**3GPP TSG-CT WG1 Meeting #141eC1-232147**

**Online 17– 21 April 2023**

**Source: Nokia, Nokia Shanghai Bell, Qualcomm Incorporated, Ericsson**

**Title: Pseudo-CR on Broadcast mode** **A2X communication over PC5**

**Spec: 3GPP TS 24.577 v0.0.0**

**Agenda item: 18.2.21**

**Document for: Approval**

**1. Introduction**

This p-CR provides content of Broadcast mode A2X communication over PC5 (Section 6.1.3) for A2X in 3GPP TS 24.577 specification related to the UAS\_Ph2 work item.

**2. Reason for Change**

Broadcast mode A2X communication over PC5 (Section 6.1.3) for A2X in 3GPP TS 24.577 specification needs to be defined based on SA2 requirements in clause 4.2.1.2.1 in 3GPP TS 23.256.

**3. Proposal**

It is proposed to agree the following changes to 3GPP TS 24.577 v0.0.0.

\* \* \* First Change \* \* \* \*

# 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".

[B] 3GPP TS 24.501: "Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".

[E] 3GPP TS 38.331: "NR; Radio Resource Control (RRC) protocol specification".

[H] 3GPP TS 23.122: "Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode".

[I] 3GPP TS 38.304: "User Equipment (UE) procedures in Idle mode and RRC Inactive state".

[K] 3GPP TS 38.300: "NR; NR and NG-RAN Overall Description; Stage 2".

[L] 3GPP TS 38.323: "NR; Packet Data Convergence Protocol (PDCP) specification".

[M] 3GPP TS 24.301: "Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3".

[N] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".

\* \* \* Next Change \* \* \* \*

### 6.1.3 Broadcast mode A2X communication over PC5

#### 6.1.3.1 Overview

This clause describes the A2X communication over PC5 reference point in broadcast mode operation. The UE is configured with the related information as described in clause 5.2.3.

#### 6.1.3.2 Transmission of broadcast mode A2X communication over PC5

##### 6.1.3.2.1 Initiation

###### 6.1.3.2.1.1 Requirements for A2X communication over PC5

When the upper layers request the UE to send a A2X message of a A2X service identified by a A2X service identifier using A2X communication over PC5, the request from the upper layers includes:

a) the A2X message;

b) the A2X service identifier of the A2X service for the A2X message;

c) the type of data in the A2X message (i.e. IP or non-IP);

d) if the A2X message contains non-IP data, the A2X message family (see clause 9.2) of data in the A2X message;

e) optionally the communication mode which is set to broadcast mode; and

f) optionally the A2X application requirements (e.g. priority requirement, reliability requirement, delay requirement).

Upon a request from upper layers to send a A2X message of a A2X service identified by a A2X service identifier using A2X communication over PC5, if:

a) the UE is configured with A2X service identifier to A2X frequency mapping rules for A2X communication over PC5 as specified in clause 5.2.3; and

b) there is one or more A2X frequencies associated with the A2X service identifier of the A2X service for the A2X message in the current altitude range and geographical area,

then the UE passes the one or more A2X frequencies associated with the A2X service identifier of the A2X service and the communication mode which is set to broadcast mode for the A2X message to the lower layers.

Then, if any of the following conditions are met:

a) the following conditions are met:

1) the UE is served by NR or served by E-UTRA for NR-PC5 A2X communication;

2) the UE intends to use the radio resources (i.e. carrier frequency) provided by a serving cell;

3) the registered PLMN is in the list of PLMNs in which the UE is authorized to use A2X communication over PC5 when the UE is served by NR or served by E-UTRA for A2X communication over PC5 as specified in clause 5.2.3; and

4) the A2X service identifier of the A2X service is included in the list of A2X services authorized for A2X communication over PC5 as specified in clause 5.2.3 or the UE is configured with a default destination layer-2 ID for A2X communication over PC5 as specified in clause 5.2.3;

b) the following conditions are met:

1) the UE is:

i) not served by NR and not served by E-UTRA for A2X communication over PC5;

ii) in limited service state as specified in 3GPP TS 23.122 [H], if the reason for the UE being in limited service state is one of the following:

A) the UE is unable to find a suitable cell in the selected PLMN as specified in 3GPP TS 38.304 [I];

B) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #11 "PLMN not allowed" as specified in 3GPP TS 24.501 [B]; or

