Kapsch V2X Overview

Steve Sprouffske
V2X 5.9 Landscape
Expanding information flow

- A truly connected vehicle is being realized
- 5.9 GHz DSRC, LTE/cellular, and even 915MHz all provide a mechanism for getting information to the driver and road operator
- Each technology decision has advantages and disadvantages
  - Where does the cost reside?
  - Connectivity options
  - Bandwidth
  - Ability to integrate with other technologies
- Technology selection should provide a solution that meets the needs of the end-user
What is V2X?

- V2X is the combination of services utilizing bi-directional communications between vehicles and the roadside.

- Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication are the core communication paths utilized within the connected vehicle environment.

- Safety and mobility services fall into one of these categories.

- V2V focuses on those services which provide safety of life and property between vehicles. **V2V extends the safety envelope around the vehicle.**

- V2I focuses on those services which utilize roadside infrastructure to provide not only safety services but also mobility improvement services.
V2V Safety

- Forward Collision Warning
- Blind spot Detection
- Emergency Brake Light
- Lane Change Warning
- Do Not Pass Warning
- Other Safety Applications

Source: U.S. DOT
V2I Safety

- Intersection Safety
- Run-off Road Prevention
- Smart Roadside
- USDOT Truck Parking Programs
  - SmartPark
- Automated Enforcement
- Wireless Roadside Assessment
- Curve Speed Warning
- Other Safety Applications
US Department of Transportation Program

- Defined V2V Apps
- Application Development (Safety Pilot)
- Pilots/Early Deployment
- 2011
- 2012
- 2013
- 2014
- 2015

- Defined V2I Safety Apps, Mobility
- V2V/V2I Apps, AERIS apps
- NHTSA Decision
  - Light Vehicles
- NHTSA Decision
  - Heavy Vehicles
- FHWA Deployment Guidelines
V2X European Research Projects.

**Cooperative Vehicle Infrastructure Systems**
SPs COMM, FOAM; 2006 - 10

**REALSAFE**
ftw*, ASFINAG, KTC, UT Vienna**, nast consult; 2008 - 09

**ROADSAFE**
ftw*, ASFINAG, KTC, TU Vienna**, fluidtime; 2010 – 11

**ITS Evolution**
ftw*, ASFINAG, KTC, TU Vienna**, 2012 - 2013

**Christian Doppler Lab**
TU Vienna**, 2008 – ongoing, 802.11p MIMO Testbed

**Chalmers Antenna Systems VINN Excellence centre**
Chalmers University of Technology, 2007 – ongoing
Volvo Cars, Ericsson
Kapsch Contribution: Conformal Antenna Design

**Enabling Technologies for Transport Efficiencies**
SP, Volvo Cars, Volvo Trucks, Actia, 2011-ongoing
Kapsch Contribution: 5.9 Radio node
Why 5.9 GHZ DSRC?

- Adaptable to medium and short range communication zones provide the best of both worlds:
  - Communication range up to over 3000 ft.
  - Large bandwidth as compared to existing technology
  - Data transfer at high mainline speeds
  - Exact Lane-Level Localization at the transaction point
  - Enables correlation with other roadside sensors

- Multiple security options and methods

- Multiple applications support

- Multi-service enforcement
  - Fixed and mobile enforcement

- Open standards
  - Multiple vendors
  - Vendor interoperability
  - Standardized by IEEE as “WAVE”: IEEE 802.11 & IEEE1609.x; ETSI as G5
The V2X Architecture
Kapsch 5.9 V2X in the USA

- E-470 5.9 GHz Test Site (Denver)
- USDOT Test beds Ann Arbor Safety Pilot, DTE, Telegraph Rd. SPAT corridor MI, I94 Truck Parking
- ITS World Congress (New York City), CVO Test bed (Long Island, Schodack)
- Kapsch (Virginia)
- CVII Test bed (Greensboro)
- ITS World Congress 2011, Florida Corridor
- Auburn University 5.9Ghz test bed
- Lee County Tollway
- Hood River Bridge Tollway
- Connected Traveler & SafeTrip 21 (SF – Bay Area)
CVO Specific Services

- Driver Identification
- Vehicle Health
- EOBR
- Dynamic Routing
- E-Permitting
- Truck Parking
Wireless Roadside Assessment Solution

- Multiple service offering from single location
- Integrate safety, mobility and solutions
- Benefit entire commercial vehicle value chain (carrier, states, enforcement)
- Solution flexible to support weigh station, port ops, border etc
Vehicle Health Information Model

- Acquired from multiple sources
  - GPS
  - Driver
  - CANbus
- Position
- Driver Data
  - Commercial Vehicle Drivers License Number
  - Commercial Vehicle Drivers License Issuing State
  - Commercial Vehicle Drivers License Expiration Date
  - Class (A, B, C)
  - Name
  - Address
  - Birthdate
- Tractor Information:
  - VIN
  - Tire Information (Pressure, Temperature) per tire
  - Brake Status (ABS, Stroke, Remaining Lining) per axle
  - Lighting Status
- Trailer Information per trailer:
  - VIN
  - Position Behind Tractor
  - Tire Information (Pressure, Temperature) per tire
  - Brake Stroke Status per axle
  - Lighting Status
I94 Truck Parking Project

- Safety service to carriers
- Minimizes hazardous roadside parking
- Pilot project through USDOT/FHWA pending
- Partners include FHWA, HNTB, Delcan, ParkingCarma
HELP Inc CVO Pilot status

- 5 stations installed and functioning
- 3,250+ truck passes since initialization
  - Compiling transaction statistics
- Working through OBU installation and operation issues with carriers
- Vehicle health data ready for truck integration and initial testing
In-vehicle component

- Simplistic NFC-like Programming
- Convenient NFC-like card
  - Stores Driver Data
- Secure NFC data transfer to OBU
- 5.9 GHz DSRC transponder
Thank you for your attention!

