PIARC Task Forces B1 & B2
Connected and Automated vehicles: challenges and opportunities for road operators

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Agenda

1. What is PIARC?
2. TF B.1’s Mission and Objectives
3. Input Data & analysis
4. Opportunities & Challenges
5. TF B.2’s at a Glance
6. Conclusion
PIARC ?
The Association

• Stands for “Permanent International Association of Road Congresses”
• The World Road Association-PIARC, is a non-political, non-profit association established in 1909
• It brings together the road administrations of 122 governments
• Mission to promote international cooperation on issues related to roads and road transportation
• www.piarc.org
2016 to 2019 cycle

• World Congress each 4 years

- Montréal 1995
- Durban 1999
- Kuala Lumpur 2003
- Paris 2007
- Mexico 2011
- Seoul 2015
- Abu Dhabi 2019

• Strategic plan with 5 focus areas
  A - Management and finance
  B - Access and mobility
  C - Safety
  D - Infrastructure
  E - Climate Change, Environment and Disasters

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Focus area B – Access and mobility

• B.1 Road Network Operations / ITS
• B.2 Winter services
• B.3 Sustainable multimodality in urban areas
• B.4 Freight
• TF B.1 - Connected vehicles: Challenges and opportunities for road operators
• TF B.2 – Automated vehicles: Challenges and opportunities for road operators
Task Force B.1
Connected vehicles: challenges and opportunities for road operators
Composition

- 29 Experts covering 18 countries across the globe
- Chair Eric Ollinger – French Ministry of Transportation
- Started June 2016 – Ended July 2018
Setting the frame

• Goal - Identify major considerations in the development and deployment of V2I and V2V communication in road design and operations
  • From a road operator’s point of view
  • Identify best practices regarding the main challenges and formulate recommendations for countries or regions who would like to step in
  • Highways are in the main focus
• Output : Report outlining key topics being explored and with references to other organizations.
CV technology in a global context

- The work is based on surveys carried out on 23 existing projects all over the world, completed by a review of the existing literature.
Methodology

• A total of 47 reference documents were collected and reviewed, including:
  • 23 Connected ITS project surveys (40+ questions)
  • 13 Connected ITS project description reviews
  • 4 documents from previous PIARC cycles
  • 7 reference documents from countries with various deployment strategies or research activities and also from European working groups
Task Force B.1
Input Data and analysis
Connected Vehicles ??

• What do we mean by connected driving ?
• An exchange of information between a vehicle and :
  • Other vehicles : sensors embedded in the vehicles gather and transmit them automatically to vehicles behind (V2V)
  • The infrastructure : the same information is received by the road operator (V2I) ; the road operator can also send information directly displayed in the vehicle (I2V)
  • Other road users (V2Others)
• This is also called Cooperative Intelligent Transport Systems (C-ITS) or V2X.
Projects Sample

US: Connected Vehicle Pilot Deployment Program

South Korea: Dajeon and Sejong city

China: Beijing, Shanghai, Chongqing

Europe: C-Roads

Australia

Japan: Smart use of road project
Benefits Expected by Operators

- Benefits expected from the projects are grouped into the following three main categories:
  - Safety (and security)
  - Mobility
  - Environment
## Services provided to users

- Priority of emergency vehicles
- Protection of vulnerable users

<table>
<thead>
<tr>
<th>Service</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road Work</td>
<td>15</td>
</tr>
<tr>
<td>Probe vehicle data</td>
<td>13</td>
</tr>
<tr>
<td>Weather</td>
<td>12</td>
</tr>
<tr>
<td>In-Vehicle signage</td>
<td>12</td>
</tr>
<tr>
<td>Traffic Jam</td>
<td>11</td>
</tr>
<tr>
<td>Speed limit</td>
<td>10</td>
</tr>
<tr>
<td>Slow Vehicle</td>
<td>10</td>
</tr>
<tr>
<td>Intersection safety</td>
<td>9</td>
</tr>
</tbody>
</table>
Communication Standard

