

Submitted by the expert from Germany

Working Paper **VCTF-02-08**
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Provisional agenda item 4(a)



Vehicular Communications

ITS Task Force on Vehicular
Communications (2nd session)
June 23rd 2023

Content

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- Current situation
- Communication technologies
- Stakeholder
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- Accidentology
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Background

- Research started roughly 30 years ago, political discussion 20 years ago
 - Enough scientific evidence to ensure the positive impact on vehicle safety
- The goal was indicated to achieve harmonization and area-wide deployment in order to realize the positive impacts on vehicle safety and traffic flow
- Deployment takes place only at a slow pace
 - Fragmented solutions have established
 - Lack of planning certainty

Current situation

- Why now?
 - With UN R155, cybersecurity can be ensured in the vehicle, being a prerequisite for secure communication
- Current market is fragmented and no overarching solutions are available (e.g. communication technology)
- Different standards exist or are in development (e.g. ETSI, ISO, SAE)
- The technical maturity is given by the fact that the implementation is present in some vehicles

Communication technologies

- Different technologies might be fit for purpose
 - Long-range via existing 3G / 4G / 5G mobile networks
 - Short-range via ETSI ITS-G5 / WAVE (WIFI-based, 802,11p) or Sidelink / PC5
 - Combination of both – „hybrid communication“
- Different requirements for different services / use cases
 - No hard latency requirements, e.g. comfort and navigation
 - Latency critical, i.e. immediate crash avoidance

Communication technologies

- Many potential criteria to be considered
- For each individual technology
 - Availability on the market
 - Coverage / range
 - Performance (Latency, throughput...)
 - ...
- Across different technology
 - Compatibility (technology-wise)
 - Interoperability (content-wise)
 - Interference / congestion on the radio channel – spectrum use
 - ...

	<u>ETSI ITS-G5 (802.11p)</u>	<u>3GPP R14 PC5</u>	<u>3GPP R16/R17 PC5</u>	<u>3GPP LTE Uu</u>	<u>3GPP 5G Uu</u>	<u>Bluetooth 5.0 (LE)</u>
<u>EU-Deployments</u>		Not existent	Not existent	Proprietary, not applicable to SECUR	Deployment has started Proprietary, not applicable to SECUR	Not existent
<u>V2X-Profile Standardization for cross OEM interoperability:</u>		Not tested	Not existent	Not existent	Not existent	Not existent
<u>V2X-Message Standardization for cross OEM communication:</u>				Not existent	Not existent	Not existent
<u>Radio Access Technology:</u>			Not tested, Hardware not available			
<u>Regulatory & Deployment aspects:</u>		CEPT/ECC regulation • Coexistence with existing deployments • Tolling Coexistence	CEPT/ECC regulation • Coexistence with existing deployments • Tolling Coexistence	GDPR- / CPOC- / Policy-Compliance	GDPR- / CPOC- / Policy-Compliance	GDPR- / CPOC- / Policy-Compliance

