

IETF-115 IPMON Side Meeting

IPv6 over 3GPP 5G V2X

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Related Documents for V2X in 3GPP

- **TS 23.287**: Architecture enhancements for 5G System (5GS) to support Vehicle-to-Everything (V2X) services.
- **TS 24.587**: Vehicle-to-Everything (V2X) services in 5G System (5GS); Stage 3
- **TS 33.536**: Security aspects of 3GPP support for advanced Vehicle-to-Everything (V2X) services
- **TS 23.285**: Architecture enhancements for V2X services

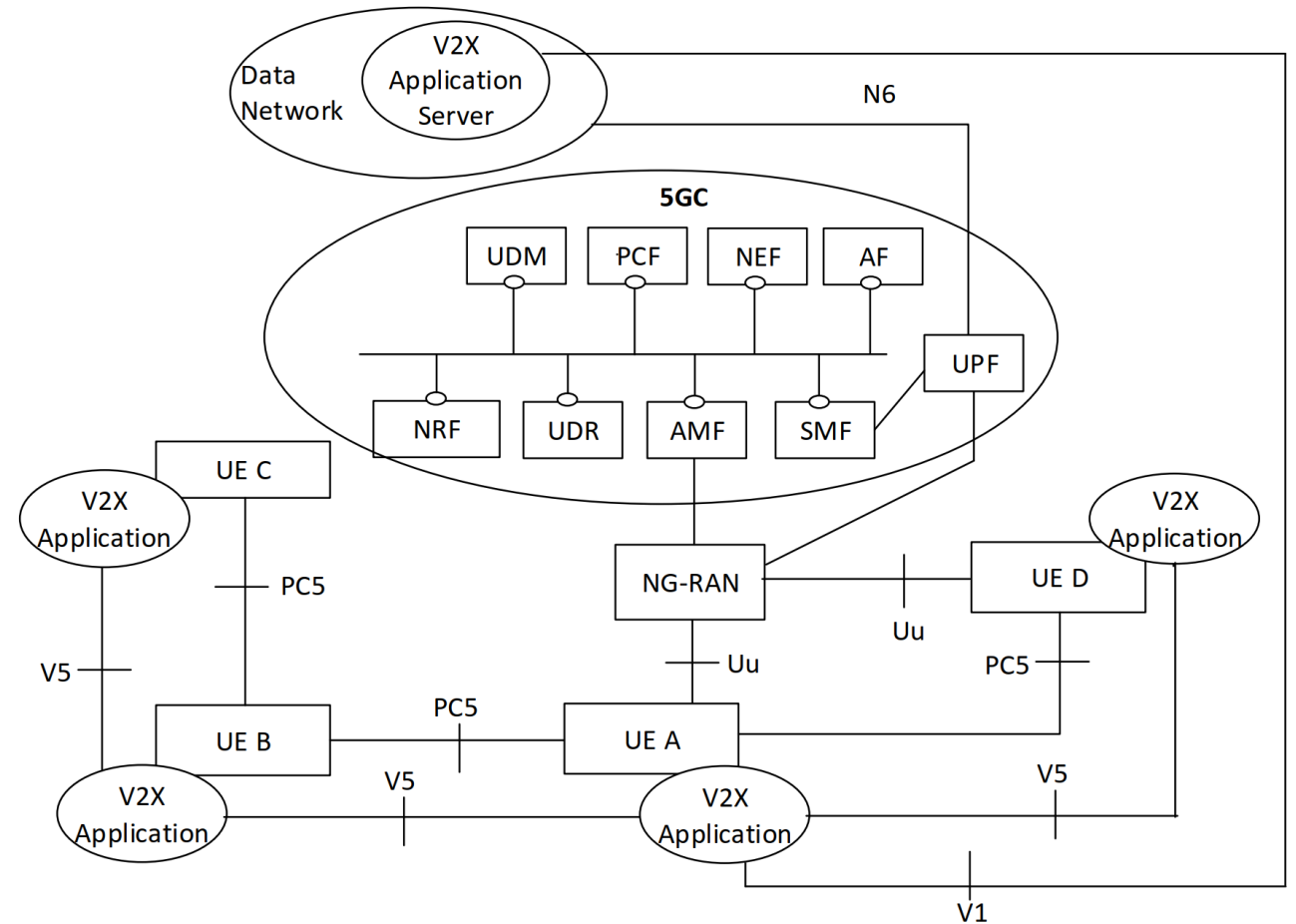
Foundation Documents of 5G in 3GPP

- **TS 23.501**: System architecture for the 5G System (5GS); Stage 2
- **TS 38.300**: NR; NR and NG-RAN Overall Description; Stage 2

TS 23.287: Architecture enhancements for 5G System (5GS) to support Vehicle-to-Everything (V2X) services.