- ITS-G5 in Europe (it’s not 5G!!)
- 5.9/5.8 GHz DSRC in Asia
Task Force B.1 Opportunities and Challenges
Why investing in Connected technology

Today

Data Collection ➔ Analysis ➔ Action

Real Time

Off Time

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Why investing in Connected technology

With Connected technology

Data Collection -> Analysis -> Action

Real Time

Off Time

V2I

I2V

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Why investing in Connected technology

With Connected technology

Data Collection → Analysis → Action

<table>
<thead>
<tr>
<th>Services</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic - PVD</td>
<td>Speed, position</td>
</tr>
<tr>
<td>Extended - PVD</td>
<td>Speed, position, +++</td>
</tr>
</tbody>
</table>

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Why investing in Connected technology

With Connected technology

Data Collection → Analysis → Action

<table>
<thead>
<tr>
<th>Services</th>
<th>Messages</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLOSA</td>
<td>Green Light Optimal Speed Advisory</td>
</tr>
<tr>
<td>RWW</td>
<td>Road Works Warning</td>
</tr>
<tr>
<td>IVSL</td>
<td>In vehicle speed limit</td>
</tr>
<tr>
<td>IVS</td>
<td>In vehicle Signage – virtual VMS</td>
</tr>
</tbody>
</table>

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• GOAL – Increasing mobility. Providing advice to optimize the way vehicles approach and pass through an intersection.

Advice to slow down to 27km/h to catch the green light

Next traffic light will be green

Driver can prepare to stop, the light will stay red

Next traffic light is green, but will turn red
Challenges of the implementation

- Services to deploy first
- Interoperability
- High penetration path
- Business models
- Choice of technology
- Access to quality data
- Security, privacy and data protection
- Operator’s organization
## Services to deploy first (from EU C)

<table>
<thead>
<tr>
<th>#</th>
<th>Day 1 Services</th>
<th>Bundle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Emergency electronic brake light V2V Safety 1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Emergency vehicle approaching V2V Safety 1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Slow or stationary vehicle(s) V2V Safety 1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Traffic jam ahead warning V2V Safety 1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Hazardous location notification V2I Motorway 2</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Road works warning V2I Motorway 2</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>Weather conditions V2I Motorway 2</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>In-vehicle signage V2I Motorway 2</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>In-vehicle speed limits V2I Motorway 2</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>Probe vehicle data V2I Motorway 2</td>
<td>2</td>
</tr>
<tr>
<td>11</td>
<td>Shockwave damping V2I Motorway 2</td>
<td>2</td>
</tr>
<tr>
<td>12</td>
<td>GLOSA / Time To Green (TTG) V2I Urban 3</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>Signal violation/Intersection safety V2I Urban 3</td>
<td>3</td>
</tr>
<tr>
<td>14</td>
<td>Traffic signal priority request by designated vehicles V2I Urban 3</td>
<td>3</td>
</tr>
</tbody>
</table>
## Services to deploy second (from EU C)

<table>
<thead>
<tr>
<th>#</th>
<th>Day 1.5 Services</th>
<th>Bundle</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Off street parking information</td>
<td>V2I Parking</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>On street parking information and management</td>
<td>V2I Parking</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Park &amp; Ride information</td>
<td>V2I Parking</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Information on AFV fueling &amp; charging stations</td>
<td>V2I Smart Routing</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Traffic information and smart routing</td>
<td>V2I Smart Routing</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Zone access control for urban areas</td>
<td>V2I Smart Routing</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Loading zone management</td>
<td>V2I Freight</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>Vulnerable road user protection (pedestrians and cyclists)</td>
<td>V2Others VRU</td>
<td>7</td>
</tr>
<tr>
<td>9</td>
<td>Cooperative collision risk warning</td>
<td>V2V Collision</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>Motorcycle approaching indication</td>
<td>V2V Collision</td>
<td>8</td>
</tr>
<tr>
<td>11</td>
<td>Wrong way driving</td>
<td>V2I Wrong Way</td>
<td>9</td>
</tr>
</tbody>
</table>
Interoperability