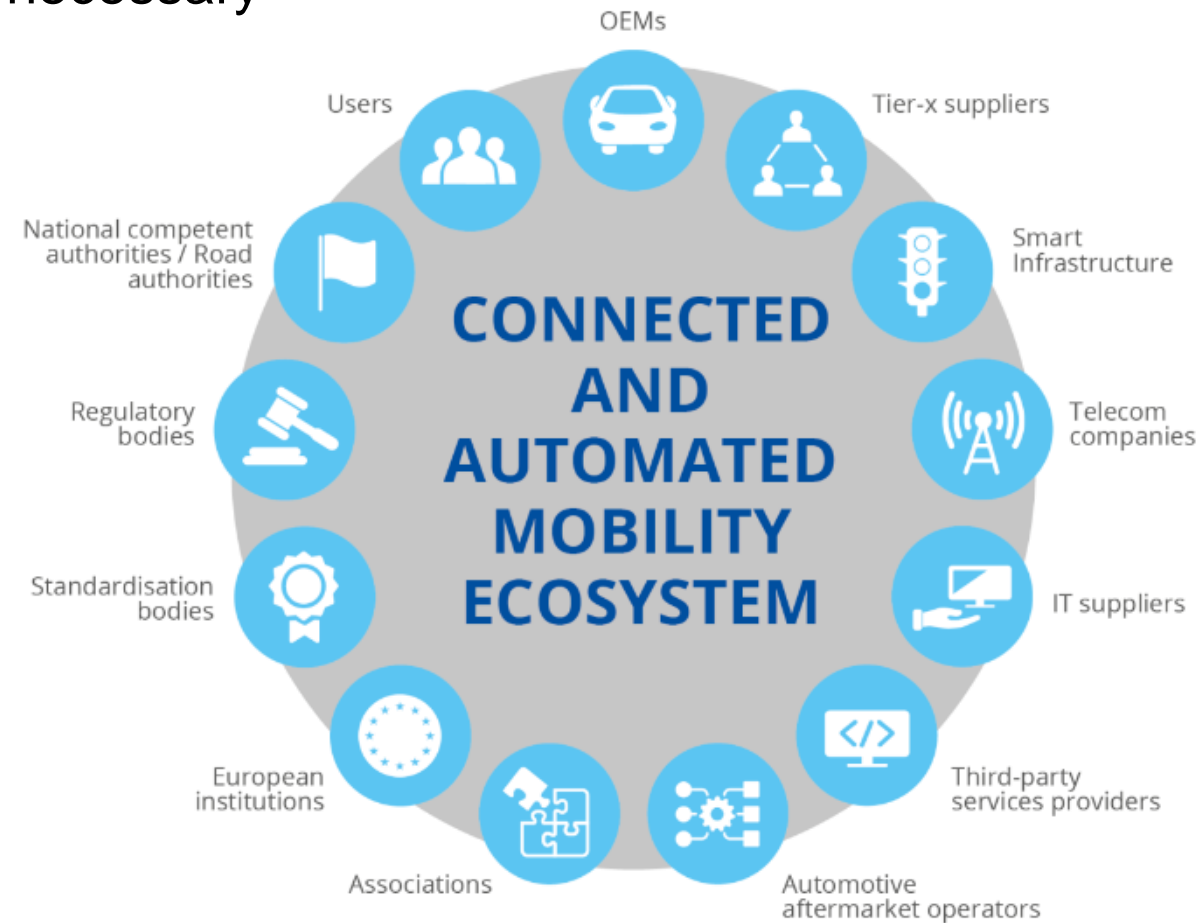
: No issues
 : Known issues, currently not resolved
 : Not existent

Source: SECUR Project, UTAC

<https://www.utac.com/wp-content/uploads/2023/04/SECUR-D2.2-Suitability-of-the-different-technologies-for-the-selected-use-cases-v1.4.pdf>

Stakeholder

- System are not owned/run by one single actor/group
- Alignment within and across stakeholder groups is necessary
- Different roles/sectors
 - Regulators
 - Road operators & authorities
 - Automotive industry
 - Telecommunication
 - Service providers
 - ...



Source: ENISA
<https://www.enisa.europa.eu/publications/cybersecurity-stocktaking-in-the-cam/@@download/fullReport>

