Insights on V2X Telematics

*Latest developments on V2X from ITRI Taiwan*

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Industrial Technology Research Institute

Jul 29, 2014 @IRT System X
Outline

• ITRI Overview
• ITRI V2X Development and Vision
  – ITRI V2X Technology
  – Achievements
  – Standard Activities in EU and US
  – Next Step in Europe
• Concluding Remarks
Where is ITRI

France

13 hours

Korea

Japan

Taiwan

Philippines

China

Malaysia

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Where is ITRI

ITRI Headquarter
In Hsinchu

ITRI South
In Tainan
ITRI Worldwide Offices & Global Partners

USA
- ACM
- CMU
- Corning
- Deloitte Financial
- HP
- IBM
- Motorola
- Macromedia
- MIT
- Princeton U.
- Qualcomm
- Rohm and Haas
- SRI
- TI
- U. of Cincinnati
- UCB
- UCSB
- U. of Texas Austin
- Underwriters Lab

Canada
- CGW
- NRC
- ProSensus
- Semiconductor Insights

China
- Semiconductor Insights

EC Government
- ETSI

Germany
- AZO
- BASF
- Bayer
- Eyonik Degussa
- Fraunhofer
- LKH
- PTB
- R+P
- TU Darmstadt
- TU Berlin
- TUV
- UK

Netherlands
- ASML
- Holst Center
- NKI
- TNO
- To-BBB

France
- BioSystems
- CEA/LETI
- GOCAD
- OpenCASCAD

Hungary
- HAS

India
- Trident

Malaysia
- CAS
- ETRI
- KTTC
- KIER

Norway
- SINTEF

ITRI Netherlands office

ITRI Russia office
- RAS (IOFFE, ICPC, PTI...)
- MAI
- MSU

ITRI Headquarter

ITRI Western Europe office

ITRI Tokyo office
- Japan
- AIST
- Asahikasei
- IDE-JETRO
- JST
- Kyushu U.
- Keio U.
- Kyoto U.
- NTT
- NiCT
- NEC
- Nagoya U.
- Osaka U.
- RIKEN
- Sekisui Chemical
- SONY
- TEL
- Toray
- Taiyo Yuden
- Tohoku U.
- U. of Tokyo
- Waseda U.
- Zerosoft

ITRI International Inc. (USA)
- Broadcom
- Correll U.
- Dow Chemical
- DuPont
- Honeywell
- Intel
- Kodak
- Marvell
- NDT
- PSU
- Sun Microsystems
- Sarnoff
- Telcordia
- U. of California
- U. of Florida
- US Hybrid
- U. of Washington
- Wi-Fi Alliance
- Xantech

China
- Displaybank

Taiwan
- AIST
- Asahikasei
- IDE-JETRO
- I2R
- Nanyan Technology U

Australia
- CSIRO
- Prodrive

New Zealand
- IRL
- NZTDC

India
- TurboTech

Japan
- Displaybank
- ETRI
- KTTC
- KIER
- KU
- TISTR
- NSTDA
- NIMT
- GITS
- Singapore
- Glowtec
- ISE
- TISTR
- NSTDA
- NIMT
- GITS

Singapore
- Glowtec
- ISE
- TISTR
- NSTDA
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Sweden
- AIST
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- IDE-JETRO
- JST
- Kyushu U.
- Keio U.
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- NTT
- NiCT
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- SONY
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- Toray
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- Tohoku U.
- U. of Tokyo
- Waseda U.
- Zerosoft

(signed contracts within 2006-2011.06)

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ITRI at a Glance

Total Staffs: 5,813
Ph.D. : 1,379 (24%)
Master : 3,147 (54%)
Alumni : 21,937+

Start-ups
Spin-off : 71
Incubated : 154

UMC  1983

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ITRI Organization

- Advanced Technology Research
- Industrial Services
- IP Business and New Venture

Focus Centers

- Strategy & R&D Planning
- Marketing Communications
- ITRI International
- Technology Transfer
- Commercialization and Industry Service

Core Labs

- Information & Communications
  - Electronics & Optoelectronics
  - Mechanical & Systems
  - Biomedical Technology & Device
  - Display Technology
  - Computational Intelligence Technology

