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An overview of the 3GPP identified Use Cases for V2X Services

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Abstract

Recently, the telecommunication standard development body reported LTE support for V2X services-based use cases along with their potential requirements. However, these requirements overlap and require a huge effort to understand. Therefore, it is imperative to know the outcomes of the use cases and categorization of the potential requirements. In this paper, we provided an overview of the use cases, their potential outcomes, and a comparison between the potential requirements based on their categorization i.e. latency, message size, mobility performance, response time, message frequency, anonymity and integrity, reliability, and communication. The outcomes help in knowing about the response envisioned by the identified use cases for V2X services. The comparison of potential requirements describes three important requirements: latency, message size, and mobility performance for realizing the V2X service-based use cases. In future work, we aim to provide a holistic overview of realizing enhanced use cases in real-world scenarios to accomplish V2X service communication.

Keywords: V2X services; Use cases; V2X Requirements; V2X Scenarios; LTE-V2X Services.

1. Introduction

The shift in telecommunication standard body towards improving and standardising vehicular communication will place a phenomenal mark in the automotive industry and specifically in the vehicle-to-everything (V2X) service applications [4]. Although, the issues related to realizing the advance V2X communication are still open and need to be addressed e.g., improving latency and reducing computing power to enable true Long Term Evolution (LTE)-V2X and Fifth Generation Wireless (5G)-V2X communication. Therefore, it becomes imperative to start looking into the foundation use cases and their corresponding scenarios identified for achieving the V2X service-based vehicular communication. In this connection, the 3rd Generation Partnership Project (3GPP) started working on reporting technical documentations describing LTE-supported use cases for realizing V2X services since late 2015 [13, 15].

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Since then, the 3GPP has produced a number of standards and reported various technical documents which support V2X service communication. Among these technically reported documents, the LTE-supported use cases for V2X services became the underpinning technical report for a number of standardizations which leverage the use of V2X service applications [13].

The global partnership body aimed for addressing safety and non-safety aspects in vehicles by enhancing the vehicular communication using the on going cellular technology i.e. LTE technology [1]. Therefore, LTE-supported use cases and their potential requirements were reported for V2X services (also known as LTE-V2X services) and its underlying initial supporting types i.e. V2V, V2I, and V2P services. Each use case reported by 3GPP contains description, pre-conditions, service flows, post-conditions, and potential requirements to successfully achieve the implementation and standardize a possible solution for that use case [13]. In this paper, we provide an overview of the use cases, their potential outcomes when successfully addressed, and a comparison between the potential requirements for each use case. This is an on going work aiming to provide a full overview of how these use cases are realized in the real world scenarios and what potential requirements are added/dropped to maintain the V2X services ecosystem build by these use cases. Hence, this will lead to informatively and innovatively showcase 3GPP work in standardizing technologies for supporting V2X services as provide by their technical documents until this date.

The rest of the paper is organized as follows. Section 2 presents the background regarding V2X communication. V2X service-based use cases are overviewed in Section 3, and their potential requirements are compared and discussed in Section 4. Conclusions and future work are presented in Section 5.

2. Background of V2X Types

The LTE support for V2X services indicates the inclusion the new services to the LTE platform. Therefore, the 3GPP is developing functionalities for vehicular communications to fulfil the increasing requirements of automotive industry. The 3GPP body reported LTE-supported use cases for V2X services in order to standardize an initial cellular V2X (C-V2X), which was complete during the end of year 2016 [15]. The V2X concept leverages advanced information and communication technologies to realize omni-directional vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-pedestrian (V2P) communications.

2.1. V2V Services

V2V services enable vehicles to communicate and exchange data about their driving behaviors with each other using dedicated short-range communication (DSRC) technology. The vehicles share their speed, position, traveling direction with each other aiming to improve the decision-making and traffic safety; by providing warning alerts in advance to the drivers before they face or detect the events. Some of the real-time applications of V2V communication are: i) forward collision warning; ii) left turn assistance; iii) lane change warning, etc [7].

2.2. V2I Services

V2I services enable bidirectional wireless information exchange between the vehicles and the road infrastructure. They allow the vehicles to communicate with the infrastructure such as roadside units (RSUs), traffic signals, lane marking, traffic lights, and other external entities, etc. to enhance safety, reduce road crashes and collisions. Moreover, the V2I communication provides the vehicles with useful information such as available parking slots, routes with congested traffic, and dynamic weather conditions using the DSRC frequencies. Some of the use cases of V2I communication are reduced speed, stop sign gap assistance, curve speed warning, and bad weather condition warning [16].

