Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: OOC Enabled V2X Stack Architecture for Connected Mobility
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Abstract: This document introduces the OCC enabled V2X technology stack architecture to be used in IEEE802.15.7a High Data Rate OCC (Optical Camera Communication) TG. The proposed V2X stack architecture requirements considered to use with varying channel conditions and maintaining automotive connectivity during high mobility (speeds up to 350 km/h), flicker mitigation, Radio Frequency (RF) co-existence, and a communication range of up to 200m in on-road mobility scenario.

Purpose: To provided OCC enabled V2X stack architecture for IEEE802.15.7a High Data Rate OCC.

Contents

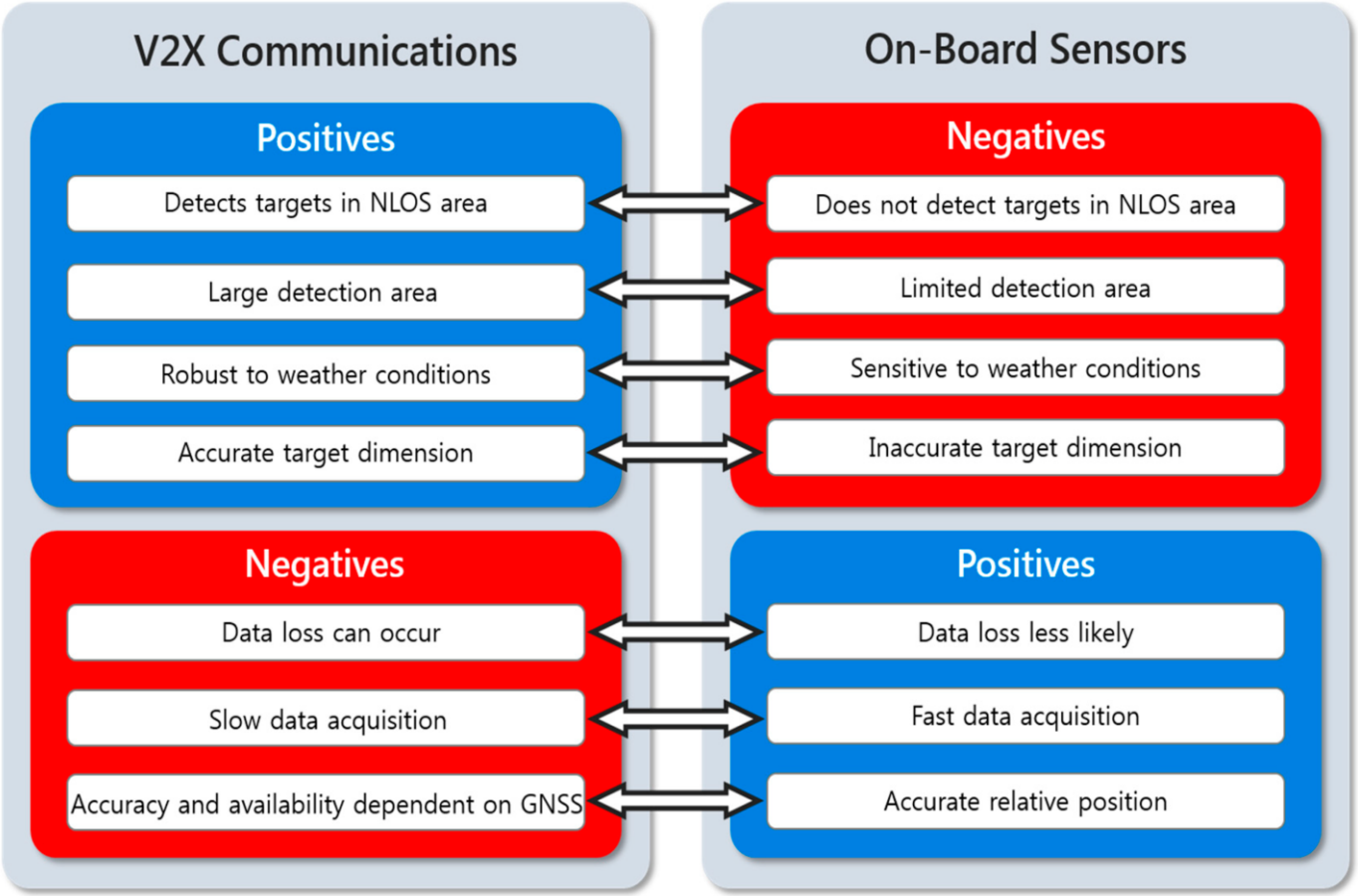
- Connectivity in the Automotive / Mobility
- V2X Technology Stack Architecture
- V2X Data Communication Standards
- OCC Enabled V2X NW Stack Architecture
- Conclusion