5G System Arch. for V2X in TS 23.287

- V2V by PC5 ref. point
- V2I by Uu ref. point
- UEs can be ground vehicles, drones, pedestrian devices, scooters, etc.



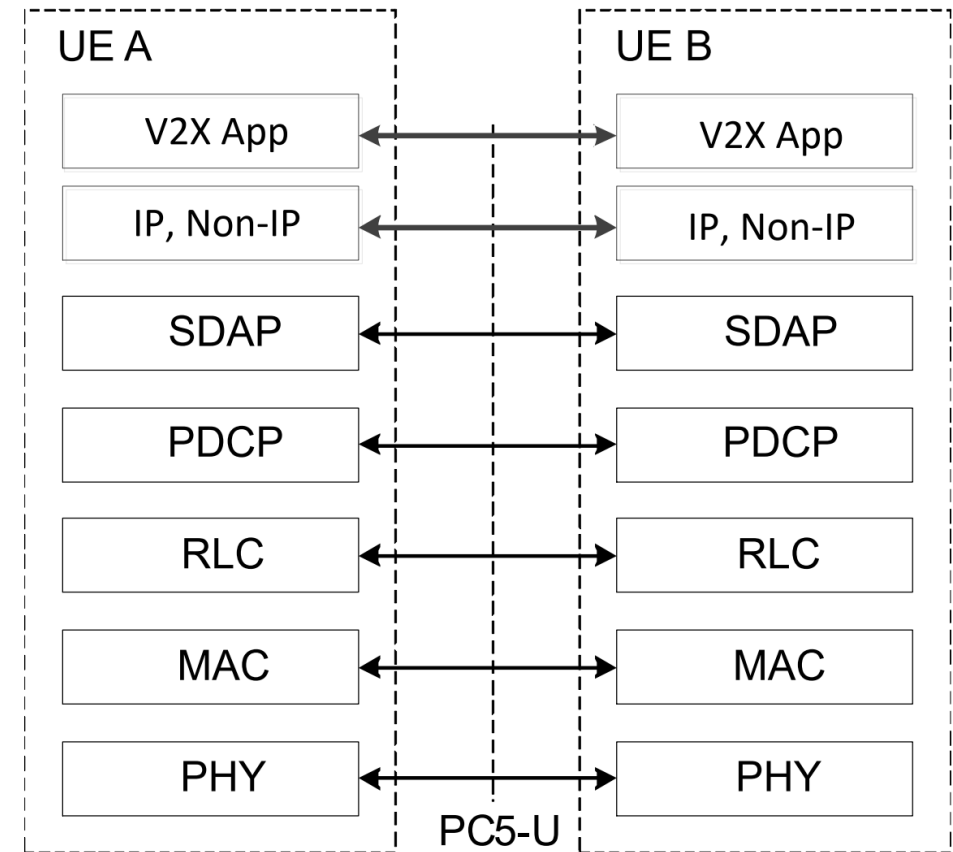
IPv6 Support Mentioned in TS 23.287

• Section 5.2

- **V2X services** communication support between UEs over PC5 user plane.
 - Both IP based and non-IP based V2X services communication are supported over PC5 reference point.
 - For IP based V2X services communication, only IPv6 is used. IPv4 is not supported.
- **V2X messages** are exchanged between UEs over PC5 user plane.
 - Both IP based and non-IP based V2X messages are supported over PC5 reference point.
 - **For IP based V2X messages, only IPv6 is used.** IPv4 is not supported.

Traffics via PC5 Ref. Point in 5G V2X

- Both IP and Non-IP traffics are supported.