2.3. V2P Services

In V2P services, communication occurs between the vehicles and the vulnerable road users (VRUs) within the proximity. The V2P communication works for different purposes such as road safety, convenience, and to deal with a group of VRUs i.e., pedestrian, road user, and cyclist. The user equipment unit carried by the autonomous vehicle and the pedestrians is capable of receiving and sending various warning alerts to each other such as alerts provided to the VRU of an approaching vehicle and vice versa. Moreover, the vehicles can communicate with the pedestrians even when they are not in the line of sight and in low visibility environments including heavy rain and foggy weather [10].

3. Overview of LTE-Supported Usecases for V2X Services

The V2X service applications are distributed among device, edge, and cloud layer. Keeping in mind the actual categorization of V2X services based on these layers, we have divided the foundation use cases into four different categories such as V2V, V2I, V2P, and V2X services as shown in Table 1. The aforementioned activity is performed by the researchers after studying their descriptions, pre-conditions, service flows, post-conditions, and potential requirements. The V2X service-based use cases include other services such as V2V service, V2I service, and V2P service. Unlike V2X category, the other categories of use cases only depends on the corresponding services. Furthermore, we provide the number of potential requirements to each use case that shows an idea about its importance, but still the importance depends on the critical situation covered in the use case. Equally important, the Table 1 provides details for the use case outcomes, which is a quick way to know about the exact response of a use case. In what follows next, we provide our overview of the use cases for V2V, V2I, V2P, and V2X services.

3.1. V2V Services-based Use Cases

V2V services include applications where two UEs make direct communication with each other [17, 9, 3, 8]. The 3GPP standardization body provided a list of use cases in order to provide support of LTE for V2X services. In what follows next, we provide a brief version of the use cases identified for LTE-based V2V services meaning that these use cases are realized with the help of V2V services.

1. **Forward Collision Warning (FCW):** This use case alerts vehicle driver to avoid forthcoming vehicle collision meaning that the driver will be able to get a audio/visual warning when there is a potential collision in its path.
2. **Control Loss Warning (CLW):** This use case alerts vehicle driver to avoid collision caused by control loss. In such cases, an automatic event i.e. CLW describing about the control loss is triggered to the surrounding vehicle with the help of V2V service.
3. **Emergency Vehicle Warning (EVW):** This use case informs vehicle drivers to free way in emergency situations. EVW systems are designed to warn vehicle drivers about its location, speed and direction in advance.
4. **Emergency Stop:** This use case informs other vehicle drivers to take appropriate action in case of emergency stop. Reflecting to the possibility of a stationary vehicle becoming dangerous to other vehicles in its proximity, an emergency stop will reduce the hazard and allow safer behaviour of other vehicles.
5. **Cooperative Adaptive Cruise Control (CACC):** This use case allows other vehicles to join and leave the CACC group of vehicles. Hence, it brings an amazing improvement in fuel efficiency and becomes a safe way for other vehicles to participate with other vehicles.