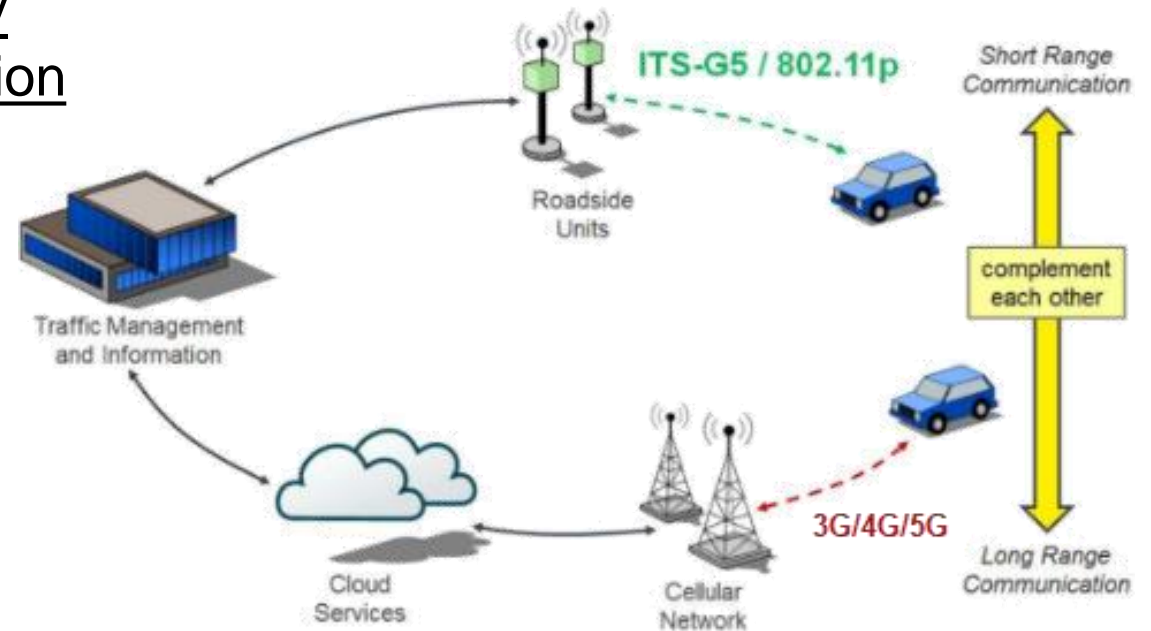
Stakeholder

- Numerous public and private actors
- OEM, aftermarket, national, international
- Might be sender / receiver or “enabler”



Infrastructure

- C-Roads / Cooperative ITS Corridor
- Construction site warning system / „Baustellenwarner“
 - 1500 devices are being rolled out and will be active on the highways
 - But the messages can only be received by few vehicles via short-range communication



- It is becoming noticeable that the infrastructure is implementing more and more systems that have integrated communication technologies

Use cases

- Agreed list of so-called „Day One“ Services
- Different benefits to be realized
- Combination of **safety**, **comfort**, traffic flow / reduced emissions

☐ *List of Day1 services*

Hazardous location notifications:

- ➔ *Slow or stationary vehicle(s) & Traffic ahead warning*
- ➔ *Road works warning*
- ➔ *Weather conditions*
- ➔ *Emergency brake light*
- ➔ *Emergency vehicle approaching*
- ➔ *Other hazardous notifications*

Signage applications:

- In-vehicle signage*
- In-vehicle speed limits*
- ➔ *Signal violation / Intersection Safety*
- Traffic signal priority request by designated vehicles*
- ➔ *Green Light Optimal Speed Advisory (GLOSA)*
- Probe vehicle data*
- Shockwave Damping (falls under ETSI Category “local hazard warning”)*

