The Car-2-Car Communication Consortium
Roadmaps beyond Day-1
The Car-2-Car Communication Consortium (C2C-CC)

### Vehicle Manufacturers
- Audi
- BMW Group
- Daimler
- Ford
- Honda
- Hyundai
- Jaguar
- Land Rover
- KTM
- MAN
- Opel
- PSA Peugeot Citroën
- Renault
- Volkswagen
- Volvo

### Suppliers
- Atmel
- Autotalks
- Bosch
- Certicom
- Cohda Wireless
- Commsignia
- Continental
- Delphi
- Denso
- DSPace
- Hitachi
- IAV
- KEW
- LG
- MARBEN
- NEC
- NXP
- Nordsys
- Renesas
- Rohde & Schwarz
- Security Innovation
- Siemens
- Spirent
- Swarco
- Tass Interations
- TE Connectivity
- Ublux
- Vector
- Visteon
- Pauls
- Kapsch
C2C-CC – V2X Technology

Communication via WLANp (enhancement of the 802.11 standard) in a reserved frequency band at 5.9 GHz (EU and USA)

- At Day-1 vehicles broadcast periodic awareness information (heart-beats), e.g. their position, speed, acceleration.
  - EU: Cooperative Awareness Message, CAM
  - USA: Basic Safety Message 1 (BSM.1)

- At Day-1 vehicles also broadcast situation-based information when an emergency situation is detected, e.g. an accident or if an emergency vehicle is in action.
  - EU: Decentralized Environmental Notification Message, DENM
  - USA: Safety Extensions of BSM.1 + BSM.2
C2C-CC – Where are we today?

- Day-1 specifications are ready
- Compliance Assessment requirements defined
- Testing - Cooperative ITS Corridor in Europe
- Working on Day-2-3-4 specifications
C2C-CC – Guiding principles for V2X roadmaps

- Focus on information exchange (between traffic participants)
- Cooperate on providing information
  - Provide clearly defined information (standards)
  - Use commonly agreed air-interfaces (WLANp)
  - Focus on localized dissemination patterns (geo-areas)
  - The information provided has to build “on top of each other”

- Compete in capitalizing on the information (applications)
  - Each traffic participant can (freely) use the received information
  - Automatic driving functions are enhanced
V2X Roadmaps – Applications

Take-over of the driving functions

- Fully Automated Driving
- Optimal Traffic Flow

Status Data
- Intersection Collision W
- Emergency Vehicle W
- Dangerous Situation W
- Stationary Vehicle W
- Traffic-Jam W
- Pre-/Post-Crash W
- Hazardous Location W
- Adverse Weather W

Sensor Data
- GLOSA 1.0
- In-Vehicle Information
- Roadworks W 2.0
- Connected ACC
- Overtaking W
- VRU Warning 1.0
- ...

Intention Data
- GLOSA 2.0
- Roadworks Assistance
- Lane-Merge Assistance
- Area Reservation
- Cooperative ACC
- VRU Warning 2.0
- Platooning
- ...

Coordination Data
- Cooperative Merging
- Overtaking Assistance
- Intersection Assistance
- Dynamic Platooning
- VRU Assistance
- ...

Automation Level

Phase 1 Awareness Driving
Phase 2 Sensing Driving
Phase 3 Cooperative Driving
Phase 4 Synchronized Cooperative Driving
Phase 5 Accident-free Driving

Dissemination
Cooperation

100% installation of new vehicle sales
100% installation of new vehicle platforms
10 year ramp-up to 100% installation of new vehicles
Installation on select new vehicle type of luxury and upper middle class vehicles

07.03.2016
V2X Roadmaps – Applications

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Phase 2
Sensing Driving

Phase 3
Cooperative Driving

Phase 4
Synchronized Cooperative Driving

Phase 5
Accident-free Driving

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- VRU Assistance
- ...

07.03.2016
Day 1

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Phase 1 Status Data

position, speed, events, …
Phase 1 Status Data

Phase 2 Sensor Data

+ position, speed, events, ...

objects, field-of-view, ...

Day 2

07.03.2016
V2X Roadmaps – Applications

- **Take-over of the driving functions**
  - Fully Automated Driving
  - Optimal Traffic Flow

- **Intention Data**
  - GLOSA 2.0
  - Roadworks Assistance
  - Lane-Merge Assistance
  - Area Reservation
  - Cooperative ACC
  - VRU Warning 2.0
  - Platooning

- **Coordination Data**
  - Cooperative Merging
  - Overtaking Assistance
  - Intersection Assistance
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  - VRU Assistance

- **Sensor Data**
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  - In-Vehicle Information
  - Roadworks W 2.0
  - Connected ACC
  - Overtaking W
  - VRU Warning 1.0
  - Platooning

- **Status Data**
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  - Adverse Weather W

- **Automation Level**
  - Phase 1: Awareness Driving
  - Phase 2: Sensing Driving
  - Phase 3: Cooperative Driving
  - Phase 4: Synchronized Cooperative Driving
  - Phase 5: Accident-free Driving

- **Dissemination**
  - Cooperation

- **Coordination Data**
  - Cooperative Merging
  - Overtaking Assistance
  - Intersection Assistance
  - Dynamic Platooning
  - VRU Assistance

- **Phase 1**
  - Awareness Driving

- **Phase 2**
  - Sensing Driving

- **Phase 3**
  - Cooperative Driving

- **Phase 4**
  - Synchronized Cooperative Driving

- **Phase 5**
  - Accident-free Driving

- **100% installation of new vehicle sales**
- **100% installation of new vehicle platforms**
- **10 year ramp-up to 100% installation of new vehicles**
- **Installation on select new vehicle type of luxury and upper-middle class vehicles**

07.03.2016
Day 3

Phase 1
Status Data

Phase 2
Sensor Data

Phase 3
Intention Data

+ position, speed, events, ...

+ objects, field-of-view, ...

+ intentions, trajectories
<table>
<thead>
<tr>
<th>Phase 1 Status Data</th>
<th>07.03.2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 2 Sensor Data</td>
<td></td>
</tr>
<tr>
<td>Phase 3 Intention Data</td>
<td>synchronized trajectories</td>
</tr>
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</tbody>
</table>
V2X Roadmaps – Technology

 Phase 1

 - CAM
 - CAMv2
 - Day1 CC
 - dual-channel CC
 - switched-mode

 Phase 2

 - Data Streaming
 - Advanced FWD
 - GN-Groupcast
 - GN-GBC
 - GN6
 - GN/BTP + QoS
 - GN-Unicast
 - multi-channel CC

 Phase 3

 - Segmentation/Reassembly
 - Symmetric Crypto.
 - Sec-Maintainability
 - PC-change rules
 - Day-1 PKI
 - security

 Phase 4

 - Automatic-driving Messages
 - I2V Coop. Messages
 - Intention Msg.
 - Platoon Control Msg.
 - Platoon Management Msg.
 - Electronic Horizon Msg.
 - IVI-Platoon Extensions
 - SAM
 - CAMv2
 - CAM
 - DenM
 - Electronic Horizon
 - Day1 PKI

 Channel Management
 Networking
 Security
 Dissemination
 Automation Level
 Cooperation

 Release / time

 07.03.2016
V2X Roadmaps – What should we also consider?

- until now the focus was set on V2X safety-related applications,

- What other applications, information should we consider around the Smart-Cities concepts? What are the needs?
Thank You!
Questions?
Intersection Collision Warning / VRU Warning