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V2X Use Cases
## 5.9 Applications – Demonstrated applications at ITS WC2012

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<th>Application</th>
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<td>Decentralized floating car data</td>
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<td>Hazardous location notification</td>
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<td>Traffic information and recommended itinerary</td>
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<td>Weather warning</td>
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<td>Travel times, status and on route update</td>
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<td>Information on flight delays</td>
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<td>Park and ride information</td>
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<td>SPaT</td>
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<td>Green light optimal speed advisory</td>
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<td>Emergency prioritisation</td>
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</tbody>
</table>
In-vehicle signage

- Informing drivers about current road signs as they travel, both static and dynamic

- The shown messages will comprise:
  - all possible variable message signs (VMS) messages
  - the most important signs used in urban traffic (e.g. speed limit)
  - additional pictograms
  - Predefined text messages (source: Asfinag)

- Option: virtual VMS option

- VMS messages can also be shown on locations where no VMS are present
Hazardous location notification

- Warning drivers from upcoming hazards as broke down vehicles, oil on the road, wrong-way driver, or lost goods.

- The warning is sent from the traffic management centre to the roadside units to give warnings to drivers.

- Hazardous location information may be recognised via various sensors, traffic information organizations (e.g. ORF Ö-drivers) and XFCD information from travelling vehicles.
Road works warning

- Informing drivers of road works and associated obstruction (e.g. reduced speed limits, closed lanes, deviated lanes, and extended travel times) on the route ahead.

- Increasing awareness and informing of potential dangerous conditions. The driver receives information on distance to the road works and any speed limits, detours, and so forth.

- Sensors are detecting traffic conditions within the roadwork area. Those are sent to the RSUs and the TMC. The VMS on the trailer will inform the driver approaching the road segment.
Weather warning

- Weather warning messages are issued if weather changes are expected with influence on traffic safety.
- Weather data is sent from traffic management centre and made available through the roadside units to the drivers.
- Drivers are prepared for any changes in order for taking necessary actions in time, such as reducing speed, increasing distance to the vehicle in front, closing the sun roof, and so forth.
Signal Phase and Timing - SPaT

- The Signal Phase and Timing (SPAT) message is used to communicate the current status of one or more signalized intersections.
- The SPAT message sends the current movement state of each active phase in the system as needed (values of what lights are active and values of for what durations the light is expected to continue).
- The current signal preemption and priority status values (when present or active) are also sent.
Green light optimum speed advisory

- Drivers receive a recommendation in order to hit the next traffic lights in green phase and to avoid waste acceleration.
Emergency Prioritization

- Drivers of emergency car gets free path at intersection and allowance to use different track for passing
More Applications

- Cooperative Intersection Collision Avoidance System – Violations
  - Intersection collision warning systems are designed to detect and warn drivers of approaching traffic at high-speed intersections. The vehicle device senses its speed, acceleration and deceleration (including breaking) and the vehicle position, determine the approach on a correct lane and combine it with received traffic signal position and status (SPaT), timing, and if available weather conditions and create corresponding indications and warnings to be indicated on the driver-vehicle interface (visual indications, audio alerts).

- Curve Speed Warning
  - Curve speed warning systems use roadside detectors and electronic warning signs to warn drivers, typically those in commercial trucks and other heavy vehicles, of potentially dangerous speeds in approach to curves.
  - The device receives this messages, extract relevant content and creates corresponding information (e.g. curve information, pre-warning, over-speed warning).
Our 5.9 Product Portfolio

Kapsch TrafficCom 5.9 Products

Roadside products

MTX/TRX-9450

In-vehicle products

TS3306
# Road-side Solution

<table>
<thead>
<tr>
<th>Product name</th>
<th>MTX/TRX-9450-E</th>
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<tr>
<td>Description</td>
<td>Transceiver platform for CVO, Tolling e.g. HOT, ORT/MLFF, Tolling (Single Lane) and V2I ITS and Safety applications Listed on the USDOT RSE rQPL</td>
</tr>
<tr>
<td>Special features</td>
<td>Precise localisation, stand-alone operation, dual Ethernet, internal or external antennas selectable, built-in GPS RX, IEEE 802.11p, IEEE 1609 compliant</td>
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</table>
## TS3306 5.9 GHz ITS On Board Unit

### Key Features
- Compatible with IEEE 802.11p, IEEE 1609.x and SAE J2735
- Compatible to current specifications of DSRC WAVE
- Listed on USDOT Aftermarket Safety Device QPL
- Supports IEEE 1609.2 based security for signing and verification
- Optional external antenna connector for WAVE
- Bluetooth interface to smart phone, tablet or laptop.
- Built-in GPS receiver

### Characteristics
- Single PCB design with integrated 5.9 WAVE/ITS G5, GNSS and Bluetooth solutions. No internal connectors.
- Operational temperature range: -40°C to +85°C
- Internal re-chargeable battery tested up to +105°C.
- Output power: +14 dBm
- Receiver Sensitivity: -90 dBm (6 Mbps)

### Target Applications
- Commercial Vehicle Inspection
- Electronic Payment and Access Control
- Transit Signal Priority
- Traveler Information
- Signal Phase and Timing
- USDOT Safety Pilot applications
- CAM/DENM

### References
- HELP Inc CVO Pilot
- US DOT Schodack
- FTE / Sun Pass
- US DOT Safety Pilot
- Testfeld Telematik / ITS WC 2012