C) the UE received a REGISTRATION REJECT message or a SERVICE REJECT message with the 5GMM cause #7 "5GS services not allowed" as specified in 3GPP TS 24.501 [B]; or

iii) in limited service state as specified in 3GPP TS 23.122 [H] for reasons other than A), B) or C) above, and located in an altitude range and a geographical area for which the UE is provisioned with "non-operator managed" radio parameters as specified in clause 5.2.3;

2) the UE is authorized to use A2X communication over PC5 when the UE is not served by NR and not served by E-UTRA for A2X communication as specified in clause 5.2.3; and

3) the A2X service identifier of the A2X service is included in the list of A2X services authorized for A2X communication over PC5 as specified in clause 5.2.3 or the UE is configured with a default destination layer-2 ID for A2X communication over PC5 as specified in clause 5.2.3;

then the UE shall proceed as specified in clause 6.1.3.2.1.2, else the UE shall not perform transmission of A2X communication over PC5.

###### 6.1.3.2.1.2 PC5 QoS flow match and establishment

When determining if any existing PC5 QoS flow match the request from upper layers, UE shall proceeds as follows:

a) according to the PC5 QoS mapping rules specified in clause 5.2.3, the UE shall use the PC5 QoS parameters corresponding to the A2X service identifier and optionally A2X application requirements;

b) according to the A2X service identifier to destination layer-2 ID for broadcast mapping rules specified in clause 5.2.3, the UE shall use the destination layer-2 ID corresponding to the A2X service identifier;

c) if there is no existing context for the destination layer-2 ID, then:

1) build a new context for the destination layer-2 ID;

2) self-assign a new source layer-2 ID; and

3) pass the source layer-2 ID and the destination layer-2 ID to lower layers.

d) if in the context for the destination layer-2 ID, there is no PC5 QoS rule for the existing PC5 QoS flow(s) matching the service data or request, the UE shall derive the PC5 QoS parameters based on the A2X application requirements provided by the upper layers (if available) and the A2X service identifier(s) (e.g. PSID or ITS-AID) according to the PC5 QoS mapping rules defined in clause 5.2.3 and shall perform the following:

1) if there is no existing PC5 QoS flow that fulfils the derived PC5 QoS parameters, then the UE shall create a new PC5 QoS flow by performing the following operations:

i) self-assign a new PQFI;

ii) create a new PC5 QoS flow context which contains:

- the PQFI;

- the A2X service identifier(s); and;

- the derived PC5 QoS parameters;

iii) create a new PC5 QoS rule which contains:

- a PC5 QoS rule identifier;

- the PQFI;

- a set of packet filters; and

- a precedence value; and

iv) pass the following parameters to the lower layers:

- the PQFI;

- the PC5 QoS parameters;

- the source layer-2 ID and the destination layer-2 ID; and

- the NR Tx Profile corresponding to the A2X service identifier, if all the A2X service identifier(s) for the given destination layer-2 ID have NR Tx profiles available, as determined for the respective A2X service identifier based on the configuration parameters and conditions described in clause 5.2.3;

NOTE: When the PC5 DRX operation is needed based on the provided NR Tx Profile, the lower layers use PC5 QoS parameters to determine the PC5 DRX parameter values (see 3GPP TS 38.300 [K]) for transmission operation over PC5 reference point.

2) if there is an existing PC5 QoS flow that fulfils the derived PC5 QoS parameters, then the UE shall update the PC5 packet filter set in the PC5 QoS rule of this PC5 QoS flow, e.g. add the new packet filter in the PC5 QoS rule of this existing PC5 QoS flow; and

3) the UE shall use the new PC5 QoS flow created as described in bullet 1) or the existing PC5 QoS flow with the updated PC5 QoS rules as described in bullet 2) to perform the transmission of A2X communication over PC5 as specified in clause 6.1.3.2.2; and

e) if in the context for the destination layer-2 ID, there is a PC5 QoS rule for the existing PC5 QoS flow matching the service data or request, the UE shall use this existing PC5 QoS flow to perform transmission of A2X communication over PC5 as specified in clause 6.1.3.2.2.

Two types of packet filters are supported for A2X communication over PC5, i.e. the IP packet filter set and the A2X packet filter set. A PC5 QoS Rule contains either the IP packet filter set or the A2X packet filter set.