Connectivity in the Automotive / Mobility

- Automotive / Mobility landscape is undergoing a significant transformation driven by connectivity
- Connectivity on Mobility is a critical piece of automotive evolution that will unlock new capabilities such as safety alerts, enhanced traffic management, and next-gen capabilities (e.g., ADAS, Autonomous).
- Connectivity-enabled services in Mobility will support a proliferating, future set of mobility models and continued evolution in the connected vehicles, which requires communication standards to ensure data interoperability and security to maximize the benefits of V2X (vehicle-to-everything) infrastructure.
- Wi-Fi DSRC (Dedicated Short-Range Communications), C-V2X (Cellular V2X), and 5G C-V2X standards have risen as the primary candidates for V2X data communication.

Connectivity in the Automotive / Mobility…Cont.

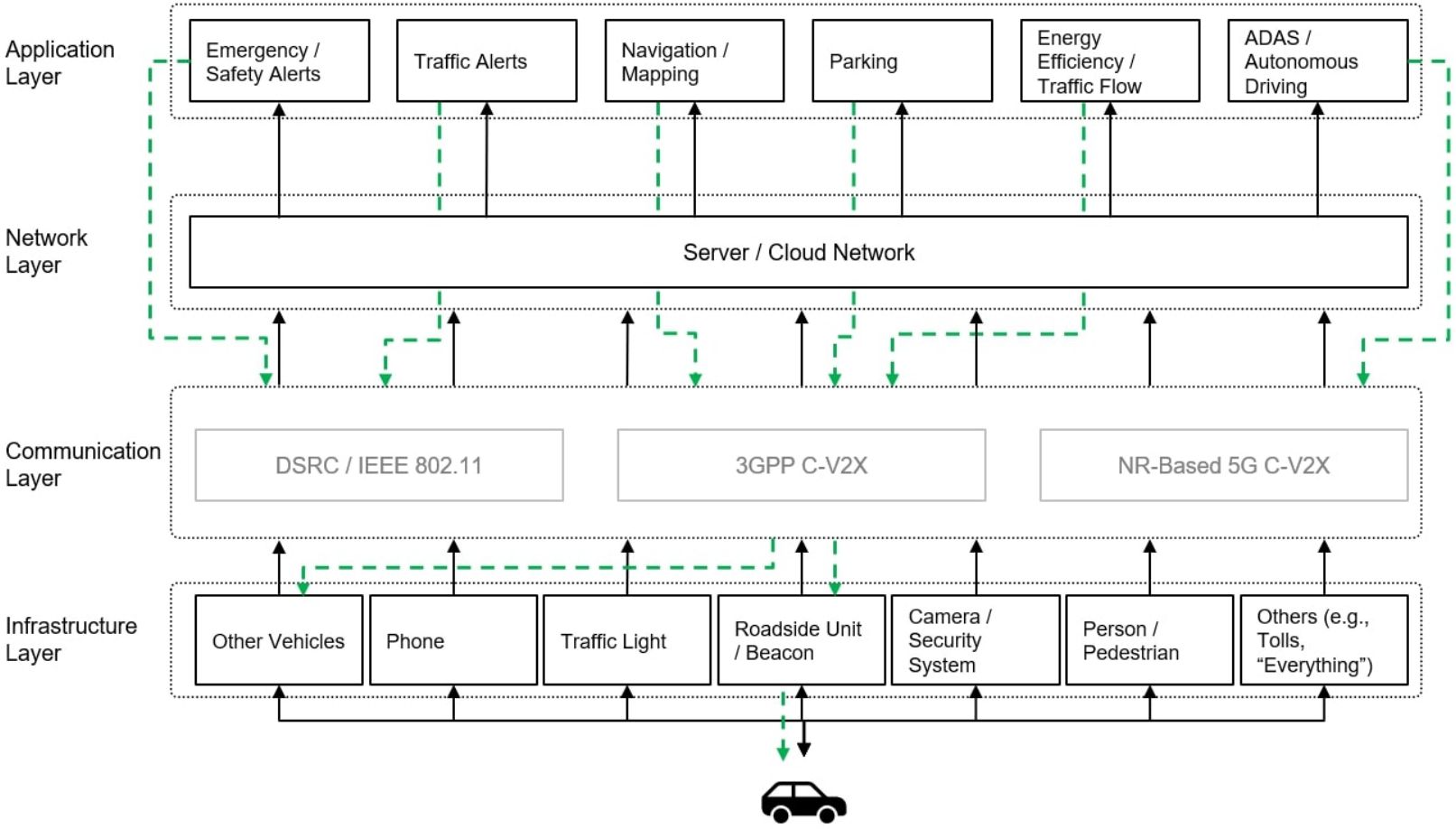
- Connectivity-Enabled Services Vs On-Board Sensors-Enabled Services