TS 23.287: IPv6 Address Allocation.

Unicast Mode

5.2.1.5 IP address allocation

For **unicast** mode of V2X communication over PC5 reference point, the following mechanism for IP address/prefix allocation may be used:

- a) **IPv6 Stateless Address auto configuration** specified in **RFC 4862** [21] for assignment of **IPv6 prefix**, with one of the two UEs acting **as IPv6 default router**.

NOTE 1: Which UE acts as an IPv6 default router is negotiated during secure layer-2 link establishment by exchanging the IP Address Configuration as described in clause 6.3.3.1.

- b) **IPv6 link-local addresses** as defined in RFC 4862 [21] are formed by UEs **locally**. The IPv6 link-local addresses are exchanged during the establishment of a secure layer-2 link over PC5 reference point as described in clause 6.3.3.1. The UEs shall disable duplicate address detection after the layer-2 link is established.

TS 23.287: IPv6 Address Allocation.

Broadcast and Groupcast Mode

For **broadcast** and **groupcast** modes of V2X communication over PC5 reference point, the following source IP address management applies:

- The UE configures a link local IPv6 address to be used as the source IP address, as defined in clause 4.5.3 of TS 23.303 [17]. **The UE may use this IP address for V2X communication over PC5 reference point without sending Neighbour Solicitation and Neighbour Advertisement message for Duplicate Address Detection.**

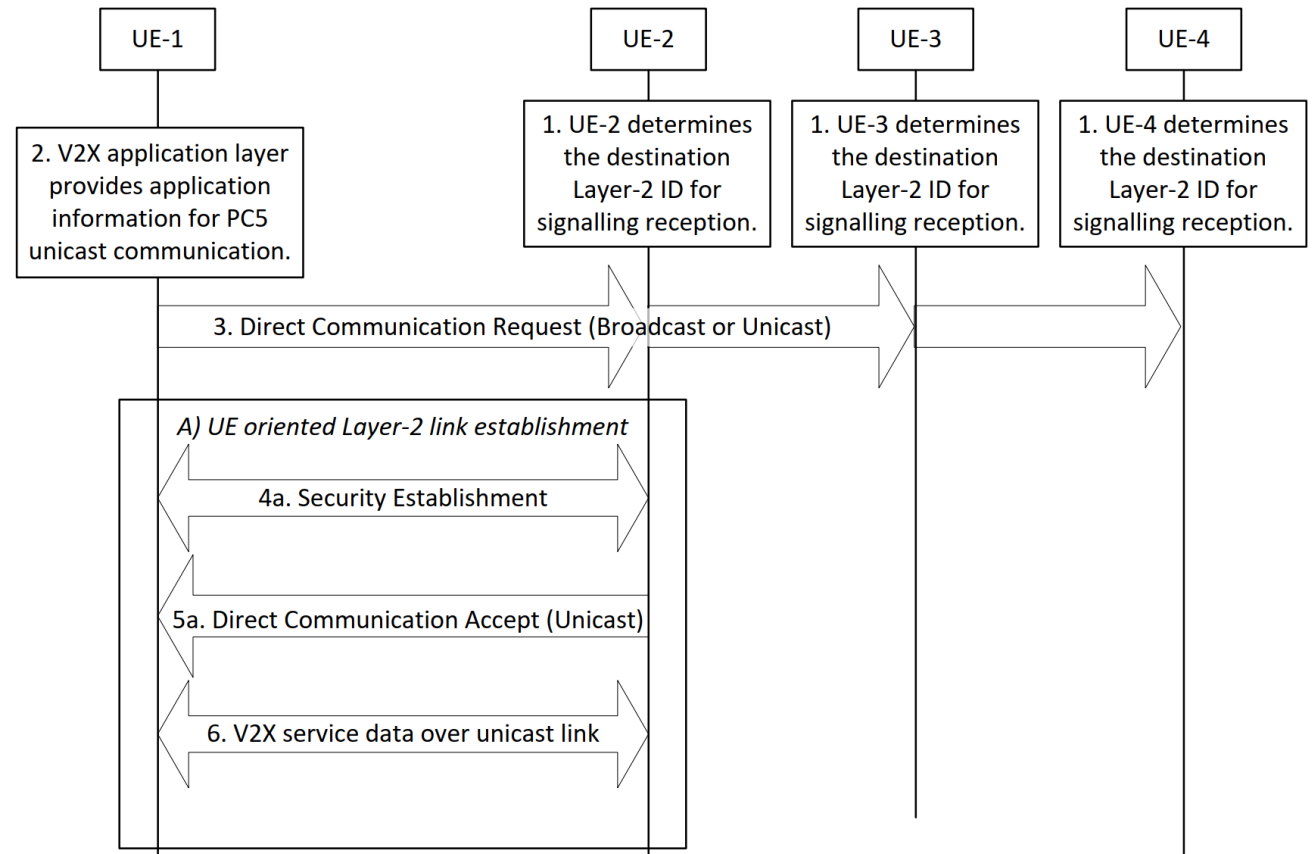
NOTE 2: **The destination IP address management for broadcast and groupcast modes of V2X communication over PC5 reference point is left to UE implementation.**