Table 1. LTE-supported Usecases for V2X Services

#	Services	Use Cases	Outcome	PR
1	V2V Services	Forward Collision Warning	Alert vehicle driver to avoid collision	11
2		Control Loss Warning	Alert vehicle driver to avoid collision	9
3		Emergency Vehicle Warning	Inform vehicle driver to free the street way	5
4		Emergency Stop	Inform vehicle driver to take appropriate action	5
5		Cooperative Adaptive Cruise Control	Allow vehicle to join and leave the CACC group	4
6		Wrong Way Driving Warning	Alert vehicle driver to take appropriate action	1
7		V2X message transfer under MNO control	Allow driver to receive message from another vehicle	11
8		Pre-crash Sensing Warning	Alert vehicle driver to take appropriate action	3
9		V2X in areas outside network coverage	Allow vehicle drivers to know the location, direction, and speed of each other	4
10		Privacy in the V2V communication environment	Allow vehicle drivers to ensure privacy	1
11	V2I Services	Emergency Stop	Inform vehicle driver to take appropriate action via service RSU	5
12		Queue Warning	Inform vehicle driver about queue to take appropriate action via service RSU	7
13		Road Safety Services	Alert vehicle driver to take preventive action for possible risky situation	9
14		Curve Speed Warning	Alert vehicle driver to take appropriate action	5
15		Remote diagnosis and just in time repair notification	Update vehicle driver about diagnostic and maintenance of the vehicle	1
16	V2P Services	Warning to Pedestrian against Pedestrian Collision	Alert pedestrian to take preventive action due to risky situation	15
17		Vulnerable Road User (VRU) Safety	Inform vehicle driver to take necessary action of the potential hazard	8
18		Pedestrian Road Safety via V2P awareness messages	Alert vehicle driver to avoid collision by taking appropriate action	4
19		Overview to road traffic participants and parties	Allow RTP to have a wider view of other RTPs	6
20	V2X Services	Automated Parking System	Allow authorized vehicle to park and unauthorized to purchase reservation	6
21		V2X Road safety service via infrastructure	Allow vehicle drivers to reduce potential risk of pedestrian fatality	6
22		V2N Traffic Flow Optimisation	Inform vehicle drivers to follow the instructions for optimize traffic flow	8
23		V2X by UE-type RSU	Allow vehicle driver to adjusts speeds for intersection and avoid car collision	2
24		V2X Minimum QoS	Allow vehicle to use minimum QoS and emergency vehicle to reach in time	2
25		Use case for V2X access when roaming	Alert vehicle driver to take alternative route causing low delay	4
26		Mixed Use Traffic Management	Allow vehicle drivers and pedestrians to stop in a timely manner	1
27		Enhancing Positional Precision for traffic participants	Allow vehicle driver to know the position of the car	2

6. **Wrong Way Driving Warning (WWDW):** This use case alerts vehicle drivers to take appropriate action when they are happen to be in wrong way driving and opposing each other on a one-way direction road. Therefore, it is important to alert both vehicle drivers when a vehicles detects another vehicle in a wrong-way driving direction.
7. **V2X message transfer under MNO control:** This use case allows vehicle drivers to receive V2X messages from another vehicle which is under E-UTRAN coverage. In this scenario, the sender vehicle is able to make V2X communication even when it is under MNO control and using its coverage.
8. **Pre-crash Sensing Warning:** This use case alerts vehicle drivers to take appropriate action during a non-avoidable crash detection. The vehicles communicate through V2V service and provide warnings by exchanging the vehicles attributes in order to reduce the risk of an unavoidable accident. Hence, the severity of the accident can be greatly reduce by realizing this use case in today vehicles.
9. **V2X in areas outside network coverage:** This use case allows vehicle drivers to know the location, direction, and speed of each other even in scenarios where the area is outside the network coverage. Hence, V2V services provide vehicular communication to the vehicles in order to avoid and reduce risks.
10. **Privacy in the V2V communication environment:** This use case allows vehicle drivers to ensure privacy during the vehicular communication of vehicles in a longer journey. The privacy or anonymity has an important role in realizing a successful V2V communication environment for the vehicles in the V2V system.

3.2. V2I Services-based Use Cases

The vehicular communication does not only rely on a direct communication between vehicles, but any two UEs happen to make vehicular communication with each other via a unit available in the infrastructure, which is known as V2I service [2, 14]. The 3GPP standardization body enlarge the list of use cases from V2V service-based to V2I service-based use cases. In what follows next, we provide a brief version of the use cases identified for LTE-based V2I services meaning that these use cases are realized with the help of V2I services or applications.

1. **Emergency Stop:** This use case informs vehicle driver to take appropriate action via service RSU. The main difference lies in the use of service RSU instead of direct communication between vehicles.
2. **Queue Warning:** This use case informs vehicle driver about a queue to take appropriate action via service RSU. Hence, it helps in reducing the potential danger caused by a queue and improve the flow of traffic specially in scenarios where a queue is tend to increase into other lanes. The service RSU gathers the queue information and updates the approaching vehicle drivers whom can take appropriate action towards mitigating the crashes.
3. **Road Safety Services:** This use case alerts vehicle driver to take preventive action for possible risky situation with the help of V2I service using an RSU. The role of RSU is receiving (and transmitting) the V2X messages from (and to) the UEs supporting V2I service. Hence, the vehicle drivers are notified with the information to perform actions that reduces risks.
4. **Curve Speed Warning (CSW):** This use case alerts vehicle driver to take appropriate action during passing a curve. When a vehicle driver is approaching a curve or leaving a curve too fast, the CSW provides warning to manage the speed in order to reduce the risk of crashes and/or collisions.
5. **Remote diagnosis and just in time repair notification:** This use case updates vehicle driver about diagnostic and maintenance of the vehicle with the help of service RSU. However, the UEs are required to provide its information to the service RSU when passing by it.

