CAN and data formats are slightly different for OEMs and even among vehicle models within a company
Issues to embed ICT devices in Car

- Difference of product life cycle

  *A) Years between sales as a new car until expiration of registry
  *B) Data from Car Information Center (ref. 10.60 years in 2001)
  *C) Average year of Car in use

Average years of Car in use (Japan)*A
13.04 years*B (2011)

存在问题

- 产品生命周期的差异

  *A) 新车销售至登记届满年数
  *B) 车辆信息中心数据（参照2001年的10.60年）
  *C) 使用中的车辆平均年数

平均使用中的车辆年数（日本）*A
13.04年*B（2011年）
Issues to embed ICT devices in Car

- Long Dev. Cycle and Long Product Life of Cars

Let's make Low Cost Navigation with functional level of PND

Since the introduction of iPhone

In-Vehicle Device

Development

★ Spec. Fix

★ Market Launch

Bug fix

+ Car Integration

Three Years to launch

Remain additional 3 years as a “new car” and stay 10+ years after the purchase

At the product launch, people can use Google NAVI on iPad2

With high volume and short development cycle, up-to-date technologies will be used. Software update and application down-load will keep the product attractiveness.
Application update will solve the problem

- **Future direction**

- **Three Years**
  - Development
  - Spec. Fix
  - Market Launch

- **Layered Struc. Generic OS**

- **General IT Products**

- **Vehicle IT**

**S/W: Short but on-going development cycle**

**H/W: Long Dev. Cycle**

**Hardware**
- Low level Middleware
- High Level Middleware

**APs**

**Remain additional 3 years as a “new car” and stay 10+ years after the purchase**

**Market Launch**

**Application**
- 0.5
- 0.9
- 1.5
- 1.8

**OS**
- 0.9
- 1.0
- 1.2
- 1.4
- 1.8

**H/W**
- 0.5
- 1.0
- 1.2
- 1.4
- 1.8

**S/W; Short but on-going development cycle**

**H/W; Long Dev. Cycle**

**Development**

**Competitiveness**

**Time**
Market Penetration of NAVI: Recent Change

- Smartphone came into the market.

Market volume accelerates the advancements of technology.
Contents and Services reside in the Cloud

- **Cloud** provides data processing
- **User Devices** focus on intuitive and better UX and GUI

INTERACTIVITY

Contents & Services

- MIDI Music
- Weather
- News
- Train Exchange
- Game
- Dictionary
- Movie
- Video Clip
- Digital TV
- Data Base Oriented
- Entertainment
- Mobile Solution
- Web-mail
- e-mail
- DL
- Mobile Solution
- Mobile Solution
- Mobile Solution

Relation between Car and Smartphone

Amplifier, Speaker, Power, Private space, Probe

Information (Safety, Comfort)
Foreseeing the Future Trend

- Next Generation IVI
  - Three key entities

Modified from TeleNav data
Role of HTML5 for IVI Client

**HTML5**

- CSS3
- SVG
- Canvas
- WebGL
- Cross Document Messaging
- Speech Input
- Offline Event
- Geo Location
- Device Access API
- Storage
- Web Socket
- WebGL
- Speech Input
- Cross Document Messaging
- Offline Event
- Geo Location
- Device Access API
- Storage
- Web Socket

In-Vehicle Display Audio

(Hybrid) Navigation Application

Cloud

Tethering

Terminal Mode?

Smartphone w/ HTML5

F/W

Power-train CAN

Body CAN

Multimedia CAN

CPU/ Device

Drivers

MW/OS

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Example of Big Data Applications (already implemented in Japan)

Crowd Sourced MAP

- **Dynamic & Relational DB**
- **Probe Data**
- **Service**

**Dynamic Route Guidance**
- Traffic information from others
- Send driving info to the server.
- Sends back real-time traffic info and suggests best route

**Downloading precise information on destinations**
- Send information on temperature, raining...etc.
- The weather of the destinations

**Connected Cars**
- Probe Data Service
- Send the information of GPS
- Ex. Charging Spots
- Ex. ECO Driving
- Ex. Slippery Spots

**Live update of the map**
- No road is indicated.
- A new road is indicated.
- A new road info to map DB

**Dynamic Route Guidance**
- Server sends driving info to the server.
- Server requests real-time weather information.
- Server sends back real-time traffic info and suggests best route.