TS 23.287: Unicast Mode, A)

- Clause 6.3.3.1: Unicast Mode

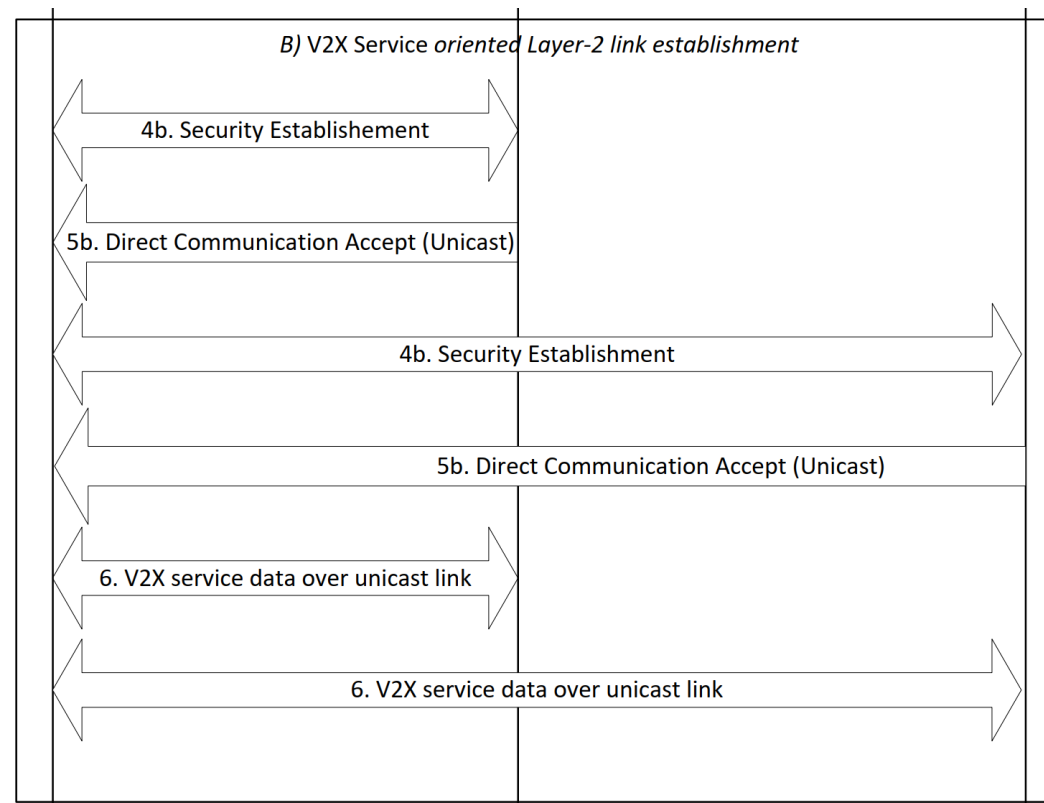
- A) **UE oriented link establishment**

- Security Establishment
- Direction Comm. Accept
- V2X service data



TS 23.287: Unicast Mode, B)

- B) **V2X service-oriented** link establishment
 - Security Establishment
 - Direct Comm. Accept
 - V2X service data over unicast link



TS 23.287: Architecture enhancements for 5GS to support V2X services.