Impact on Automotive / Mobility Industry

- **Communication Standards in V2X Evolution**
  - Player across the Automotive, Mobile, and Telecom industries are driving investment / innovation in connectivity / sensors for vehicles, infrastructure, and vehicle networks on the path towards next-generation V2X mobility.
- **Growth of Smart Mobility**
  - Incumbents and new entrants are experimenting with novel mobility models (e.g. ride share) which are enhanced by a V2X connectivity environment, with the potentials to unlock new capabilities (e.g., ADAS, Autonomous).
- **Connected Ecosystem Development**
  - Driving a computing Applications in Mobility which offer added functionality for the in-vehicle experience, linkage to other connected ecosystems (e.g., connected home,), eventually surrounding vehicles, and connected on-road infrastructure .

V2X Technology Stack Architecture



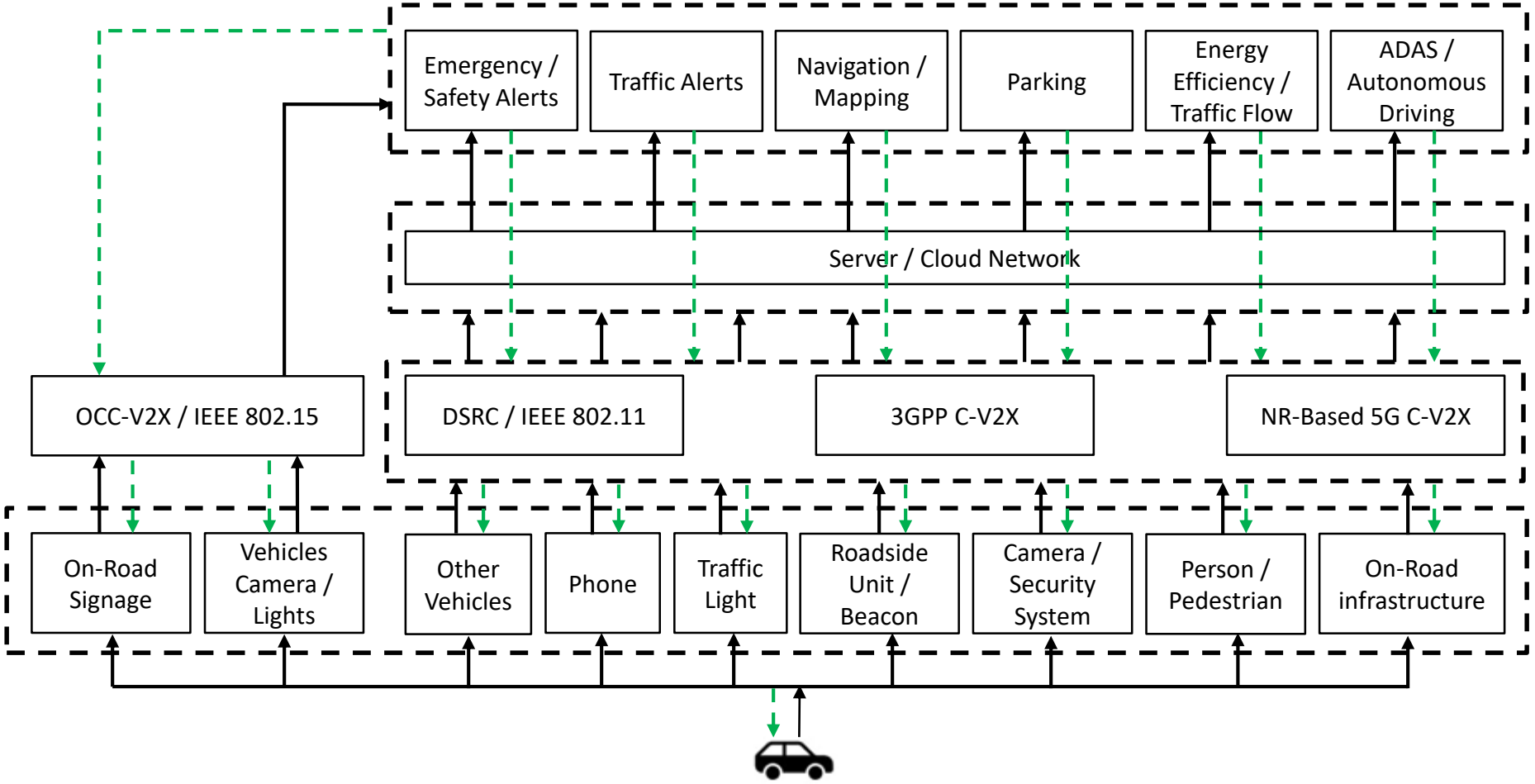
< V2X Technology Stack Architecture >

Sources(s): Red Chalk Group Analysis

V2X Data Communication Standards

	Wi-Fi DSRC / IEEE 802.11p	3GPP C-V2X	NR-Based 5G V-V2X
Commercial Readiness	Commercialized and installed in Vehicles	Commercialization started	Commercialization started
Illustrative Use Cases	Safety-related messages for local/close range communication for V2V and V2I situations	Supports node-to-note (V2V, V2I, V2P) as well as node-to-network (V2N) communication	Ability to support autonomous driving due to data volume, reliability and latency capabilities
