Vehicle-to-Everything technology

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Introduction

Vehicule to Everything (V2X) is a communication system that allows vehicles to communicate with each other, infrastructure or pedestrians.
This technology incompasses six specific types of communication:

- Vehicle-to-infrastructure (V2I)
- Vehicle-to-network (V2N)
- Vehicle-to-vehicle (V2V)
- Vehicle-to-pedestrian (V2P)
- Vehicle-to-device (V2D)
- Vehicle-to-grid (V2G)

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V2X's main purpose is to increase road safety, taffic efficiency and decrease energy consumption by sharing information such as location and speed to act on different vehicle parameters, such as itinerary and cruise control speed.

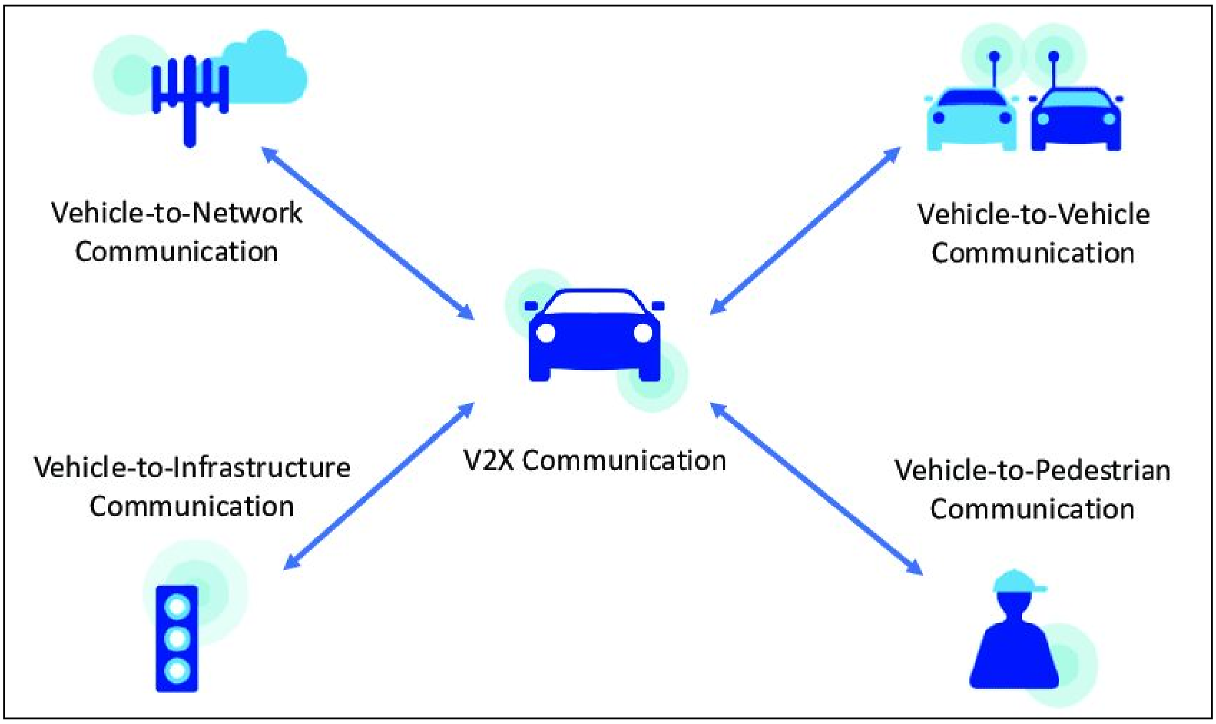
Vehicle-to-Network Communication
Vehicle-to-Vehicle Communication
V2X Communication
Vehicle-to-Infrastructure Communication
Vehicle-to-Pedestrian Communication

Fig 1: Basic represention of V2X system

Source:
https://www.st.com/en/applications/telematics-and-networking/vehicle-to-everything-v2x.html
https://www.researchgate.net/figure/Towards-seamless-ubiquitous-vehicle-to-everything-V2X-communication_fig1_331676083

Normalization

As governments perceive V2X as a general safety asset, they encourage the automotive industry to keep developing it.

In 2012, IEEE published a standardization of V2X based on WLAN (802.11) which supported communication between V2V and V2I because of the short maximum range of the radio protocol.

In 2016, 3GPP published new V2X specifications based on LTE. Since this date, V2X technology can use cellular networks to communicate on a wider range, introduced V2N.

Source:
https://www.see.asso.fr/node/11510/landing

V2X principle

Considering modern high bandwidth and high reliabilty links, a V2X system is able to use vehicule sensors to communicate in real-time with infrastructures, vehicles or users.

Vehicle-to-vehicle and vehicle-to infrastructure are the main components of a V2X system. Through these two communication methods, the vehicle can exchange data about parking places, accidents, weather or road state.

