The Digital Guardian Angel
A Cellular-assisted VRU protection solution

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The Digital Guardian Angel

Background

- VRU Protection Project in the City of Hamburg (PoC)
- Validation of a cellular-assisted solution as a contribution to a **VRU Protection solution suite**

Talking Points

- Safety Challenges of Cities
- Use Case Taxonomy
- A Cellular-Assisted Solution Setup to Protect Road Users
- Why MEC
- PoC Observations & Benefits
- Lessons Learned / Conclusions
Safety Challenges of Cities

Road traffic injuries (June 2021)

- Approximately 1.3 million people die each year as a result of road traffic crashes.
- The United Nations General Assembly has set an ambitious target of halving the global number of deaths and injuries from road traffic crashes by 2030 (A/RES/74/299)
- Road traffic crashes cost most countries 3% of their gross domestic product.
- More than half of all road traffic deaths are among vulnerable road users: pedestrians, cyclists, and motorcyclists.
- 93% of the world's fatalities on the roads occur in low- and middle-income countries, even though these countries have approximately 60% of the world's vehicles.
- Road traffic injuries are the leading cause of death for children and young adults aged 5-29 years.
**VRU Protection**

**Use Case Taxonomy**

<table>
<thead>
<tr>
<th>(*)</th>
<th>Running Up</th>
<th>Turning</th>
<th>Crossing</th>
<th>Oncoming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car vs Motorcycle</td>
<td>2%</td>
<td>21%</td>
<td>31%</td>
<td>11%</td>
</tr>
<tr>
<td>Car vs Bicycle</td>
<td>47%</td>
<td>5%</td>
<td>35%</td>
<td>6%</td>
</tr>
<tr>
<td>Car vs Pedestrian</td>
<td>26%</td>
<td>4%</td>
<td>59%</td>
<td>4%</td>
</tr>
<tr>
<td>Truck vs VRU</td>
<td>27%</td>
<td>12%</td>
<td>40%</td>
<td>12%</td>
</tr>
</tbody>
</table>

*Expectations*

- **UC Flexibility:** one solution covers majority of Use Cases
- **Road User Integration:** active protection of all Road Users (vehicles, VRUs)
- **Location Flexibility:** deployable at intersections and along the road
- **Timing/Dynamics:** temporary protection shield at large scale events (concerts, soccer games, ...)

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Vulnerable Road Users Protection
Integrated Approach

VRU Protection based on Cloud solution
- Based on 4/5G / MEC (low latency/managed Network) and Intelligent infrastructure
- Flexible hotspot allocation via dynamic geofencing
- Involved "parties": all vehicles, all VRU’s with 4/5G device

VRU Protection based on V2X communication technology
- V2X Cooperative Perception with V2V communication everywhere
- V2X Cooperative Perception with I2V Intelligent Infrastructure
- No-Line-of-Sight protection

Vehicle-only VRU Protection
- Based on in-vehicle sensors
- Line-of-Sight protection
- No connectivity
- Integrated features (examples):
  - Blind Spot Detection,
  - 360-degree surround view
  - Right-Turn Assist
VRU Protection Assisted by Cellular Network

High Level Architecture

Collision Warning Service
- **Sense** (Detection, Sensors/Map)
- **Plan** (Prediction Calculation – AI based)
- **Act** (Warning Strategy)
- **Operator Dashboard** (Monitoring, Statistics)

Standard messaging (Cloud): C-ITS

Standard messaging (OTA): C-ITS

Edge Cloud

Traffic Lights

Intell. Detection and Tracking Equipment

Sensor Scanning Technologies

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VRU Protection Assisted by Cellular Network

Why Multi Access Edge Computing

Location based services ✓
Low latency ✓
Ultra-reliability ✓
Data Privacy ✓
Inclusiveness ✓
VRU Protection Assisted by Cellular Network
PoC Observations & Benefits (1)

- **Client Server Architecture**
  - centralized highly scalable collision warning
  - thin client, easy integration in any device
- **HW agnostic**
  - deployable at any infrastructure which supports 4G/5G cellular networks
- **City Infrastructure – optionally**
  - stepwise integration - if available (TLA,...)
- **High performance communication**
  - via MEC based computing
  - optimized bandwidth needs
- **C-ITS message standards**
  - use of standardized messages (via uu interface)
    - (awareness, event notification, signal phase, ...)

**Use Case:**
VRU protection at Intersection,
vehicle-to-scooter
both road users are registered in the collision warning
integration of traffic light info
Multi Service Integration

- infrastructure service enhancements via cloud service
  Integration done via C-ITS messaging
- client API not affected

Use Case:
VRU protection at Intersection, vehicle-to-scooter
integration of Intelligent Detection Device (IDTE, Vitronic)
scooter driver only registered in the collision warning
VRU Protection Assisted by Cellular Network
PoC Observations & Benefits (3)

Multi Service Integration
• extended service value, e.g.
  combination of GLOSA / TTG service with VRU protection
  integration into (vehicle/bicycle) navigation

Use Case:
GLOSA / TTG
Integrated VRU Protection

- **Prime Service**
  - TTG (Time to Green)
    - Informational service = user has to react,
      Priotization of bicycles/scooters

- **Integrated Service**
  - Collision Warning
    - user has to react, reaction time = latency critical
VRU Protection Assisted by Cellular Network

Summary of Proof of Concept

A Cellular-Assisted VRU Protection Solution
- contributes to the digital protection shield
- increases safety for road users (drivers, VRUs)
- justifies an accident reduction for cities

Technology: high performance/low latency solution via integration of enhanced telecom network capabilities, apply standardized C-ITS messaging

Deployment: simplified deployment via SW and services driven approach; traffic infrastructure upgrade on demand

Flexibility: multitude of use cases, ease of integration of all traffic participants including bikers, pedestrians, last mile delivery robots, AD Shuttles,

Extendibility: combination with further services (like GLOSA, intersection monitoring, traffic light integration, traffic rules violation warning services)

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Be a Digital Guardian Angel
Help Us Save Lives

You can make road safer for vulnerable users
Thank you

Frank Foersterling