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LTE;  
Architecture enhancements for V2X services  
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# Foreword

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# 1 Scope

The present document specifies architecture enhancements to facilitate vehicular communications for Vehicle-to-Everything (V2X) services, which includes Vehicle-to-Vehicle (V2V), Vehicle-to-Pedestrian (V2P), Vehicle-to-Infrastructure (V2I), and Vehicle-to-Network (V2N), according to the use cases and service requirements defined in TS 22.185 [2].

The following vehicular communications for V2X services are specified:

- V2X communication over PC5 reference point.
- V2X communication over LTE-Uu reference point.

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# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] 3GPP TS 22.185: "Service requirements for V2X services".
- [3] ISO TS 17419:2014: "Intelligent Transport Systems - Cooperative systems - Classification and management of ITS applications in a global context".
- [4] IEEE Std 1609.12-2016: "[IEEE Standard for Wireless Access in Vehicular Environments \(WAVE\) - Identifier Allocations](https://standards.ieee.org/standard/1609.12-2016.html)".
- [5] 3GPP TS 23.303: "Proximity-based Services (ProSe); Stage 2".
- [6] 3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access".
- [7] 3GPP TS 23.468: "Group Communication System Enablers for LTE (GCSE\_LTE)".
- [8] 3GPP TS 23.246: "Multimedia Broadcast/Multicast Service (MBMS); Architecture and functional description".
- [9] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".
- [10] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".
- [11] 3GPP TS 26.346: "Multimedia Broadcast/Multicast Service (MBMS); Protocols and codecs".
- [12] 3GPP TS 23.203: "Policy and charging control architecture".
- [13] IEEE Std 1609.3-2010: "IEEE Standard for Wireless Access in Vehicular Environments (WAVE) - Networking Services".
- [14] ISO 29281-1:2013: "Intelligent Transport Systems - Communications access for land mobiles (CALM) - Non-IP networking - Part 1: Fast networking & transport layer protocol (FNTP)".

- [15] 3GPP TS 29.272: "Evolved Packet System (EPS); Mobility Management Entity (MME) and Serving GPRS Support Node (SGSN) related interfaces based on Diameter protocol".
- [16] ETSI TS 102 637-2 V1.2.1: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service".
- [17] ETSI TS 102 637-3 V1.1.1: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3: Specifications of Decentralized Environmental Notification Basic Service".
- [18] 3GPP TS 32.277: "Proximity-based Services (ProSe) charging".
- [19] Void.
- [20] 3GPP TS 32.251: "Telecommunication management; Charging management; Packet Switched (PS) domain charging".
- [21] 3GPP TS 32.273: "Telecommunication management; Charging management; Multimedia Broadcast and Multicast Service (MBMS) charging".
- [22] 3GPP TS 36.304: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode".
- [23] 3GPP TS 23.122: "Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode".
- [24] Void.
- [25] 3GPP TS 33.185: "Security aspect for LTE support of V2X services".
- [26] 3GPP TS 36.321: "Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification".
- [27] 3GPP TS 24.386: "User Equipment (UE) to V2X control function; protocol aspects; Stage 3".
- [28] 3GPP TS 22.186: "Enhancement of 3GPP support for V2X scenarios; Stage 1".

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## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

For the purposes of the present document, the following terms and definitions given in ISO TS 17419:2014 [3] apply:

#### **Intelligent Transport Systems**

##### **ITS Application Identifier**

For the purposes of the present document, the following term and definition given in IEEE Std 1609.12-2016 [4] apply:

##### **Provider Service Identifier**

For the purposes of the present document, the following term and definition given in TS 22.185 [2] apply:

##### **Road Side Unit**

For the purposes of the present document, the following term and definition given in TS 23.303 [5] apply:

##### **Geographical Area**



## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

C-TEID	Common-Tunnel Endpoint Identifier
ITS	Intelligent Transport Systems
ITS-AID	ITS Application Identifier
PSID	Provider Service Identifier
RSU	Road Side Unit
SIPTO@LN	SIPTO at the Local Network
USD	User Service Description
V2X	Vehicle-to-Everything

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# 4 Architecture model and concepts

## 4.1 General concept

There are two modes of operation for V2X communication, namely over the PC5 and over LTE-Uu. LTE-Uu can be unicast and/or MBMS. These two operation modes may be used by a UE independently for transmission and reception, e.g. a UE can use MBMS for reception without using LTE-Uu for transmission. A UE may also receive V2X messages via LTE-Uu unicast downlink.