3.3. V2P Services-based Use Cases

In vehicular communication, a UE can also perform direct communication with a pedestrian(s) when both supports V2P service. Due to direct vehicular communication, it is only possible when the pedestrian(s) is in the proximity of the UE [6, 12]. In V2P communication, a pedestrian is any VRU equipped with UE that help to enable the application of ITS. In what follows next, we provide a brief version of the use cases identified by 3GPP standardization body for LTE-based V2P services meaning that these use cases are realized with the help of V2P service applications.

1. **Warning to Pedestrian against Pedestrian Collision:** This use case alerts pedestrian to take preventive action due to risky situation caused by moving vehicles. The VRUs receive warning messages when found in the proximity of passing by vehicles, where both the vehicles and VRUs support V2P service. Hence, the VRUs are alerts of imminent collisions.

2. **Vulnerable Road User (VRU) Safety:** This use case informs vehicle drivers to take necessary action for VRUs during the presence of a potential hazard. Using the capabilities of V2P service, both vehicle drivers and VRUs are alerted about forthcoming threat and hence, improve the safety for VRUs by reducing the likelihood of risks.
3. **Pedestrian Road Safety via V2P awareness messages:** This use case alerts vehicle driver to avoid collision by taking appropriate action upon receiving broadcast messages from pedestrian UE supporting V2P service. The messages include speed, position, and heading information about pedestrian UE. The vehicle UE alert the driver after performing collision risk assessment.
4. **Overview to road traffic participants and interested parties:** This use case allows RTP to have a wider view of other RTPs by broadcasting the data through the network. The data from RTPs in a certain area is collected and then broadcast to other RTPs in order to provide an overview of the surrounded area.

3.4. V2X Services-based Use Cases

The V2X services contain direct and indirect vehicular communication between UEs through its various types such as V2V service, V2I service, and V2P service [11, 5]. Hence, any entity (UE) that may affect by the vehicle is considered in the V2X vehicular communication. This allow real time communication with vehicles and any UE in surrounding. In what follows next, we provide a brief version of the use cases identified by 3GPP standardization body for LTE-based V2X services meaning that these use cases are realized with the help of V2V-, V2I-, and V2P-service applications.

1. **Automated Parking System (APS):** This use case allows authorized vehicle to park and unauthorized to purchase reservation. The APS perform such services with the help of real-time information of vehicles available in a database. Moreover, the APS supported by V2X services can be realized in a building or street parking.
2. **V2X Road safety service via infrastructure:** This use case allows vehicle drivers to reduce potential risk of pedestrian fatality. The traffic safety servers and service RSUs are responsible for generating and distributing road safety messages. This distribution helps in improving the safety and reducing potential risks.
3. **V2N Traffic Flow Optimisation:** This use case informs vehicle drivers to follow the instructions for optimizing traffic flow during approaching an intersection (or any other situation). The communication between vehicle and the traffic light signals will lead the vehicle driver to safety pass through green light.
4. **V2X by UE-type RSU:** This use case allows vehicle driver to adjust speeds for intersection in order to reduce crashes and avoid car collision. However, this is possible when V2X-supported UE is able to find and exchange information with another UE-type RSU.
5. **V2X Minimum QoS:** This use case allows vehicle to use minimum QoS and emergency vehicles to reach in time since they need a free way to their target locations. The minimum QoS describes a scenario i.e. "E-UTRA(N) resource is not enough for every UEs 10 Hz V2X message transmission".
6. **Use case for V2X access when roaming:** This use case alerts vehicle drivers to take alternative route when the given route is causing high delays due to any major infrastructure construction project. The vehicle drivers need to be informed with the help of V2X service supported by other network operators.
7. **Mixed Use Traffic Management:** This use case allows vehicle drivers and pedestrians to stop in a timely manner in situations which involve various types of vehicular traffic. The UEs velocity, reaction time, and other environmental conditions are considered when managing such scenarios through a V2X system.
8. **Enhancing Positional Precision for traffic participants:** This use case allows vehicle driver to know the position of the car in order to avoid any uncertainty during driving the vehicle in multiple lanes. The correct and precise knowledge about the vehicle position is important for other road participants.