**Downloading precise information on destinations**
- Server receives the information on temperature, raining...etc.
- Server requests real-time weather information.
- Server sends back real-time traffic info and suggests best route.
Crisis Response on Google Map

- After the Earthquake, probe data were uploaded in collaboration with NISSAN, Toyota, Honda, and Pioneer in order to publish the functional roads on Google Map.
Possibilities to apply Big Data Analysis

Probe data example

Statistical processing

Effective use of information

Data collection

Information delivery

| Probe car | GPS | Wiper | Velocity | ABS | Steering wheel | Brake | Accelerator | Air bag | ECU | SOC | RPM ?? | Fuel, State of Charge | temperature |

| Location | Rain | Velocity change | Discovery of potential danger | Acceleration and deceleration and Traffic jam tail | Possible Collision | Vehicle Condition |

| Location-Based Services | Weather Info. | Traffic info. | Prevent Danger |

| Social Network Services | Safety driving info. | Environment info. |

| Drivers and Social Benefits | Early detection of accident | Emergency call to police/fire station or caution to surrounding vehicles |

| Early detection or prevention of breakdown | Contact to maintenance/security companies or nearest facilities |

| Gas & Charging Spot info. | Probe Processing Center |

Providing attractive service first is key for acquiring critical mass and large probe data.

Source: National Museum of Emerging Science and Innovation
New Mobile Service Opportunities w/Big Data

Need useful information for comfortable and safe driving.

New Business Opportunity
Internet of Things (M2M)

Want to attract potential customers. (Car can be an effective marketing tool)

3rd Party Companies
- Gas/Oil reseller
- EV Charging Co.
- Smart Grid Operator
- Insurance Co.
- Convenience Store
- Digital Signage
- Hotel/Restaurant
- Transportations such as Railroads, Airline..
- Fleet Management
- Car Sharing
- Courier Service
- etc...

Probe Data
(probe, presence, attributes)

Probe DB

Probe is a trigger for personalizing service/info.

B2C service/info

IT and Communication networks handle transactions

Personalized service (DRG, etc.)

Data fee

Probe provides a unique advantage for Automotive Companies by providing probe-originated new service opportunities. But.. data from large customer base is necessary.
Data Size and Real-time requirements

• Relation of Data size and Real-time Requirements

Supported by User Cell Phone

<table>
<thead>
<tr>
<th>Data Size</th>
<th>Time</th>
<th>Car Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>GB</td>
<td>Sec</td>
<td>Full Map Update</td>
</tr>
<tr>
<td>MB</td>
<td>Min</td>
<td>Partial Update of Map</td>
</tr>
<tr>
<td>x00KB</td>
<td>Hour</td>
<td>Restaurant</td>
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<tr>
<td>100KB</td>
<td>Day</td>
<td>Parking Lot</td>
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<tr>
<td>x0KB</td>
<td>Week</td>
<td>EV Charging Spot</td>
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<tr>
<td>KB</td>
<td>Month</td>
<td>Full Map Update</td>
</tr>
<tr>
<td></td>
<td>Year</td>
<td>Partial Update</td>
</tr>
</tbody>
</table>

- Video DL
- Audio/Game DL
- TV Re-broadcast
- Traffic Information
- Dynamic Route Guidance
- Car Monitoring
- Remote Diagnosis
- Collision Notification
- Full-parking
- ECOガイド
- Destination Set
- Movie Reserve
- Fleet Management
- Maintenance
- ETC Payment
- Safety
- Door Lock/Unlock
- SVT
- Weather
Dispersion of Communication Load

MVNO-like Dispersion

A

B

A+B

Characteristics of data
(Time • Data Size)

Can take time to download

Use hours of low usage

Bandwidth Occupancy

Car Usage

Internet Access

Small data but need to be real-time

Large Data

Access would be happened in proportion to Car usage

Small data
Summary

- Cars will be finally connected to wireless network and become a Cloud Computing Client

- HTML5 will be a “glue” which connects cars with Cloud-based services via Smartphone and pave the way for new service & business development

- It seems an obvious awareness, even for OEMs, that ICT implementation such as “Web and Automotive” requires horizontal collaborations among ICT and Automotive companies.
Thank You