- If **IP communication** is used:
 - **IP Address Configuration**: For IP communication, IP address configuration is required for this link and indicates one of the following values:
 - **"IPv6 Router"** if **IPv6 address allocation mechanism is supported by the initiating UE**, i.e., acting as an IPv6 Router; or
 - **"IPv6 address allocation not supported"** if IPv6 address allocation mechanism is not supported by the initiating UE.
 - **Link Local IPv6 Address**: a link-local IPv6 address formed locally based on RFC 4862 [21] if UE-1 does not support the IPv6 IP address allocation mechanism, i.e. the IP Address Configuration indicates "IPv6 address allocation not supported".

TS 23.287: Architecture enhancements for 5GS to support V2X services.

- **Link Local IPv6 Address**: a link-local IPv6 address formed locally based on RFC 4862 [21] if the target UE does not support the IPv6 IP address allocation mechanism, i.e. the IP Address Configuration indicates "IPv6 address allocation not supported", and UE-1 included a link-local IPv6 address in the Direct Communication Request message. The target UE shall include a non-conflicting link-local IPv6 address.

If both UEs (i.e. the initiating UE and the target UE) selected to use link-local IPv6 address, they shall disable the duplicate address detection defined in RFC 4862 [21].

NOTE 3: When either the initiating UE or the target UE indicates the support of IPv6 router, corresponding address configuration procedure would be carried out after the establishment of the layer 2 link, and the link-local IPv6 addresses are ignored.

TS 24.587: Vehicle-to-Everything (V2X) services in 5G System (5GS); Stage 3

TS 24.587's Scope

- It defines procedures for transporting V2X messages in 5G system.
 - V2X Messages are transported by PC5 and Uu ref. points.
- Messages over PC5
 - Both IP based and Non-IP based messages are supported.
 - For IP-based messages, only **IPv6** is used.

Procedures in Unicast Mode over PC5

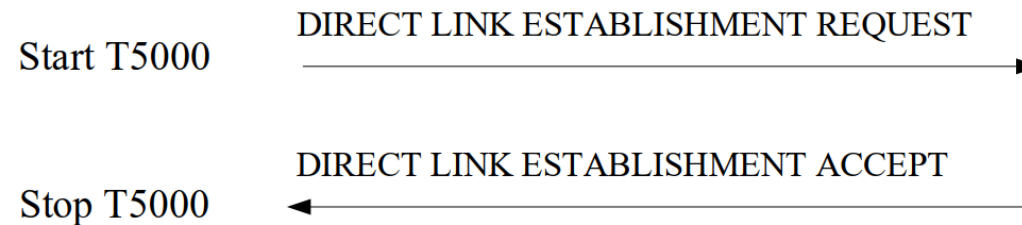
- **Unicast link establishment** ➡ **IPv6 Address Configuration**
- Unicast link modification
- Unicast link release
- **Unicast link identifier update** ➡ **IPv6 Address Update**
- Unicast link authentication
- Unicast link security mode control
- Unicast link keep-alive
- Unicast link re-keying procedure

Unicast Link Establishment over PC5

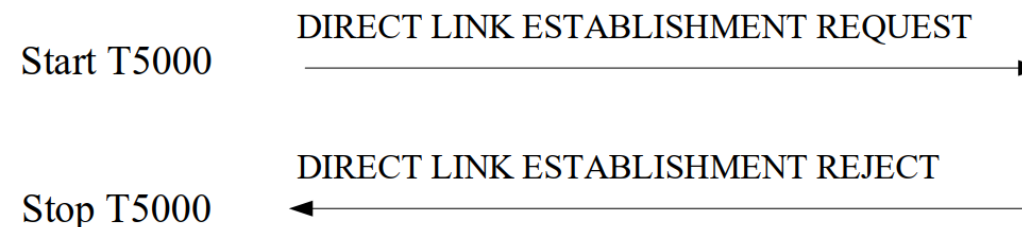
- UE oriented PC5 unicast link establishment procedure