- To ensure that the same standards and specifications are used when deploying systems and hardware
- Between provinces and with US States
- Significant coordination is required between road operators, car manufacturers and Telco carrier to ensure interoperability;
- The relationship between the required technology and the services being deployed (both now and in the future) needs to be understood.
Choice of Technology

Short Range Communication (DSRC)

**PROS**

Most suitable to broadcast tactical information that needs to be spread **quickly** and **very near** to the information location.

**CONS**

Requires a large network of RSU, which implies **significant investment** and the need for **open standards** in order to limit technological obsolescence.

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Information Classification: General
Choice of Technology

Long Range Communication (3G/4G)

**PROS**
- Highly suited to strategic information broadcasts and the coverage and capacity of cellular networks are growing as technology continues to evolve

**CONS**
- Restricted data transmissions rates can be an obstacle in some locations for users
Choice of Technology

Wide area broadcast (Digital Audio Broadcasting +)

**PROS**
- it is already generally widespread and installed in most parts of the world

**CONS**
- This communication technology requires specific devices

Due to the varying requirements for different CV services and applications, the open hybrid approach may be the most appropriate scenario to allow future growth.
Access to Quality Data

- Quality requirements
- Collection processes
- Quality assurance processes and attributes
- Data accessibility

Opened and shared the data sources among the different CV players would bring many benefits:
- Improvements to data quality through cross checking
- Comparisons and validations
- Support for a wider range of existing and new applications through the aggregation of different datasets
- The generation of new data-related revenue streams
Task Force B.2 - Automated vehicles: challenges and opportunities for road operators
## SAE J3016™ Levels of Driving Automation

### Automated Vehicle 🚗?

**What does the human in the driver's seat have to do?**

- **LEVEL 0**: 
  - You are driving whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering.

- **LEVEL 1**: 
  - You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety.

- **LEVEL 2**: 
  - These features provide steering OR brake/acceleration support to the driver.

- **LEVEL 3**: 
  - These features provide steering AND brake/acceleration support to the driver.

- **LEVEL 4**: 
  - These automated driving features will not require you to take over driving.

- **LEVEL 5**: 
  - You are not driving when these automated driving features are engaged – even if you are seated in “the driver’s seat.”

**What do these features do?**

**These are driver support features**

- **Example Features**
  - automatic emergency braking
  - blind spot warning
  - lane departure warning

**These are automated driving features**

- **Example Features**
  - traffic jam chauffer
  - local driverless taxi
  - pedals/steering wheel may or may not be installed
  - same as level 4, but feature can drive everywhere in all conditions
Automated vehicle - report structure

• From a road operator’s point of view, challenges and opportunities
  • Physical Infrastructure
  • Digital Infrastructure
    ◦ Connectivity
    ◦ Digital maps and positioning
    ◦ Data
  • Road Network Operation
  • Responsibility and Financing
  • Social Issues
Conclusion
Conclusion

• Many opportunities offered by CV technology for road operators,
  • In terms of road safety, road network operations, traffic information, asset management....

• The question is where to start?
  • Based on experience from the various pilot from all over the world
    ◦ Start small and learn by doing
    ◦ Deploy a few of the most mature services (Day1 services)
    ◦ The section in the report on the pros and cons of each technology can help make the best choice
Conclusion

• Security and privacy are important challenges that must be tackled with appropriate experts

• But the key point is not technical, it is to involve all relevant stakeholders and consider seriously the social aspect

• Road operators cannot deploy the technology by themselves, they need to work in close relationship with car manufacturers and telecom carrier who will be delivering the service to the driver
The Report

• The final report of the TF B.1 is available on:
  https://www.piarc.org/en/publications/technical-reports/

• Search for: 2019R11EN
Thanks for your Attention!

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