- Material & Chemical
- Green Energy & Environment

ITRI College

- Administration Service
- Accounting Service
- Information Service
- Human Resources

ITRI South

- Cloud Computing for Mobile Application
- Service Systems Technology
- Display Technology
- Computational Intelligence Technology

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ICL Organization

Total Employee: 751
Ph.D.: 25%
Master: 64%
ICL R&D Fields

Next Generation Communication Technologies
- Smart Antenna Technology
- LTE-A/WiFi Dual-RAT Baseband & RF
- LTE-A/WiFi Dual-RAT System Software
- Small Cell Base Station Technology
- LTE-A/WiFi Dual-RAT Access Gateway
- Test and System Integrated Verification
- Millimeter Wave Mobile Radio
- Massive MIMO and Beam Forming
- Device 2 Device Communication
- Mobile Network Virtualization

Broadband Convergence System and Integration Technologies
- Intelligent Video Cloud & Network Access
- Over the top Video Service
- Proximity-Based Application Services
- Content Aware Media Platform
- Intelligent Fiber Broadband Network
- High Efficiency Diverse Video Content Coding
- High-Speed Moving Network
- Software Defined Network

Smart Internet of Everything
- Smart Connected Home Technology
- Smart Device Market
- Video Networking and Analyzing
- Interactive Question Answering
- Wireless Access in Vehicular Environments/Dedicated Short Range Communications
- Vehicle Comm. Gateway
- Intelligent Vehicle Service Platform
- Scope Monitoring Technology
- Advanced Driving Assistance System

SOC and System Platform Design Technology
- Electronic System Level Design
- Normally-Off Computing
- New Memory Architecture
- 3D–IC Design & Test
- Analog/Mixed-Signal & RF Circuits
- Ultra Low Power/Low Voltage ICs
- Automotive Electronics
- Energy Harvesting Technologies
- Power Management ICs
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ITRI V2X Technology

ITRI is one of the few organizations in the world having complete V2X solutions, with up-to-date and robust IEEE 802.11p/1609 and ETSI TC-ITS compliant 5.9GHz DSRC devices and systems, and with experiences in product interoperability testing in US and Europe.
Taiwan’s First WAVE/DSRC Unit: With ITRI’s connected vehicle research power, IWCU is an integrated wireless communication system designed for deploying Intelligent Transportation Systems (ITS) Vehicle-to-Vehicle (V2V), Vehicle-to-Roadside (V2R) and Vehicle-to-Infrastructure (V2I), or called V2X applications and improving driving safety and convenience on the roadways.

* WAVE/DSRC: Vehicular Environments / Dedicated Short Range Communications

**Standards Compliance**
- IEEE 802.11p/1609 WAVE/DSRC Standards
- SAE J2735 Message Set Dictionary Standards
- ETSI TC-ITS European Standards

**IWCU Roadmap**

- **2009**
  - Support IEEE 802.11p & IEEE1609
  - Provide SDK tools
  - Operating temperature range of -40°C to 85°C

- **2010**
  - Support IEEE 802.11p & IEEE1609
  - Support 3G/3.5G
  - Support WiFi intravehicle comm.
  - Support CAN bus 2.0
  - Provide SDK tools
  - Operating temperature range of -40°C to 85°C

- **2011**
  - Downsize with various usesages
  - PCMCIA Type II Card bus
  - Support Linux / Windows XP
  - Support Wireshark packet analyzer

- **2012**
  - Dimension: 20cm x 12cm x 3cm
  - Designed for USDOT Safety Pilot Program
  - Support IEEE 802.11p/1609 and ETSI TS 102 spec.
  - Support 5G/3.5G
  - Support WiFi intravehicle comm.
  - Support CAN bus 2.0
  - Provide SDK tools
  - Operating temperature range of -40°C to 85°C

- **2013**
  - Dimension: 9.3cm x 7.4cm x 2.8cm
  - Support IEEE 802.11p/1609 and ETSI TS 102 spec.
  - Provide SDK tools
  - Operating temperature range of -40°C to 85°C
  - Designed for flexible V2X application deployment

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ITRI WAVE/DSRC V&V and Trial Technology R&D

Center for Telematics Technology (CTT): ITRI built the Taiwan’s first WAVE/DSRC testing facility that provides integrated indoor verification & validation and outdoor field trial environment for flexibly and dynamically creating test scenarios on roads. See video
V2V Applications for Personal Mobility