For both operation modes, the following principles apply:

- V2X Application Servers e.g. in different domains can communicate with each other for the exchange of V2X messages. The interface between V2X Application Servers and the methods of the exchange of messages between V2X Application Servers is out of scope of 3GPP.
- ProSe discovery feature (TS 23.303 [5] clause 5.3 ProSe Direct Discovery) is not required for V2X Services.

NOTE: ProSe discovery feature can be used by a V2X supporting UE, but that is up to UE implementation.

- Subject to regional regulations, lawful interception requirements apply to V2X Services.
- An RSU is not an architectural entity, but an implementation option. This is achieved by collocating a V2X application logic/server with some entities of the 3GPP system, as shown in examples in Annex A.

## 4.2 Architectural reference model

### 4.2.1 PC5 and LTE-Uu based V2X architecture reference model

#### 4.2.1.1 Non-roaming architecture for PC5 and LTE-Uu based V2X communication

Figure 4.2.1.1-1 shows the high level view of the non-roaming architecture for PC5 and LTE-Uu based V2X communication.

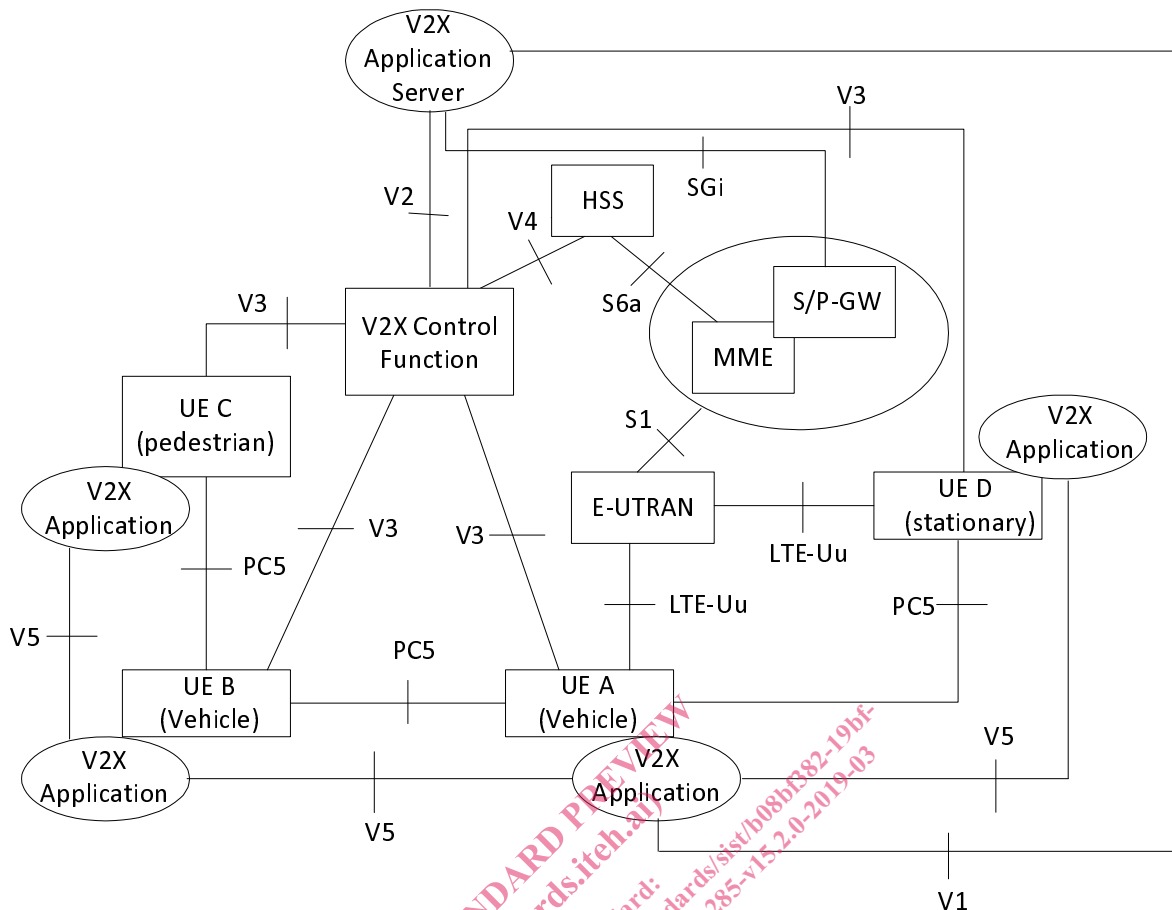


Figure 4.2.1.1-1: Non-roaming reference architecture for PC5 and LTE-Uu based V2X communication

4.2.1.2 Roaming architecture for PC5 and LTE-Uu based V2X communication

Figure 4.2.1.2-1 shows the high level view of the roaming architecture for PC5 and LTE-Uu based V2X communication. In this figure, UE A uses a subscription of PLMN A and UE B uses a subscription of PLMN B; UE A is roaming in PLMN B while UE B is not roaming.