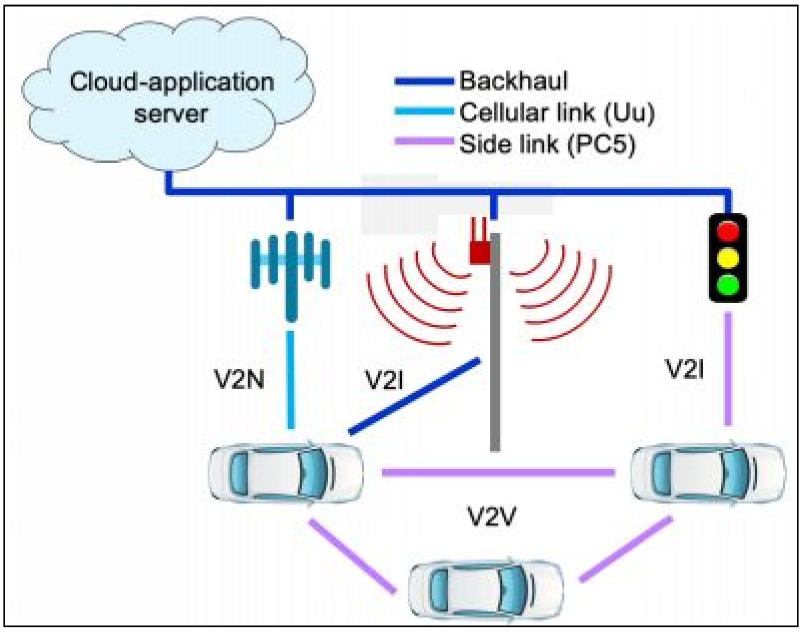

Fig 2: V2X technology detail

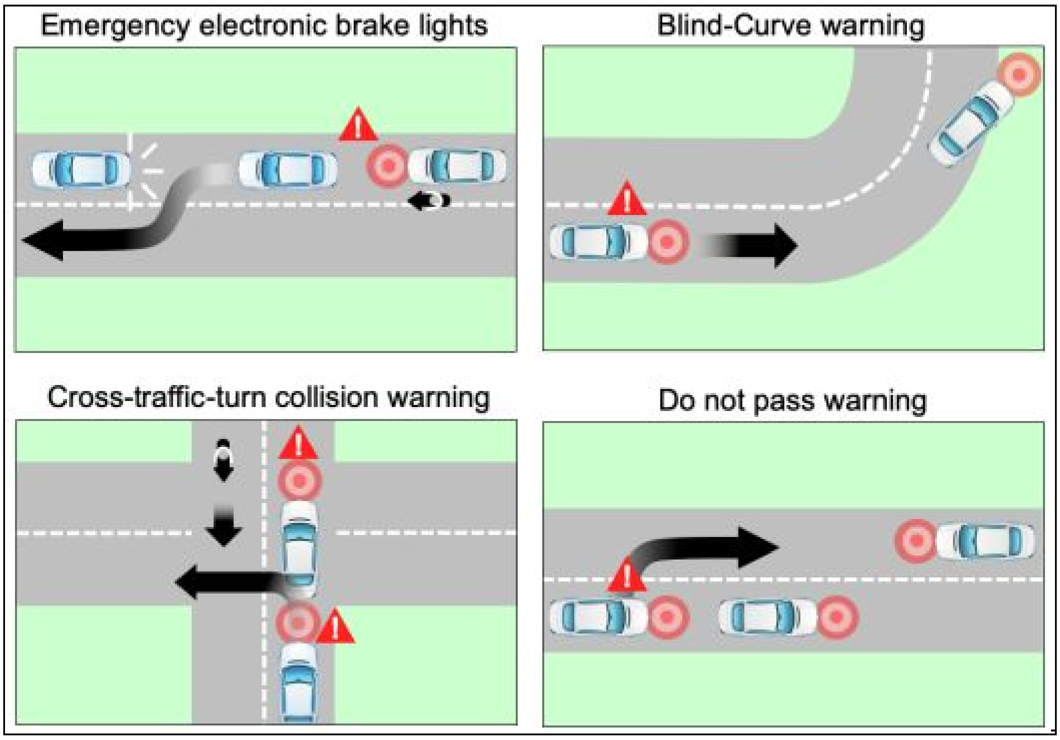
Emergency electronic brake lights
Blind-Curve warning
Cross-traffic-turn collision warning
Do not pass warning

Fig 3: V2X use cases examples

Sources:
https://corporatefinanceinstitute.com/resources/knowledge/other/vehicle-to-everything-v2x/
https://www.qualcomm.com/media/documents/files/c-v2x-drives-intelligent-transportation.pdf

V2X technology

The future of V2X comes alongside the evolution of LTE and 5G.

DSRC (Dedicated Short Range Communication) is a particular case of V2X technology. Its purpose is to allow message exchanges between nearby systems. Those messages are called BSM (Basic Safety Message).
This protocol operates on a 75Mhz band in the 5.9Ghz spectrum and is based on the IEEE 802.11p standard as its physical and MAC layers.

There are several challenges in V2X communication which are common to IoT systems. Since the purpose of this technology is mainly to improve road security, we can cite four obvious requirements:

- Avoid messages collisions
- Minimize latency
- Ensure Quality of Service
- Limit energy consumption

Source:
https://www.qualcomm.com/media/documents/files/introduction-to-c-v2x.pdf

Conclusion

From an innovation standpoint, Vehicle-to-Everything technology looks very promising. The ability to communicate with all other road-related entities can ensure more safety by alerting of road accidents or critical weather conditions. Moreover, receiving traffic lights information and other vehicles' position could increase traffic speed and fluidity which would in turn have a positive impact on the environment through decreased fuel consumption

V2X technology is also very compatible with other innovation fields, such as autonomous vehicles and driving assists. As autonomous vehicles are scanning their surroundings, V2X could be an asset to allow vehicles to retrieve more information and improve specific situation forecasting.

However, Vehicle-to-Everything innovation can raise different questions regarding IT security and data privacy. As every user has their position (and other sensitive data) potentially shared, companies will have to guarantee data privacy and implement advanced security protocols follow ethical guidelines.

Besides, the system's security is incredibly sensitive, as the data has a direct impact on vehicle behaviour. It is legitimate to ask what would happen if an entity were to send malicious data to autonomous vehicles in order to create a disaster. This technology's purpose is mainly to ensure security and limit human implication on accidents but it could also open the door to a new way for ill-intentioned parties to cause accidents or other malicious events.