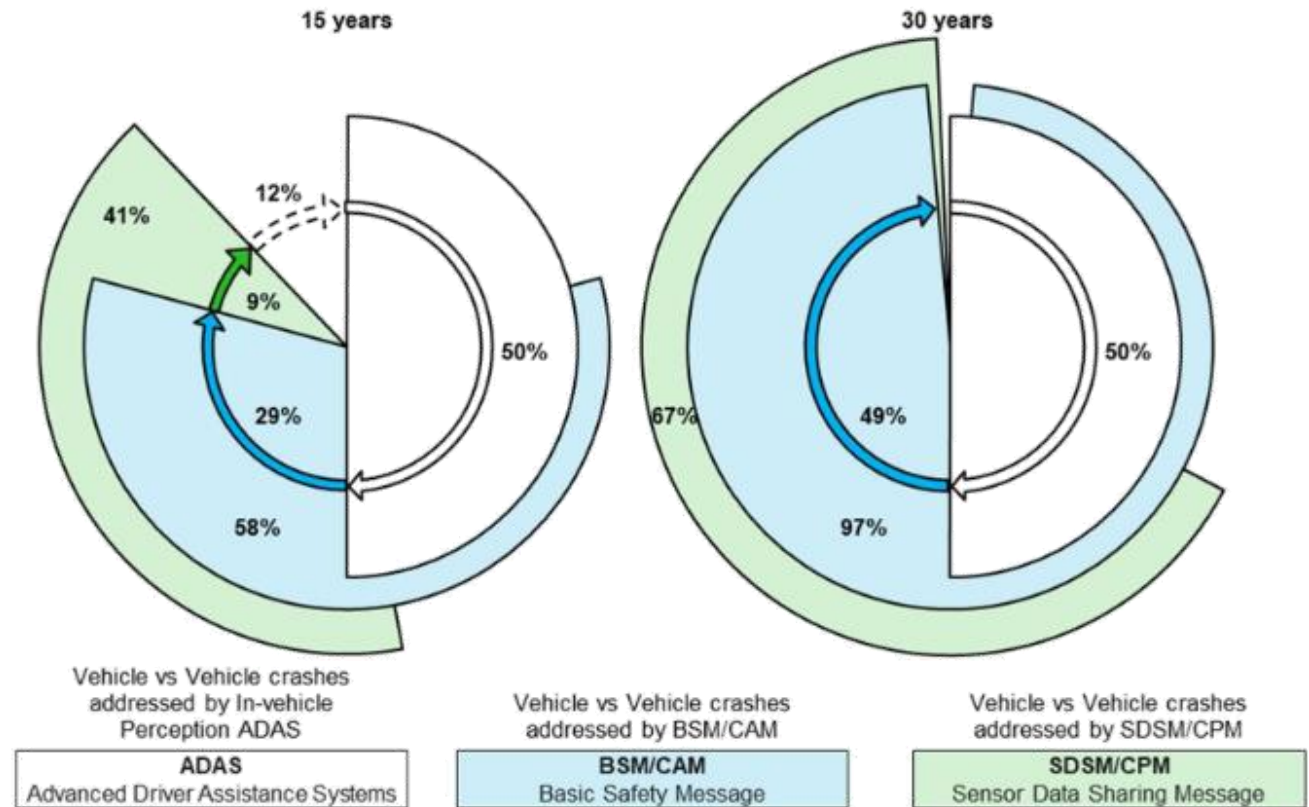
☐ *List of Day 1'5 services*

- ➔ *Information on fuelling & charging stations for alternative fuel vehicles*
- ➔ *Vulnerable Road user protection*
- ➔ *On street parking management & information*
- ➔ *Off street parking information*
- ➔ *Park & Ride information*
- ➔ *Connected & Cooperative navigation into and out of the city (1st and last mile, parking, route advice, coordinated traffic lights)*
- ➔ *Traffic information & Smart routing*

Source: EU COM, C-ITS Platform Report, 2016
<https://transport.ec.europa.eu/system/files/2016-09/c-its-platform-final-report-january-2016.pdf>

Use cases

- More services and use cases exist (e.g. collective perception)
- ADAS & on-board sensors won't solve everything (e.g. non-line-of-sight)
- Connectivity & cooperation address additional areas of interest, thereby helping to close the gap



Source: Feifel, Erdem, Menzel, Gee - 27th ESV Conference, Proceedings
<https://www-esv.nhtsa.dot.gov/Proceedings/27/27ESV-000082.pdf>

Figure 11: Fields-of-action of V2X-enhanced ADAS addressing vehicle vs vehicle crashes. At year 15 and year 30 of introduction.