The IP packet filter set is defined as content of the packet filter contents field specified in 3GPP TS 24.501 [B] figure 9.11.4.13.4 and table 9.11.4.13.1.

The A2X packet filter set shall support packet filters based on at least any combination of:

- A2X service identifier (e.g. PSID or ITS-AID);

- the source layer-2 ID and the destination layer-2 ID; and

- Application Layer ID (e.g. UAV ID);

##### 6.1.3.2.2 Transmission

The UE shall include the A2X message in a protocol data unit with the following parameters:

a) a layer-3 protocol data unit type (see 3GPP TS 38.323 [L]) set to:

1) IP packet, if the A2X message contains IP data; or

2) non-IP packet, if the A2X message contains non-IP data;

b) the source layer-2 ID set to the layer-2 ID self-assigned by the UE for A2X communication over PC5;

c) the destination layer-2 ID set to:

1) the destination layer-2 ID associated with the A2X service identifier of the A2X service in this list of A2X services authorized for A2X communication over PC5 as specified in clause 5.2.3, if the A2X service identifier of the A2X service is included in the list of A2X services authorized for A2X communication over PC5 as specified in clause 5.2.3; or

2) the default destination layer-2 ID configured to the UE for A2X communication over PC5 as specified in clause 5.2.3, if the A2X service identifier of the A2X service is not included in the list of A2X services authorized for A2X communication over PC5 and the UE is configured with a default destination layer-2 ID for A2X communication over PC5;

d) if the A2X message contains non-IP data, an indication to set the non-IP type field of the non-IP type PDU to the value corresponding to the A2X message family (see clause 9.2 and clause 9.3) used by the A2X service as indicated by upper layers;

e) if the A2X message contains IP data, the source IP address set to the source IP address self-assigned by the UE for A2X communication over PC5;

f) the PQFI set to the value corresponding to the PC5 QoS Rules as specified in clause 6.1.3.2.1;

g) if E-UTRA-PC5 is used for A2X communication over PC5, the UE is configured with A2X service identifier to Tx Profile mapping rules for A2X communication over PC5 as specified in clause 5.2.3, the Tx Profile associated with the A2X service identifier as specified in clause 5.2.3; and

h) if NR-PC5 is used for A2X communication over PC5, the UE is configured with A2X service identifier to NR Tx Profile mapping rules for A2X communication over PC5 as specified in clause 5.2.3 and all the A2X service identifier(s) for the given destination layer-2 ID have NR Tx profiles available, the NR Tx Profile associated with the A2X service identifier as specified in clause 5.2.3;

then UE shall request radio resources for A2X communication over PC5 as specified in 3GPP TS 38.300 [K], and pass the A2X message on the PC5 QoS Flow identified by the PQFI to lower layers for transmission. The PC5 QoS Rules corresponding to the PQFIs map A2X messages with the same A2X service identifier and with the same PC5 QoS parameters to the same PC5 QoS Flow, and apply PQFI to A2X messages.

If the UE is camped on a serving cell indicating that A2X communication over PC5 is supported by the network, but not broadcasting any carrier frequencies and radio resources for A2X communication over PC5 as specified in 3GPP TS 38.331 [E], the UE shall request radio resources for A2X communication over PC5 as specified in 3GPP TS 24.501 [B].

Editor's note (pCR C1-232147, UAS\_Ph2): 3GPP TS 38.331 and 3GPP TS 24.501 still need to be updated with requesting radio resources for A2X communication over PC5.

If the UE has an emergency PDN connection, the UE shall send an indication to the lower layers to prioritize transmission over the emergency PDN connection as compared to transmission of A2X communication over PC5.

##### 6.1.3.2.3 Procedure for UE to use provisioned radio resources for A2X communication over PC5

When the UE is not served by NR and not served by E-UTRA for A2X communication and is authorized to use A2X communication over PC5, the UE shall identify the RAT to be used for A2X communication over PC5 according to the list of RATs in which the UE is authorized to use A2X communication over PC5. If both E-UTRA-PC5 and NR-PC5 for A2X are authorized to the UE for A2X communication over PC5, the UE selects a RAT used for A2X communication over PC5 according to local policy. The UE shall select the corresponding radio parameters to be used for A2X communication over PC5 as follows:

a) if the UE can determine itself located at an altitude range in a geographical area, and the UE is provisioned with radio parameters for the altitude range at the geographical area, the UE shall select the radio parameters associated with that altitude range in that geographical area; or

b) in all other cases, the UE shall not initiate A2X communication over PC5.

