FROM STAND-ALONE ITS TO CONNECTED ITS:
WHAT DOES IT MEAN FOR CITIES
AND REGIONS?
It has always been the prerogative of children and half-wits to point out that the emperor has no clothes. But the half-wit remains a half-wit, and the emperor remains an emperor.

(Neil Gaiman)
CITIES AND ITS

• There is a lot in Europe
• It’s increasingly integrated
  • Standards like DATEX, frameworks like UTMC
  • Exploiting developments in mainstream ICT
• What about C-ITS?
  • Direct communication with all (equipped) vehicles for traffic management and information purposes
  • May offer a more (cost-)effective way of delivering certain traffic management functions
C-ITS DEVELOPMENTS

- Historically, a lot of early interest in
  - “Connected vehicles”
  - “Automated highways”
- Urban context much less well studied
- Cities are not slow to react – many have had extensive C-ITS systems for years
  - Bus priority systems
  - Tolling systems
TWO GENERIC APPROACHES

City

Local comms

Traveller

Wide area comms

Local comms

Wide area comms
WHAT’S NEW: COMMS

• ITS G5
  • Reserved WiFi spectrum for safety applications and other C-ITS services
  • Short-range: 300-500m (up to 1000m) depending on environment
  • Spectrum not (currently) owned by any market player = free of charge communications...
  • ...but requires a road-side unit
  • Low latency of data transfer = critical for safety applications (eg, emergency braking) but less relevant for urban applications – traffic efficiency oriented
WHAT’S NEW: STANDARDS

• Standardised message sets
  • CAM / Cooperative Awareness Message: a message (‘I am here’) sent by a vehicle one to ten times per second with data on vehicles position, direction, speed etc.
  • DENM / Distributed Environmental Notification Message: warning message (e.g., slippery road, crash) sent with high priority to a vehicle based on information from the vehicle or the infrastructure
  • SPaT / Signal Phase & Timing: information to the vehicle on traffic light state and future changes
  • MAP: describes the physical geometry of an intersection
  • IVI / In-vehicle information: presentation of physical road sign information in-side the vehicle
Part 2: Requirements and solutions
CITY INTERESTS IN C-ITS

• Many analyses of C-ITS services with “in principle” city benefits

• The following examples come from city voices:
  • Kassel (CIMEC partner city)
  • CODECS
  • C-ITS Platform, Urban WG
  • CIMEC collation
Some opportunities

- Exact prediction for PT vehicles
- Better priority correlated towards competing demands (dialog with vehicle)
- Priority for emergency vehicles with same technology
- New and better tools for quality management
- New and better data available
- Prediction of traffic situations
- Reliable traffic information
- Less traffic signs and less costs
## CODECS

### Day 1 Services

<table>
<thead>
<tr>
<th>Service Description</th>
<th>V2V</th>
<th>Safety</th>
<th>Bundle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency electronic brake light</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Emergency vehicle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slow or stationary vehicle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traffic jam ahead</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Hazardous location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Road works warning</td>
<td></td>
<td></td>
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<tr>
<td>Weather condition</td>
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</tr>
</tbody>
</table>

- Tram warning (general)
- Tram interlocking control
- Blind spot detection (to avoid collisions with cycles and pedestrians)
- Localisation of vehicles
- Use of C-ITS to improve inter-modal transport
- Consideration of common safety objectives for different vehicle types
- Motorcycle approaching awareness (M2V)
- Motorcycle warning (Car sends CAM (V2V) triggering a warning generation M2V)
- Pedestrian warning by public transport (V2V)
- Pedestrian warning by RSU (Car sends CAM (V2V) triggering a warning generation I2V)
- Pedestrian warning by P2V (Car sends CAM (V2V) triggering a warning generation P2V)
- Bicyclist approaching awareness (B2V)
- Bicycle warning (Car sends CAM taking a turn at crossing (V2P), bicycle sends warning (P2V))

### Test Scenarios

**Veloce Analysis - (2005-2009 GES Data)**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Cases</th>
<th>% Total FYL</th>
<th>Fatality</th>
<th>% Fatality</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>115,000</td>
<td>84%</td>
<td>7,000</td>
<td>88%</td>
</tr>
<tr>
<td>S2</td>
<td>2,000</td>
<td>1%</td>
<td>16</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>S3</td>
<td>9,000</td>
<td>1%</td>
<td>0</td>
<td>0%</td>
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<tr>
<td>S4</td>
<td>13,000</td>
<td>1%</td>
<td>1,000</td>
<td>12%</td>
</tr>
</tbody>
</table>