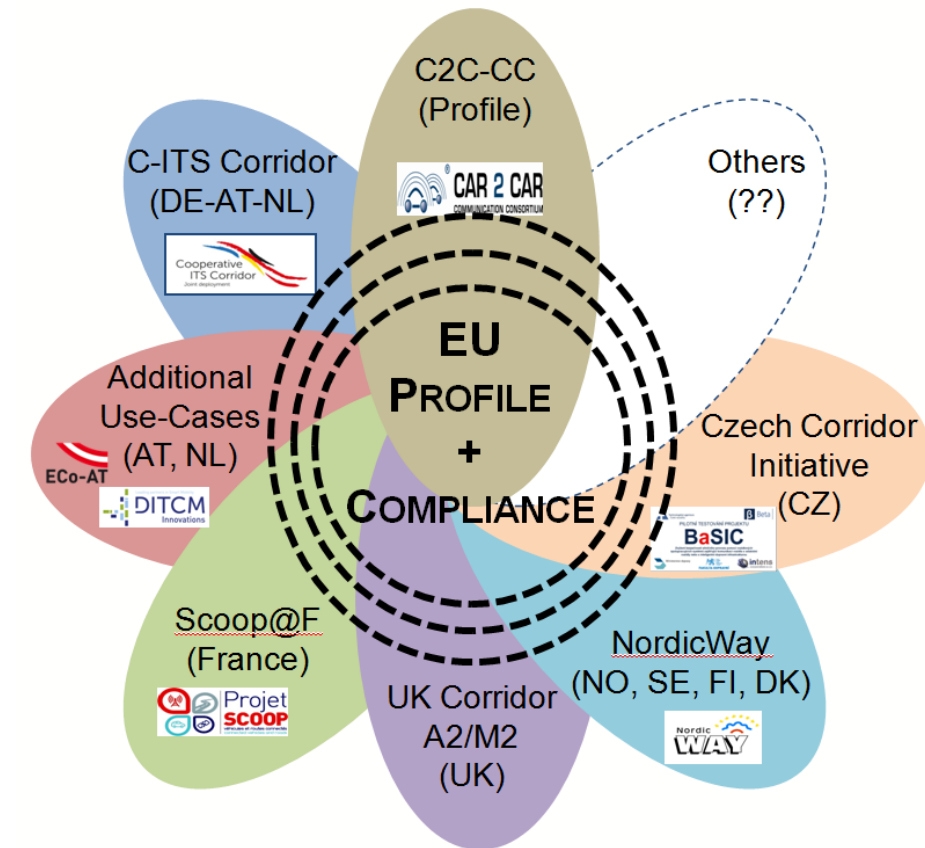
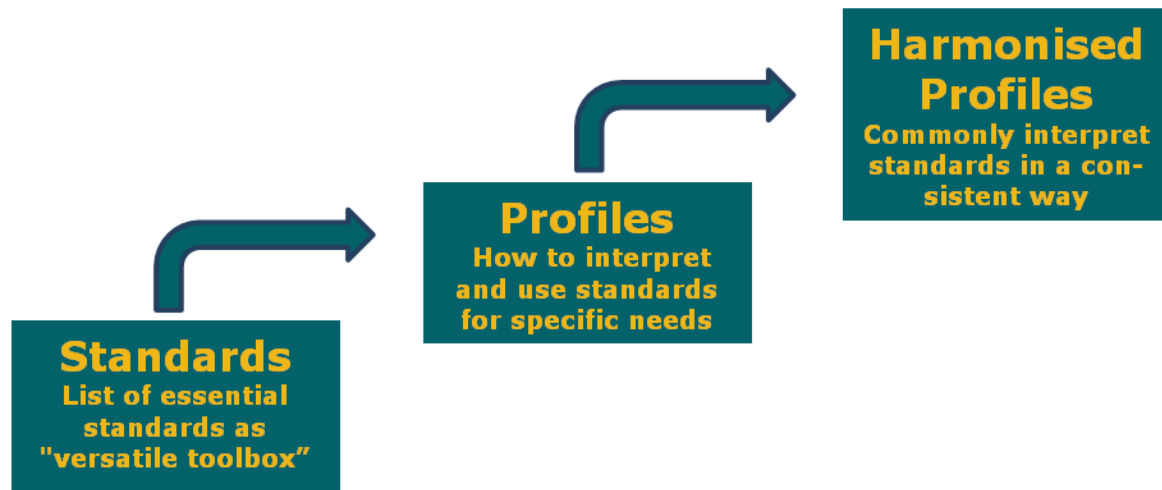
Accidentology

- Enough scientific evidence to ensure the positive impact on vehicle safety
- Direct communication among vehicles, or V2V, has the potential to address approximately **80 percent** of unimpaired multi-vehicle crashes and if collective perception service is included in combined V2V and V2I technologies the potential to address vehicles versus VRU crashes is also around **80 percent** to protect VRU (based on crash data: in Japan 76%, in Germany 83% and in US 84%)

Source: Working document towards a preliminary draft new Report
ITU-R M.[CAV] - Connected Automated Vehicles (CAV)
https://www.itu.int/dms_pub/itu-r/md/19/wp5a/c/R19-WP5A-C-0708!N16!MSW-E.docx

