V2X Communication for Autonomous Driving
Technical Brief

The automotive industry is witnessing a perfect storm, as autonomous functionality coupled with connectivity capabilities enables the introduction of new vehicle driving models. Self-driving vehicles will allow for relaxed and enjoyable travel while writing emails or watching a movie. A global interdisciplinary effort is taking place to bring this autonomous vision to reality. The emergence of DSRC-based Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communications increases the level of certainty regarding a vehicle's surroundings, and serves as an enabler for autonomous driving.

Autonomous vehicles use maps to follow a route. Vehicle to Everything (V2X) communication enables map usage by improving positioning information when GPS is unavailable, such as in urban canyons. In addition, V2X allows the vehicle to better understand the intentions of surrounding vehicles, to receive guidance from infrastructure, and to allow cloud connectivity. Functional safety certification is required for reliable operation.

This paper discusses V2X-related communication considerations in the area of autonomous driving, and describes Autotalks' V2X strategy for autonomous driving safety.

Autonomous driving requirements

Enabling autonomous vehicles and autonomous driving requires perfect spatial orientation and a human-equivalent perception of situations. A wide range of sensors allows the vehicle to orient itself and maneuver, taking into consideration the different extreme cases that vehicles and drivers encounter in everyday driving. To enable a safe, autonomous journey, basic problems in the realm of physics must be solved. Will the morning sun saturate car cameras and LiDARs optics? Can the vehicle analyze correctly a situation on a foggy highway or in urban night traffic in a heavy rainstorm? Answers to these questions are based on heuristics, big data and deep learning mechanisms.

V2X communications may add a new layer of certainty to every operation with information obtained with DSRC-based messaging. Exactly how many cars are in the vicinity? What are their speeds and their trajectories? What are the intentions of out-of-sight vehicles, and what objects can they observe? Did this car stop around the corner to yield to a pedestrian?

Self-driving autonomous vehicles need to know the answers to these questions with certainty. As V2X communications evolve from Cooperative Awareness Messages (CAM) to Environmental Perception Messages (EPM), we may reach the confidence levels required.

Know where you are

Self-driving cars rely on exact locations for autonomous navigation. Satellites offer excellent positioning services, but they are not always available. In tunnels, urban canyons and underground parking lots, a vehicle's location is often unknown.

A self-driving car utilizes its cameras, radars, LiDARs, GPS, and its infrared, ultrasonic and motion sensors to obtain location, generate a local map, and plot best route forward – as long as the car has line-of-sight connectivity to the satellite and to other objects. V2I can be used to augment GPS service in order to provide always-available positioning.

V2X for Self-driving Cars:

- Positioning
- Safety
- Connectivity
- Trust

Integral part of safety

Safety is the main concern of autonomous driving, and V2X communications can address some of the complexities related to uncertainties. Human drivers preserve safety by signaling to each other in heavy urban traffic or in the presence of a road hazard. This type of information might produce a decision to apply emergency braking. Therefore, a V2X-based solution should comply with functional safety certifications to enable braking actuation or other preventive measures required to maintain safety.

Always connected

In the age of hyper-connectivity, cellular and Wi-Fi technologies can be leveraged to support the infotainment and operational needs of the self-driving vehicles' operator and passengers. While many vehicles today provide a Wi-Fi access point for their passengers, access to external broadband Wi-Fi service would streamline operational processes and enable always-on, high-bandwidth connectivity to cloud applications.

Security is the cornerstone of safety

Security threats have grown in sophistication, and autonomous self-driving vehicles will need to address potential vulnerabilities as this industry evolves. In traffic safety scenarios, security must not come at the expense of performance, and verification of V2V messages must be performed in real time – queueing of these messages is not an option. The solution must be cryptographic-agile, and must adapt to new threats during the lifetime of the vehicle. In addition, security systems should be certified and audited to ensure quality. In short, there is no safety without security.

Autotalks' solution was designed to meet V2X-specific security requirements based on an embedded Hardware Security Module (eHSM). This security-centric paradigm is the only viable approach to providing the performance and peace of mind required for autonomous vehicle operation.

Autotalks V2X for Autonomous

Autotalks' V2X solution was designed to meet autonomous driving and vehicles requirements.

- Know where you are – with accurate, V2X-based positioning for absolute orientation – even in challenging urban canyons
- Preparation for brake actuation with a functional safety certification
- Maintain cloud connectivity with an external Wi-Fi to complement cellular connectivity
- Build trust with embedded security for headroom performance and lower latency