4. Comparison of Usecases' Requirements

The potential requirements for LTE-supported V2X service-based use cases mainly focus on latency, message size, mobility performance (i.e. absolute speed and relative velocity), response time, message frequency, anonymity and integrity, reliability, communication (i.e. message transfer, message receive, authorization, and other supports), and some miscellaneous collection of requirements. Furthermore, the main aim of these use cases is enabling Level 1 communication with the help of environmental awareness and warning messages for vehicle drivers and pedestrians. In this paper, we present a unique approach for summarizing the potential requirements for LTE-supported V2X service-based use cases as shown in Table 2. Therefore, it provides a simplified way for the readers when looking into

Table 2. Comparison of Requirements for V2X Service-based Use Cases

#	Use Cases	Latency (Max)	Message Size (Bytes)		Mobility Performance		Response Time	Frequency (Max)	Anonymity and Integrity	Reliability	Communication				Others
			Actual	Upto	Absolute Speed	Relative Velocity					Message Transfer	Message Receive	Authorization	Other Supports	
1	Forward Collision Warning	100ms	50-300	1200	160 km/h		4s	10 msgs/sec	V2V service	High	Yes	Yes	Yes	Yes	
2	Control Loss Warning	100ms	50-300	1200		280 km/h	4s	10 msgs/sec	MNO Network	High	Yes	Yes			
3	Emergency Vehicle Warning	100ms	50-300	1200		280 km/h	4s	10 msgs/sec							
4	Emergency Stop	100ms	400	1200	160 km/h		4s	10 msgs/sec							
5	Cooperative Adaptive Cruise Control	1s					4s	1 msg/sec		High					High Density (e.g., 4-lane motorway with traffic jam)
6	Wrong Way Driving Warning										Yes				
7	V2X message transfer under MNO control										Yes	Yes	Yes	Yes	Minimize battery consumption and Network controlled establishment
8	Pre-crash Sensing Warning	20ms	50-300		160 km/h					High					
9	V2X in areas outside network coverage										Yes	Yes	Yes		
10	Privacy in the V2V communication environment														Support driver and vehicle privacy
11	Emergency Stop	100ms	400	1200		160 km/h	4s	10 msgs/sec							
12	Queue Warning	100ms	50-400	1200		160 km/h	4s		V2I service		Yes	Yes			
13	Road Safety Services	100ms		1200	160 km/h			10 Hz	V2I service		Yes		Yes		Recognize cell (eNB) supporting message transfer
14	Curve Speed Warning	1s	50-400				4s	1 msg/sec				Yes			
15	Remote diagnosis and just in time repair notification										Yes			Yes	
16	Warning to Pedestrian against Pedestrian Collision		50-300	1200	160 km/h						Yes	Yes	Yes	Yes	Minimize battery consumption due to V2X messages transmission
17	Vulnerable Road User (VRU) Safety	100ms	50-300	1200	160 km/h		4s	1 msg/sec		High	Yes	Yes			
18	Pedestrian Road Safety via V2P awareness messages					160-280 km/h	4s				Yes				Minimize power consumption
19	Overview to road traffic participants and parties	500ms	50-1200					10 msgs/sec	MNO Network				Yes		Distribute information to large number of Ues
20	Automated Parking System	100ms	50-400			160 km/h	4s							Yes	
21	V2X Road safety service via infrastructure	500ms									Yes	Yes	Yes	Yes	Provide area control to a traffic safety server / UEs / RSU
22	V2N Traffic Flow Optimisation	1000ms	50-300					1 msg/sec	V2N service				Yes	Yes	Provide location to the ITS Server
23	V2X by UE-type RSU												Yes		Control radio resources
24	V2X Minimum QoS														Prioritize transmission by purpose and type
25	Use case for V2X access when roaming													Yes	Communication support by same/different PLMN: V2V, V2I, V2P
26	Mixed Use Traffic Management													Yes	Support for different service conditions
27	Enhancing Positional Precision for traffic participants													Yes	Derive location with high accuracy

the most important requirements. In addition, the positioning of each requirement (column) is based on the number of entries for the corresponding requirement. The more use cases need that requirement the first it becomes.