Challenges

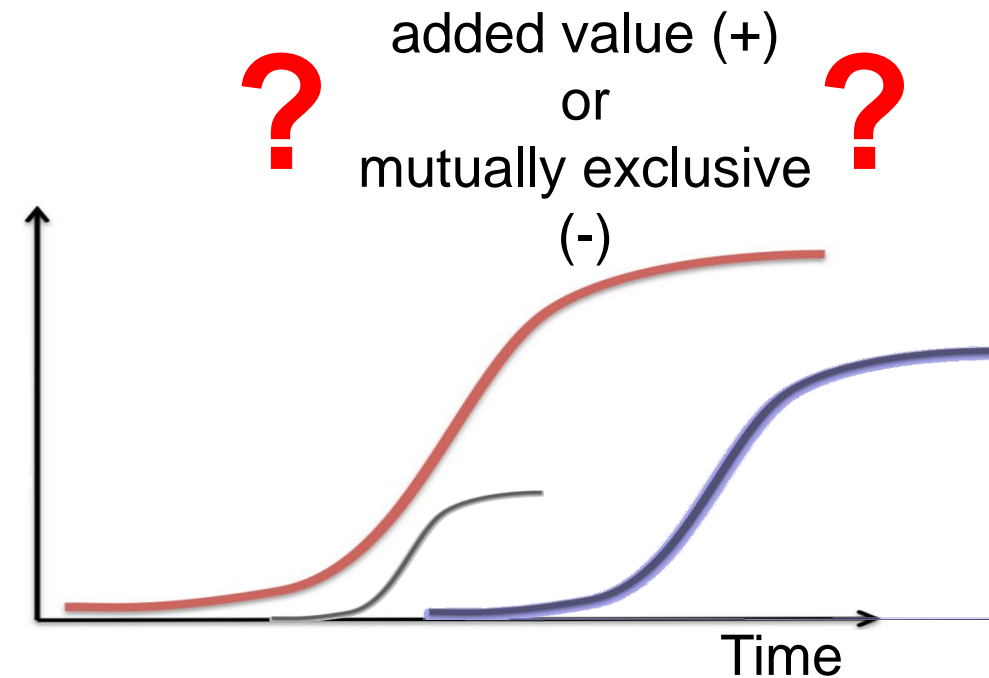
- Communication standards provide a huge toolbox as framework
- A detailed manual is needed how to use the tools properly
 - Profiles
- Communication requires sender & receiver to use harmonized profiles
- At least an agreed common core is required



Source: BASt, CODECS project

Challenges

- Ramp up of penetration rate takes time
 - Highest benefits when each vehicle/actor can communicate with every other
 - Non-interoperable solutions problematic
- Consider transition from older to newer generations
 - Avoid starting from scratch again
 - Capabilities/functionalities might be added removed
- Stability and flexibility required
 - Backward-compatibility across versions of standards
 - Need to adopt new use cases / developments



Challenges

- Vehicle manufacturers interested, but mostly cautious/hesitant
 - The first frontrunner needs to consider „the chance to explore new markets“ versus „the burden to solve all problems for followers“?
 - Keep data in silos and under control or open up for an increased benefit?
 - Which technology to use – and on which market?
- Infrastructure operators willing to modernize, but resources are limited
 - Infrastructure has long life cycles (20, 30, 40 years), technology might become outdated

Challenges

- Vehicle Challenges in many areas
 - Organizational (governance, roles and responsibilities, resources)
 - Technical (interoperability, specification details)
 - Functional (selection of services, interpretation of use cases)
 - Legal (compliance, liability)
- Majority not solvable on an individual basis
 - Changes on the sender side impact receiver
 - Certainty needs to be established along value chains and in value networks
 - Aspects like acceptance are rather social considerations

Need for regulation

- Harmonized approach for vehicle technology
- Enable vehicles to receive messages (e.g. hazard warnings)
- In the area of direct communication, commitment to one technology or enabling coexistence
- Hybrid communication offers the possibility, through the dual approach, that information can be passed on to the relevant vehicles via several channels in a way that promotes safety
- Counteracting fragmentation and increasing planning security



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