Needs & Goals
- Group talking services are expected to assist the drivers in enhancing the efficiency and convenience of driving
- ITRI applies IEEE 802.11p/1609 WAVE/DSRC technology to develop a Vehicle Group Communication System
- All members in a group are allowed to talk freely to each other during their trip using DSRC V2V communication

Features
- Full-duplex communication
- Simultaneous conversation among all group members
- Integrated user interface
- Display and track locations of all nearby group members

Benefits
- Talk freely without extra fee
- Share location, direction, track among all group members
- Report member’s status (e.g. missing, wrong way) to leader
- Call for help ability

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V2R Applications for Public Mobility

WAVE/DSRC-based Transit Signal Priority System

WAVE/DSRC-based Weigh-In-Motion System

WAVE/DSRC-based Signal Phase & Timing System Solution
WAVE/DSRC-based Transit Signal Priority System Solution

- A demand in the use of transit signal priority to increase transit ridership and reduce traffic congestion
- Use of the WAVE/DSRC communication technology to control traffic signals to improve travel times at intersections
- Design real-time control logics dedicated to bus priority that manages green signal extensions and early green recalls
- Compatible with current traffic signal controller

One-way Vehicle-to-Roadside transmission

See video

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WAVE/DSRC-based Weigh-In-Motion System Solution

System Operation on Freeway No.3, Taiwan
- Collaborated with National Freeway Bureau (MOTC, Taiwan) and Taiwan large logistics companies including the HCT Logistics and CPC (the Tao-Yuan Division)
- The second WAVE/DSRC-based WIM system test site in the world

Features
- Bidirectional HMI without causing driver distraction
- Extensible for future V2I application/service and fleet management
- Simplify the inspection process for the police

See video
DSRC-based Signal Phase & Timing System Solution

Need & Goal
- A growing need for integration system of traffic signal indication control and driver notification
- To achieve a real intelligence traffic management system
- To provide a simple and clear view of traffic signal indication
- Real time transmission, no latency
- To comply with International standards

Features
- One-way Roadside-to-Vehicle transmission
- Fully comply with IEEE 1609
- Comply with SAE J2735
- Easy to traffic system integration
- Enable to log all incoming messages

Benefits
- Improve road safety and traffic management efficiency
- Reduce the driver’s response time
- Easy to inter-operate with other traffic device

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V2I Applications for Commercial Mobility

ITRI Telematics Solution for Commercial Fleet comprises Smart Vehicle Information Gateway (SVIG) and ITRI Telematics Service Platform (iTSP). SVIG is a safety and eco-driving telematics unit that performs the functions of tracking and automatic alarm. With GPS and multi-sensor technologies, SVIG is able to report vehicle dynamics to iTSP, while iTSP is capable of invoking a command to SVIG. In this solution, fleet service provider is allowed to online monitor driver behaviors, to real time locate vehicle position coordinates and to remotely diagnoses vehicles. Not only safety monitoring, but also infotainment services can be provided from this solution for transportation and rental fleets.
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ITRI has been participated in the USDOT Connected Vehicle Research since 2010

- 2010/4: CAMP VSC3 V2V-Interoperability
- 2010/7: Here I Am (HIA) Devices
- 2011/1: Caltrans Augmented Speed Enforcement
- 2011/4: Road Side Equipment (RSE) Devices
- 2011/4: Enabling Accelerated Installation of Aftermarket On-Board Equipment for Connected Vehicles
- 2011/7: HIA for the Test Bed
- 2012/3: SAIC - Safety Pilot Stage 1 RSE Deployment
- 2013/5: SAIC – Listener Aftermarket Safety Device Phase 1
- 2013/11: SAIC - Safety Pilot Stage 2 RSE Deployment
- 2013/12: Leidos - Listener Aftermarket Safety Device Phase 2

ITRI’s Participation in the USDOT Safety Pilot Exhibition at 2011 ITS World Congress
IWCU Solution for U.S. DOT Connected Vehicle

ITRI’s roadside equipment (RSE) Entered USDOT Research Qualified Product List in 2012

ITRI’s Onboard equipment (OBE) is Selected by USDOT IntelliDrive Program in 2010
Activities in Europe