The minimum latency requirement is 100ms and maximum latency requirement is 1s. For many use cases, the end-to-end latency requirement is 100ms. Latency is one of the main requirements as it is required by almost every category of the services. Similarly, message size is yet another main requirement to realize each category of the services. The actual massage size ranges from 50-300 Bytes, 50-400 Bytes, and 50-1200 Bytes. However, these ranges can be extended upto 1200 Bytes for most of the use cases. Only two use cases require 400 Bytes, but they also support extension upto 1200 Bytes. Moving forward, an important requirement for the realization of many use cases is mobility performance, which is divided into two parts i.e. absolute speed and relative velocity. Since, these use cases consider vehicular communication, therefore, it is important to know about speed and velocity limits. The absolute speed requires a vehicle in 160 km/h and the relative velocity ranges from 160 km/h to 280 km/h. With these limits, the use cases would clearly realize the mobility performance supported by V2X services.

Since one of the key features of these use cases is warning messages, it is important to know about the response time required for realizing these use cases. In almost every required use case, the 4s response time is demanded, which is fair-enough to avoid the risk associated with vehicle crashes and collisions. Every service category includes a requirement for response time. Equally important, frequency of the messages places a key position in fulfilling the requirements of many use cases. Without knowing about the number of messages transfer/receive by UEs, it would become difficult to perform vehicular communication and make it a success. For almost every service category, frequency of messages is required and the minimum frequency requirement is 1 message per second, whereas, the maximum frequency requirement is 10 messages per second. In the V2V service-based use cases, the vehicles/UEs are required to exchange information more often and therefore majority of the use cases are in need of frequency requirement.

In some use cases, it is imperative to have anonymity and integrity requirement, which is fulfilled by V2V service, V2I service, V2N service, and Network Coverage (Operator). Hence, the vehicle drivers are ensured with privacy during the vehicular communication in a longer journey. The success of such communication environment for vehicles in the V2X system depends over the anonymity and integrity requirement. In the similar way, reliability is also required for the successful realization of these use cases. The most exacting reliability requirement is High for enabling the LTE-based V2V and V2P communication. However, in the current identified use cases reliability is not a requirement for V2I and V2X (in general) communication.

Apart from other requirements, one of the main requirement is communication, which is the back-bone of other most important sub-requirements. It includes message transfer, message receive, authorization, and other supports for making the vehicular communication possible. Indeed, without the transfer and receiving of messages, the vehicles or UEs will have no exchange of information and they will not provide any realization to almost every use case. Every service category includes at least a sub-requirement from the communication. Many use cases require the transfer and receiving of the messages for exchanging information to avoid risks and reduce the severity in crashes and collisions. Some use cases require authorization either by MNO or service RSU or server to enable the benefits of communication between vehicle to avoid risky situations. Some of the use case demand for miscellaneous collision of requirements such as minimizing battery and power consumption, providing location and area control, and supporting other service conditions.

The potential requirements from 1-10 are for V2V service-based use cases, from 11-15 are V2I service-based use cases, from 16-19 are V2P service-based use cases, and from 20-27 are V2X service-based use cases. In this paper, we provide a categorization of the potential requirements for these use cases (from latency to communication as discussed above). Therefore, it becomes easy to focus on a certain category which ultimately makes the potential possibility for the realization of many use cases. The grouping provides a simplified way of understanding about the needs and workarounds of these use cases which enables the LTE-V2X service communication.

5. Conclusion

The cellular LTE platform supported many use cases for realizing V2X services when a number of potential requirements are addressed. In this paper, we informatively and intuitively provided an overview of those use cases, their potential outcomes when successfully realized, and a comparison between the potential requirements. The outcomes provide a quick and simplified way to know about the exact response envisioned by the identified use cases. The comparison of potential requirement includes categorization of requirements i.e. latency, message size, mobility performance, response time, message frequency, anonymity and integrity, reliability, communication (i.e. message transfer, message receive, etc.). In future work, we aim to provide full overview of how these and the enhanced use cases are realized in the real world scenarios and what potential requirements are added/dropped to maintain the V2X service communication.

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