Data Transmission Characteristics	**Data Volume:** Low-to moderate data volumes	Ability to drive high capacity / throughput by leveraging existing mobile infrastructure	Expected to have order of magnitude increases in data volume and device capacity per geographical area
	Range / Reliability: Short range (~ 1 km) communication limits the possibility of data interference	High advantage on line-of-sight communication range	Strong data reliability , even in high density environment
	Latency: Low Latency (2ms) for basic safety messages	Transmission duration is fixed at 1ms	Expected to reach 1ms for V2X communication

OCC Enabled V2X Stack Architecture



< OCC Enabled V2X Technology Stack Architecture >

OCC Enabled V2X NW Stack Architecture…Cont.

- **V2X OCC Link Characteristics**
  - Carries 300 THz of license-free bandwidth carried on visible wavelengths .
  - Low-to moderate data volumes
  - Short range (~ 200 m) communication limits the possibility of data interference
  - Low Latency for basic safety and alert messages
  - Provides flexible, secure, and safety communication.
  - Does not required additional automotive cybersecurity methods in connected mobility.

Conclusion

- Proposed the OOC Enabled V2X Stack Architecture for Connected Mobility.
- This proposed V2X stack architecture will act as a central driver in the enhancement of mobility through increased safety, value-added services, and advanced driving capabilities (e.g., ADAS, Autonomous, etc.).
- Discussed the different V2X Infrastructure Data Communication standards.
- This proposed OCC Enabled V2X stack design consideration helps to provide flexible, secure, and safety communication in an on-road mobility scenario through the OCC access link.