Initiating UE

Target UE



OR



Unicast Link Establishment over PC5

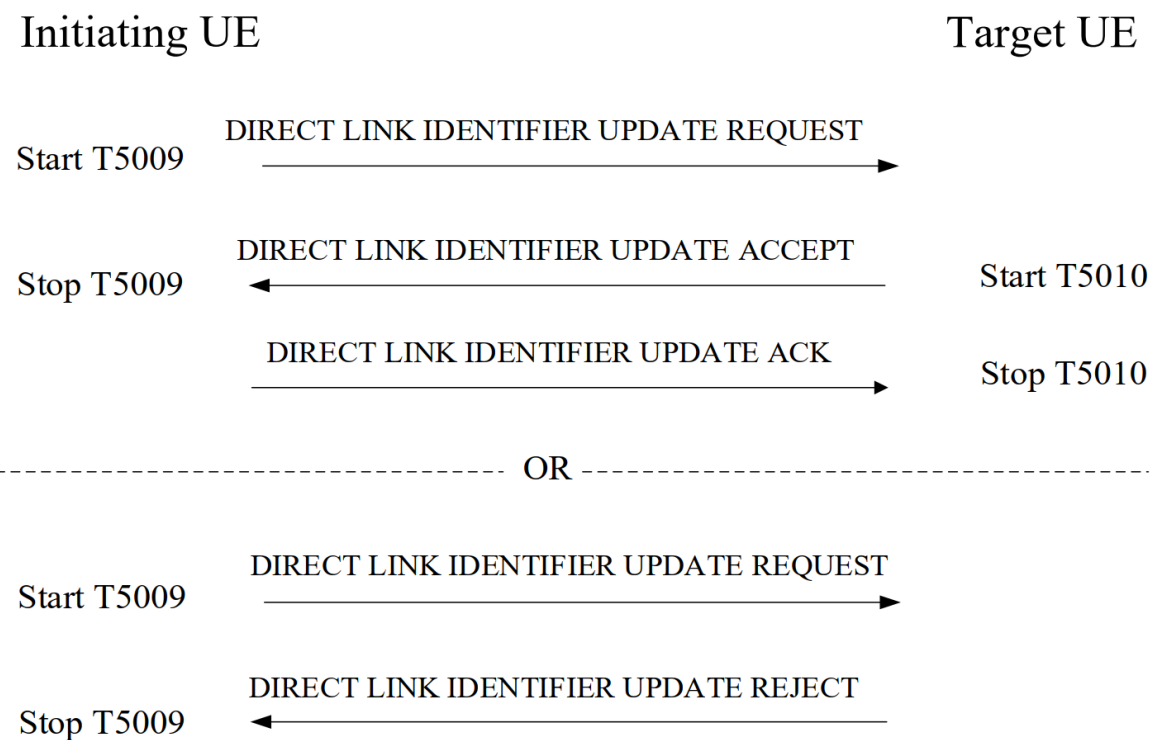
- **Clause 6.1.2.2.3**

- DIRECT LINK ESTABLISHMENT ACCEPT message

- c) shall include an IP address configuration IE set to one of the following values if IP communication is used:
 - 1) "IPv6 router" if IPv6 address allocation mechanism is supported by the target UE, i.e. acting as an IPv6 router; or
 - 2) "IPv6 address allocation not supported" if IPv6 address allocation mechanism is not supported by the target UE;
 - d) shall include a link local IPv6 address IE formed locally based on IETF RFC 4862 [16] if IP address configuration IE is set to "IPv6 address allocation not supported" and the received DIRECT LINK SECURITY MODE COMPLETE message included a link local IPv6 address IE; and

Unicast Link Identifier Update

- Clause 6.1.2.5.2, Identifier Update Procedure



Unicast Link Identifier Update

• Clause 6.1.2.5.2, Initiating UE

If the PC5 unicast link identifier update procedure is triggered by a change of the initiating UE's application layer ID, the initiating UE shall create a DIRECT LINK IDENTIFIER UPDATE REQUEST message. In this message, the initiating UE

- a) shall include the initiating UE's new application layer ID received from upper layer;
- b) shall include the initiating UE's new layer-2 ID assigned by itself;
- c) shall include the new MSB of $K_{\text{NRP-sess}}$ ID, or set to all zeros if the selected integrity protection algorithm is the null integrity protection algorithm; and
- d) shall include the new IP address/prefix if IP communication is used.