*Note: Top 20 scenarios represent 87% of estimated pedestrian fatalities*
<table>
<thead>
<tr>
<th>#</th>
<th>Day 1 Services</th>
<th>#</th>
<th>Day 1.5 Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Emergency electronic brake light</td>
<td>1</td>
<td>Off street parking information</td>
</tr>
<tr>
<td>2</td>
<td>Emergency vehicle approaching</td>
<td>2</td>
<td>On street parking information and management</td>
</tr>
<tr>
<td>3</td>
<td>Slow or stationary vehicle(s)</td>
<td>3</td>
<td>Park &amp; Ride information</td>
</tr>
<tr>
<td>4</td>
<td>Traffic jam ahead warning</td>
<td>4</td>
<td>Information on AFV fuelling &amp; charging stations</td>
</tr>
<tr>
<td>5</td>
<td>Hazardous location notification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Road works warning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Weather conditions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>In-vehicle signage</td>
<td></td>
<td></td>
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<tr>
<td>9</td>
<td>In-vehicle speed limits</td>
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<tr>
<td>10</td>
<td>Probe vehicle data</td>
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</tr>
<tr>
<td>11</td>
<td>Shockwave damping</td>
<td></td>
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</tr>
<tr>
<td>12</td>
<td>GLOSA/Time To Green (TTG)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Signal violation/Intersection safety</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Traffic signal priority request by designated vehicles</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

- Traffic signal priority request by designated vehicles V2I
- Green Light Optimized Speed Advisory GLOSA/Time To Green (TTG) V2I
- Traffic information and smart routing (V2I)
- Park and Ride information (V2I)
- Road works warning (V2I)
- In-vehicle speed limits (V2I)
- Probe Vehicle Data
- Vulnerable road user protection (pedestrians, cyclists, motorcyclists) (V2X)
CIMEC USE CASES

- UC1: Individual routing of vehicles
- UC2: In-vehicle signs
- UC3: In-vehicle signal information
- UC4: Management of loading and unloading areas for distribution vehicles
- UC5: Control the access of heavy goods vehicles with dangerous goods to tunnels
- UC6: Regulation of access to free lanes for electrical vehicles
- UC7: Green lights for police and emergency vehicles
- UC8: Traffic Light management
- UC9: Green lights for public transport vehicles
- UC10: Green lights for cyclists
- UC11: Parking management
- UC12: Inform about incidents in the road network and control access to these areas
- UC13: Inform about emergencies in the road network and control access to these areas
- UC14: Control access to given roads for not emission-free cars on days with poor air quality
- UC15: Speed enforcement around schools
- UC16: C-ITS services for vulnerable road users
- UC17: Pedestrians crossing in front of bus/tram
- UC18: Bike lane change and unusual crossing
Part 3: Challenges and practicalities
REALITY CHECK

• Why do we need this (ie what can it do for us)?
• What products are on offer, and at what cost?
• Are there other ways of doing the same thing better/quicker/more cheaply/at lower risk?
• Are there are higher priorities on our time and money?

(Existing C-ITS deployments, like bus priority, fulfil these criteria)
UNDERSTANDING THE COSTS

- Cost of acquiring (or upgrading) roadside devices
- Cost of installing and commissioning roadside devices
- Cost of acquiring (or upgrading) central systems, including the additional cost of integration of roadside devices
- (Additional) cost of the city’s communication network between centre and roadside; also possibly additional costs of electricity supply
- Cost of acquiring and/or training staff to use the system
- Cost of maintenance, repair, upgrade and replacement of system elements
- Any direct contribution to the cost of in-vehicle systems – in the case of city vehicles, the whole cost
- Cost of marketing to prospective road users
- Cost of technical support to actual road users
- Potential costs associated with consequences such as complaints and claims
SUPPLIER READINESS

- In general suppliers see potential in city C-ITS...
- A few key suppliers have a clear vision and an action plan for deployment
  - And they don’t reveal much information!
- Most have no well-defined plan – investment in product development will be limited as long as:
  - Their current ITS-market position is not in danger
  - There is no clear business case for city C-ITS
  - They still face too many challenges (technical, political, legal, etc.)
RISK

- Breach of privacy
- Accident liability
- Political risk (e.g. through poor public reception)
- Supply failure
- Imposition of excessive costs or other burdens on road users
- Operational inadequacy (e.g. through shortage of skilled staff)
Which vehicle class has the most potential for automation?
Part 4: The way ahead
CLOTHES FOR THE EMPEROR?
OUR PARTNERS

- SINTEF
- POLIS
- Albrecht Consult
- Centaur
- Statens vegvesen
  Norwegian Public Roads Administration
- Kassel documenta Stadt
- Reading Borough Council
  Working better with you
- mlc-its euskadi
  cluster de movilidad y logística
  mugikortasun eta logistika klústerra
- Cimecc
Thank you!