- ITRI is experienced in European V2X projects
  - SCORE@F is the largest French field operational test for improving traffic flow and traffic safety in Europe
  - 2010/09/01-2013/03/31, €5.6 Million
  - Led by Renault with 19 partners
  - ITRI joined the project via INRIA by providing the IEEE 802.11p radio solution as well as the corresponding driver software to help boost the progress of the project

- We are looking for further partnership and cooperation in Europe
ITRI Technology Promotion with Europe

- ITRI Hosted European Satellite Navigation Competition (ESNC) in Taiwan

- EU increase ITRI Galileo Pro Prize
- ITRI host and organized connected vehicles prototyping competition

- ITRI created a new competition Theme “Smart Moving” in Regional Challenge
- ITRI launched new prototyping competition (Galileo Pro)

- ITRI won the Switzerland region championship
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Participation in International Standard Activities

- IEEE 802.11p/1609 standards activities (2008~)
  - Comments accepted in P1609.1/.2/.3/.4/.6

- IEEE 802.11ai/aq standards activities (2012~)

- ETSI TC-ITS standard activities (2010~)
  - Comments accepted in WG1/ WG3/ WG5
  - WG1 WI Rapporteur: Facilities Layer Communication Congestion Control (Dr. An-Kai Jeng)
  - WG5 Vice-Chair: Dr. Huei-Ru Tseng
IEEE P1609 Standard Activities

- WAVE/DSRC protocol stack
<table>
<thead>
<tr>
<th>Standard No.</th>
<th>Title</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE 802.11p</td>
<td>WAVE Amendment</td>
<td>Published (2010/07)</td>
</tr>
<tr>
<td>IEEE 1609.0</td>
<td>Architecture</td>
<td>Published (2013/12)</td>
</tr>
<tr>
<td>IEEE 1609.1</td>
<td>Resource Manager</td>
<td>Scope Change to IEEE 1609.6</td>
</tr>
<tr>
<td>IEEE 1609.2</td>
<td>Security Services</td>
<td>Published (2013/04)</td>
</tr>
<tr>
<td>IEEE 1609.3</td>
<td>Networking Services</td>
<td>Published (2010/12), Cor 2-2014</td>
</tr>
<tr>
<td>IEEE 1609.4</td>
<td>Multi-Channel Operation</td>
<td>Published (2011/02), Cor 1-2014</td>
</tr>
<tr>
<td>IEEE 1609.5</td>
<td>Communication Manager</td>
<td>Deferred</td>
</tr>
<tr>
<td>IEEE 1609.6</td>
<td>Remote Management Services</td>
<td>On-going (plan for approval in 2015)</td>
</tr>
<tr>
<td>IEEE 1609.11</td>
<td>Over-the-Air Electronic Funds Collection</td>
<td>Published (2011/01)</td>
</tr>
<tr>
<td>IEEE 1609.12</td>
<td>Identifier Allocation</td>
<td>Published (2012/08)</td>
</tr>
</tbody>
</table>
Participation in U.S. DOT WAVE/DSRC equipment tests since 2012

• Research Qualified Product List (rQPL) since 2012
  – Allow to supply equipment for the connected vehicle Safety Pilot Model Deployment and other Test Bed Installations
    • 2012: ITRI’s RSE passed all tests (194 tests)
    • 2013: ITRI’s VAD/ASD passed 91.5% Tests (217 tests)

• PlugFest June 2014, Palo Alto
  – USDOT goals to transition connected vehicle technology research toward full deployment
  – Devices are tested for interoperability with emerging standards
    – ITRI passed SPaT/MAP, CSW, IPv6 Gateway, VSD (Vehicle Situation Data) Messages
# ETSI TC-ITS Standard Activities

## ETSI TC-ITS WG

<table>
<thead>
<tr>
<th>ETSI TC-ITS</th>
<th>Chairman</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC-ITS</td>
<td>Niels Peter Skov Andersen (Anemone Technology, DK)</td>
</tr>
<tr>
<td>WG1: Application &amp; Facilities Layer</td>
<td>Lan Lin (Hitachi Europe Ltd., FR)</td>
</tr>
<tr>
<td>WG2: Management Layer</td>
<td>Knut Evensen (Q-Free ASA, NO)</td>
</tr>
<tr>
<td>WG3: Network &amp; Transport Layer</td>
<td>Andreas Festag (NEC Europe Ltd, DE)</td>
</tr>
<tr>
<td>WG4: Access Layer</td>
<td>Christoph Woeste (BMWi, DE)</td>
</tr>
<tr>
<td>WG5: Security Layer</td>
<td>Brigitte Lonc (Renault SAS, FR)</td>
</tr>
</tbody>
</table>
ETSI TC-ITS Standard Activities

