



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



World Health
Organization

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

(*)	Running Up ✓	Turning ✓	Crossing ✓	Oncoming ✓
Car vs Motorcycle	2%	21%	31%	11%
Car vs Bicycle	47%	5%	35%	6%
Car vs Pedestrian	26%	4%	59%	
Truck vs VRU	27%	12%	40%	

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, ...)



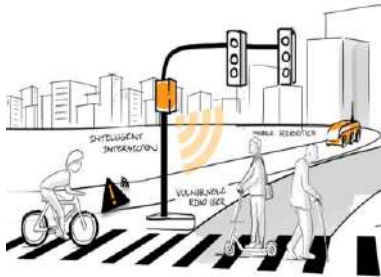
Vulnerable Road Users Protection

Integrated Approach

Safe and Dynamic Driving
towards **VISION ZERO**

SensePlanAct

ZERO ACCIDENTS
ZERO INJURIES
ZERO FATALITIES



VRU Protection Integrated approach

Connected VRU Protection

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

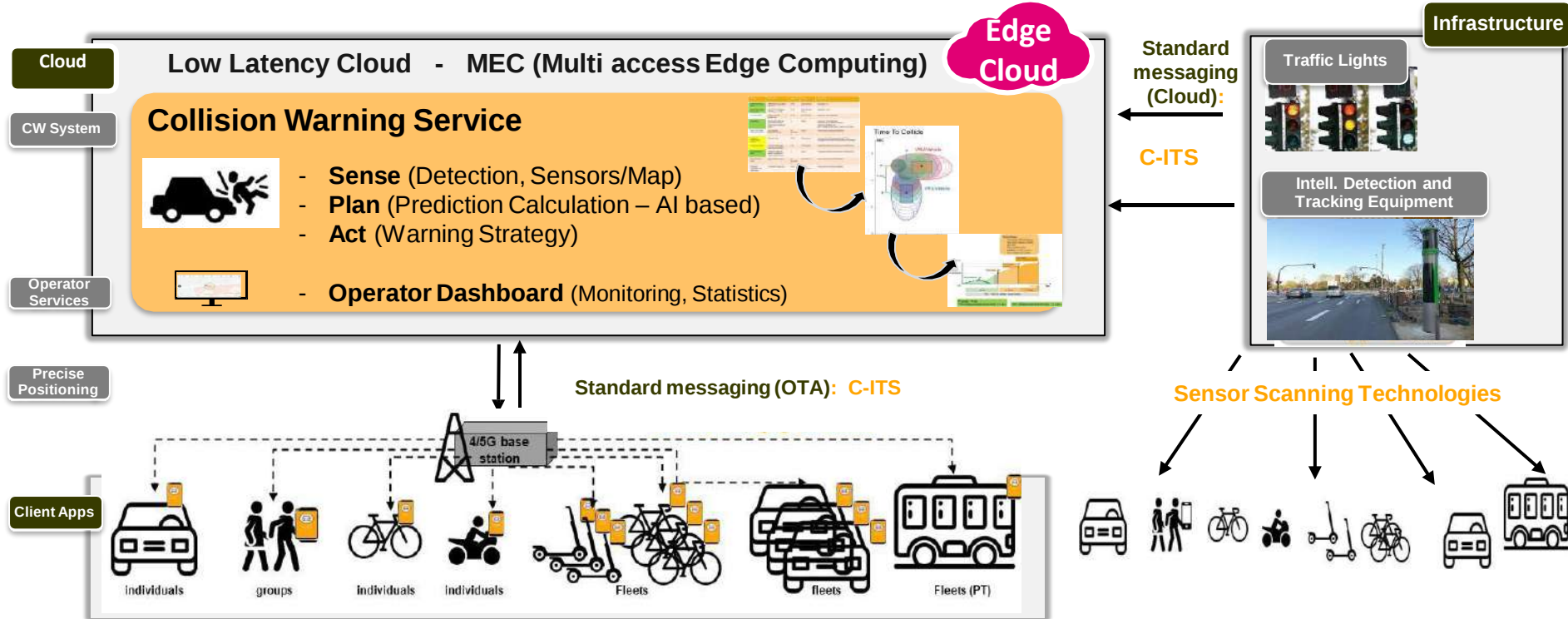


**VRU
Protection
Up to 90%**

**VRU
Protection
55%**

VRU Protection Assisted by Cellular Network

High Level Architecture



VRU Protection Assisted by Cellular Network

Why Multi Access Edge Computing



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 warner
integration of traffic light info