Unicast Link Identifier Update

- Clause 6.1.2.5.3, Target UE

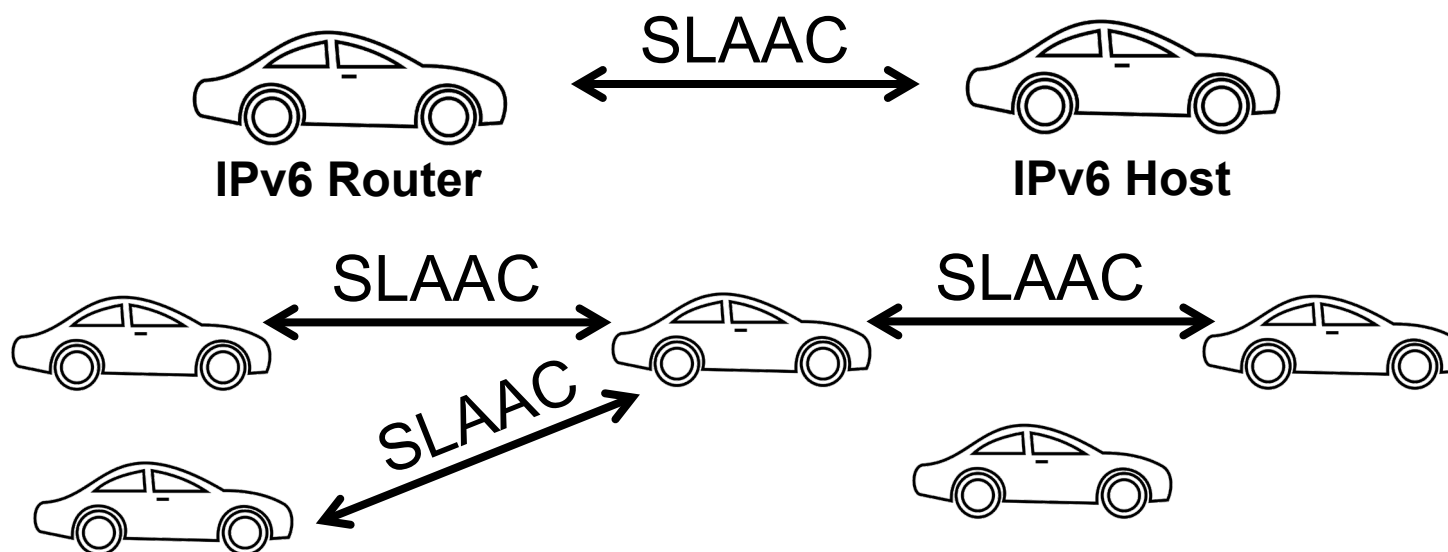
- f) shall include the initiating UE's new IP address/prefix if received from the initiating UE and IP communication is used;
- g) shall include the initiating UE's new application layer ID if received from the initiating UE; and
- h) shall include the target UE's new IP address/prefix if IP communication is used and changed.

Broadcast Mode over PC5

- The UE shall include the V2X message in a protocol data unit with the following parameters:
 - e) if the V2X message contains IP data, the source IP address set to the source IP address self-assigned by the UE for V2X communication over PC5;

Key Observation 1

- For 5G V2V by PC5 in **unicast mode**, one vehicle UE (**VehUE**) needs to be an **IPv6 router** for **SLAAC**.



Which one shall be the IPv6 router for SLAAC?

How many IPv6 address/prefix will a vehicle have in this case?

Key Observation 2

- For V2V and V2I communications in general, will they use the same IPv6 configuration?
 - Using the same prefix?
 - Using the different prefixes?

Key Observation 3

- For multihop V2V and V2I, existing routing protocols are **costly to maintain routing table**.
 - How to minimize control traffic overhead for both routing and IPv6 ND?

Key Observation 4

- **Mobility Management in 5G V2X is required for the communications between a VehUE and a server in a Data Network (i.e., Internet).**
 - How to manage mobility of vehicles that have connections with a server while they are moving along their moving paths?

Thanks!



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