• **TS 103 141 Facilities Layer Communication Congestion Control**
  - Draft updated by ITRI with functional blocks architecture
  - Compatible with existing DCC specifications of other layers
  - Ongoing work of coordinating with STF 469

• **TR 102 893 Threat, Vulnerability and Risk Analysis (TVRA) Revision**
  - Contributed by ITRI to improve the revocation process, and clarify the procedure after detecting misbehaving ITS-S
Participation in European ITS-G5 equipment interoperability tests since 2011

- **ITRI passed all mandatory tests**

### Event Date & Location

<table>
<thead>
<tr>
<th>Event Date &amp; Location</th>
<th>Companies</th>
<th>Test Scopes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Plugtests Nov. 11-18, 2011 Helmond, Netherlands (Hosted by TNO)</td>
<td>Siemens, Hitachi, Denso, CohdaWireless, NEC, PEEK, VTT, Honda, Free, Quwic, CTAG, Nordsys</td>
<td>GN, CAM, DENM</td>
</tr>
<tr>
<td>2nd Plugtests Jun. 11-15, 2012 Versailles, France (Hosted by IFSTTAR)</td>
<td>Siemens, Hitachi, TNO, Denso, CohdaWireless, NEC, Quwic, INRIA</td>
<td>GN, BTP, CAM, DENM,</td>
</tr>
<tr>
<td>3rd Plugtests Nov. 25-29, 2013 Essen, Germany (Hosted by Cetecom)</td>
<td>NExT, Autotalks, Unex, NEC, Qmic, Hitachi, Siemens, CohdaWireless, NEC, Nordsys, Vector, Kapsch, Fraunhofer LSK, Commsignia, Morfen Products</td>
<td>GN, BTP, CAM, DENM, GN Security</td>
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Participation in Horizon 2020

- Contribute ITRI V2X solutions to join European ITS development
The 7th ETSI TC ITS Workshop

- The workshop focuses on Cooperative ITS and Standards, how standards match the ITS deployment activities, testing and certification as well as future aspects for standardization
- ITRI expressed willingness to host the next (7th) ETSI ITS Workshop nearby ITRI Netherlands Office
  - ETSI members accepted our proposal to host the workshop in ETSI TC-ITS #14 Meeting on April 10, 2014

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Host</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-6 Feb 2009</td>
<td>Sophia Antipolis, France</td>
<td>ETSI</td>
</tr>
<tr>
<td>10-12 Feb 2010</td>
<td>Sophia Antipolis, France</td>
<td>ETSI</td>
</tr>
<tr>
<td>9-11 Feb 2011</td>
<td>Venice, Italy</td>
<td>Telecom Italia</td>
</tr>
<tr>
<td>7-9 Feb 2012</td>
<td>Doha, Qatar</td>
<td>QUWIC</td>
</tr>
<tr>
<td>05-06 Feb 2013</td>
<td>Vienna, Austria</td>
<td>Austria Tech, ASFINAG, Kapsch TrafficCom</td>
</tr>
<tr>
<td>12-13 Feb 2014</td>
<td>Berlin, Germany</td>
<td>ETSI</td>
</tr>
<tr>
<td>25-27 Mar 2015</td>
<td>Helmond (Automotive Campus), the Netherlands</td>
<td>ITRI</td>
</tr>
</tbody>
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Concluding Remarks

✓ ITRI provides complete V2X solutions for foreseeable needs of future connected vehicles market

✓ ITRI is looking for further partnership and cooperation in Europe
  – Provide V2X technology to boost European ITS development and accelerate European ICT innovation

✓ ITRI is ambitious to realize the next generation ITS and ICT development in Europe, enhancing new technology, services and business opportunities

✓ Welcome to the 7th ETSI TC ITS Workshop at the Netherlands Automotive Campus!