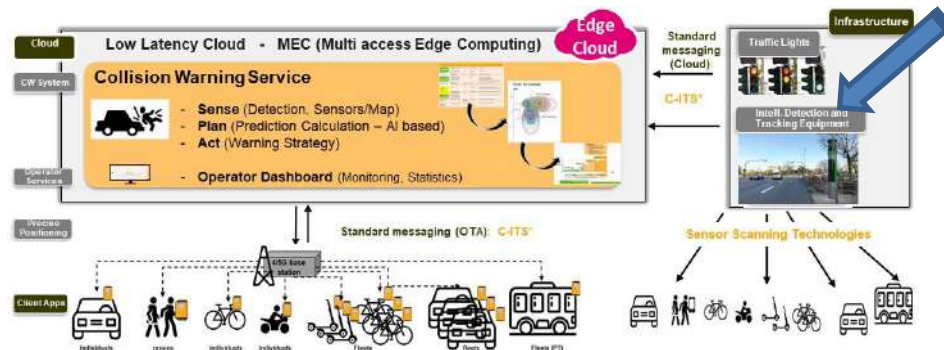


VRU Protection Assisted by Cellular Network

PoC Observations & Benefits (2)

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 warner

T · Systems ·

VITRONIC

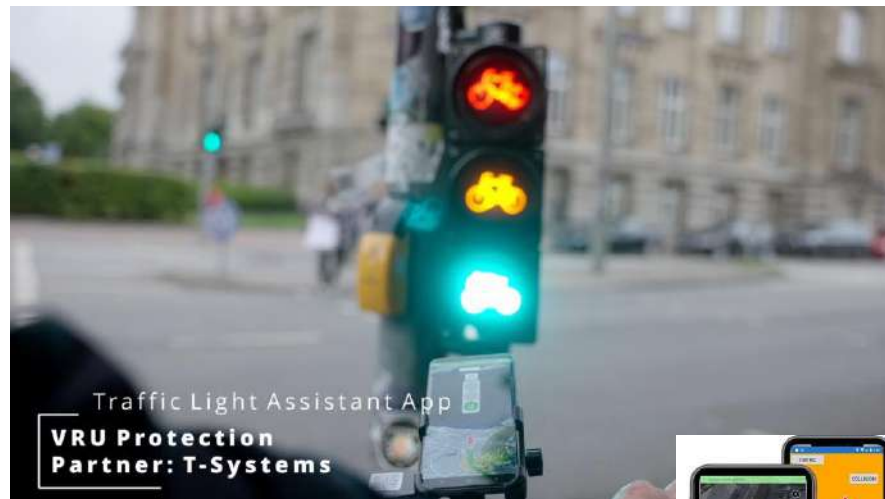
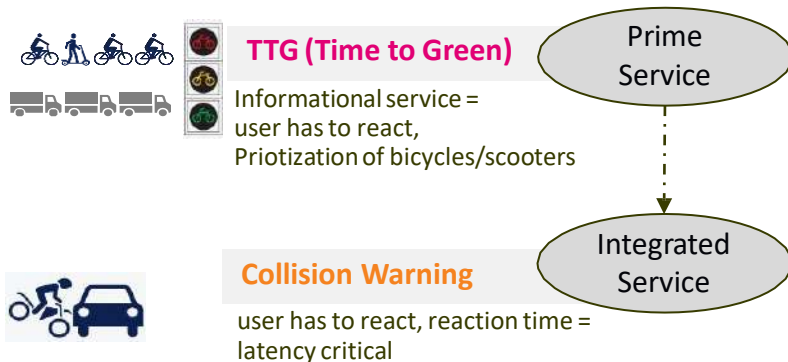
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VRU Protection Assisted by Cellular Network

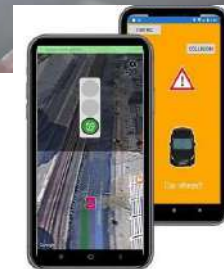
PoC Observations & Benefits (3)

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



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)

5G

**Be a Digital Guardian Angel
Help Us Save Lives**

You can make road safer for vulnerable users



Thank you

Frank Foersterling