A V2X Application Server may connect to multiple PLMNs, e.g. one V2X Application Server can connect with the V2X Control Function in PLMN A and the V2X Control Function in PLMN B in the figure.

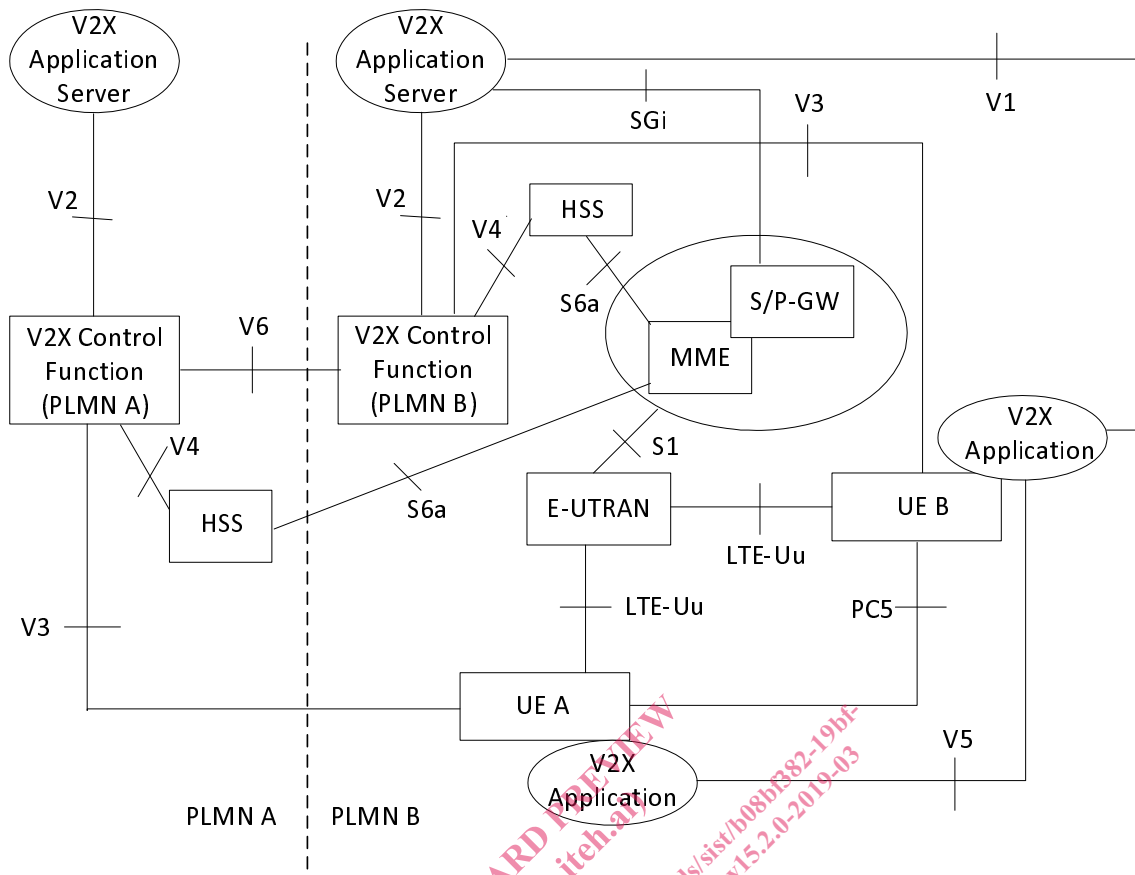


Figure 4.2.1.2-1: Roaming reference architecture for PC5 and LTE-Uu based V2X communication

4.2.1.3 Inter-PLMN architecture for PC5 and LTE-Uu based V2X communication

Figure 4.2.1.3-1 shows the high level view of the inter-PLMN architecture for PC5 and LTE-Uu based V2X communication. In this figure, UE A uses a subscription of PLMN A and UE B uses a subscription of PLMN B; UE A is roaming in PLMN C while UE B is not roaming.