Smart Mobility Consortium & Vehicle-to-Everything (V2X)

Enabling Technology for Safe & Smart Mobility

Peter Lam
Managing Director
Engineering, HKT

15 March 2017
Cellular Vehicle-to-Everything (C-V2X)

- **V2V**: Vehicle to Vehicle
- **V2P**: Vehicle to Pedestrian
- **V2I**: Vehicle to Infrastructure
- **V2N**: Vehicle to Network

C-V2X uses wireless connectivity to enable connected vehicles to achieve “Cooperative Awareness” for the realization of “Basic Set of ITS Applications” as defined by ETSI.

ETSJ Basic Set of ITS Applications

- **(32 Use Cases)**
  - Driving Assistance – Road Hazard Warning (13)
  - Driving Assistance – Co-operative Awareness (4)
  - Co-operative Navigation (4)
  - Location Based Services (4)
  - Communities Services (3)
  - ITS Station Life Cycle Management (2)
  - Safety Related Uses Cases

23 Safety Related Uses Cases
C-V2X Use Case Examples

Forward collision warning

Queue warning

Vulnerable Road User (VRU) alerts

Do Not Pass Warning (DNPW)

Curve speed warning

Discover parking and charging

Traffic signal priority and optimal speed advisory

Emergency vehicle alert

Use cases are based on ETSI ITS Basic Set of Applications
## Why Do We Need C-V2X

<table>
<thead>
<tr>
<th>Vehicle Resident (Standalone)</th>
<th>C-V2X (Connected)</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Uses on-board sensors to &quot;see&quot; the environments from the vehicle's perspective only</td>
<td>➢ Uses information provided by: 1) surrounding vehicles 2) road-side equipment to establish knowledge about the environment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No</th>
<th>&quot;see&quot; around corners</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>&quot;see&quot; through other vehicles</td>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
<td>predict the path of surrounding vehicles</td>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
<td>resilience to weather conditions, poor lighting or sensor cleanliness</td>
<td>Yes</td>
</tr>
<tr>
<td>Shorter</td>
<td>effective range</td>
<td>Longer</td>
</tr>
<tr>
<td>Shorter</td>
<td>reaction time allowed for the driver</td>
<td>Longer</td>
</tr>
<tr>
<td>Limited</td>
<td>information richness to support future capabilities (e.g autonomous driving)</td>
<td>Yes</td>
</tr>
</tbody>
</table>

C-V2X brings “Cooperative Awareness” to compliment and enhance vehicle resident solutions
Cellular Vehicle-to-Everything (C-V2X)

- C-V2X is designed based on 3GPP release 14 specification, and with clear evolution path towards 5G
- C-V2X operates over both:
  - network-based communications on commercial cellular network, and
  - direct communications over the 5.9GHz band.

Notes:
RSU: Road Side Unit
VRU: Vulnerable Road User
Key Successful Factors for Smart Mobility in Hong Kong

3 essential components for enabling Smart Mobility in Hong Kong

- Spectrum
  5.9GHz

- Technology
  Vehicle To Everything (V2X)

- Street Furniture
  Road Side Infrastructure / Unit (RSU)
### Spectrum Aspects

#### Wide Area Coverage (V2N / V2I)

- 900MHz
- 1800MHz
- 1900MHz
- 2600MHz

**Supported by existing and future allocations**

#### Short Range Transmission (V2V / V2P)

<table>
<thead>
<tr>
<th>Region</th>
<th>Spectrum Allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>20MHz</td>
</tr>
<tr>
<td>US</td>
<td>75MHz</td>
</tr>
<tr>
<td>EU</td>
<td>20MHz 30MHz 20MHz</td>
</tr>
<tr>
<td>Japan (*)</td>
<td>80MHz</td>
</tr>
<tr>
<td>HK</td>
<td></td>
</tr>
</tbody>
</table>

**(*) Japan also allocated 755.5-764.5MHz as V2X safety spectrum, making Japan an isolated case.**

**(#) Allocated for trail and testing purpose, valid till end 2017**

### Need for dedicated range in 5.9GHz for C-V2X Implementation

- **Dedicated Spectrum in 5.9GHz for ITS, HK needs a harmonized assignment to align globally**
**Road Side Infrastructure**

- **Road Side Units (RSU)** are radio base-stations installed at “road sides” that allows communications between vehicles (V2I – I2V) within a localized area.

- It is particular useful in V2V use cases under non-line of sight scenario (e.g. collision warning at junctions) with RSU installed at street level on road furniture such as lamp pole and traffic light pole.

Government needs to facilitate and enable the opening up of street furniture for RSU implementation.
Critical Success Factor: Government Lead and Participation

- The Government to commit the “Road Safety” to the level of policy objective in Smart Mobility

- Devise target for realization or adaption, such as:
  - For Government / Roadside projects, mandate the use of C-V2X capability with progressive target
  - Then extend to public vehicles (e.g. Buses, Public Light Buses, Taxi and etc)
  - Mandate the newly register vehicles to equip with C-V2X capability by a certain target
  - Encourage the adaption of C-V2X capability in existing vehicles through incentives (e.g. license fee, lower insurance rate) with a progressive target for mandatory full adaption

- Facilitates and enables the implementation of C-V2X, including:
  - Allocation of dedicated spectrum range for C-V2X ITS application
  - Enables the opening up of road side furniture for the implementation of Road Side Units (RSU)
  - Enables field pilot before full scale adoption

- Develop operation model of C-V2X, such as:
  - Appointment of agencies / operators to operate the C-V2X infrastructure / services

Government's lead and participation is of critical importance to make C-V2X a success