It is out of scope of the present specification to define how the UE can locate itself in a specific geographical area and altitude range. When the UE is in coverage of a 3GPP RAT it can for example use information derived from the serving PLMN. When the UE is not in coverage of a 3GPP RAT it can use other techniques, e.g. Global Navigation Satellite System (GNSS). The UE shall not consider user provided location as a valid input to locate itself in a specific geographical area or altitude range.

If the UE intends to use "non-operator managed" radio parameters as specified in clause 5.2.3, the UE shall initiate A2X communication over PC5 with the selected radio parameters.

If the UE intends to use "operator managed" radio parameters as specified in clause 5.2.3, before initiating A2X communication over PC5, the UE shall check with lower layers whether the selected radio parameters can be used in the current location without causing interference to other cells as specified in 3GPP TS 38.331 [E] when NR-PC5 to be used for A2X communication over PC5 and specified in 36.331 [N] when E-UTRA-PC5 to be used for A2X communication over PC5, and:

a) if the lower layers indicate that the usage would not cause any interference, the UE shall initiate A2X communication over PC5; or

NOTE: If the lower layers find that there exists a cell operating the provisioned radio resources (i.e., carrier frequency), and the cell belongs to the registered PLMN or a PLMN equivalent to the registered PLMN, and the UE is authorized for A2X communication over PC5 in this PLMN, the UE can use the radio parameters indicated by the cell as specified in 3GPP TS 38.331 [E] when NR-PC5 to be used for A2X communication over PC5 and specified in 36.331 [N] when E-UTRA-PC5 to be used for A2X communication over PC5.

b) else if the lower layers report that one or more PLMNs operate in the provisioned radio resources (i.e. carrier frequency) then:

1) if the following conditions are met:

i) none of the PLMNs reported by the lower layers is the registered PLMN or equivalent to the registered PLMN;

ii) at least one of the PLMNs reported by the lower layers is in the list of authorized PLMNs for A2X communication over PC5 and provides radio resources for A2X communication over PC5 as specified in 3GPP TS 38.331 [E] when NR-PC5 to be used for A2X communication over PC5 and specified in 36.331 [N] when E-UTRA-PC5 to be used for A2X communication over PC5; and

iii) the UE does not have an emergency PDU session in 5GS and does not have an emergency PDN connection in EPS;

then the UE shall:

1. if in 5GMM-IDLE mode (in case of 5GC) or in EMM-IDLE mode (in case of EPC), perform PLMN selection triggered by A2X communication over PC5 as specified in 3GPP TS 23.122 [H]; or
2. else if

A) in 5GMM-CONNECTED mode (in case of 5GC), either:

AA) perform a Deregistration procedure as specified in 3GPP TS 24.501 [B] and then perform PLMN selection triggered by A2X communication over PC5 as specified in 3GPP TS 23.122 [H]; or

AB) not initiate A2X communication over PC5.

Whether the UE performs AA) or AB) above is left up to UE implementation; or

B) in EMM-CONNECTED mode (in case of EPC), either:

BA) perform a detach procedure as specified in 3GPP TS 24.301 [M] and then perform PLMN selection triggered by A2X communication over PC5 as specified in 3GPP TS 23.122 [H]; or

BB) not initiate A2X communication over PC5.

Whether the UE performs BA) or BB) above is left up to UE implementation; or

2) else the UE shall not initiate A2X communication over PC5.

If the registration to the selected PLMN is successful, the UE shall proceed with the procedure to initiate A2X communication over PC5 as specified in clause 6.1.3.2.1.

If the UE is performing A2X communication over PC5 using radio parameters associated with an altitude range and a geographical area and moves out of that altitude range or that geographical area, the UE shall stop performing A2X communication over PC5 and then:

a) if the UE is not served by NR and not served by E-UTRA for A2X communication over PC5 or the UE intends to use radio resources for A2X communication over PC5 other than those operated by the serving cell, the UE shall select appropriate radio parameters for the new altitude range and geographical area as specified above; or

b) if the UE is served by NR or served by E-UTRA for A2X communication over PC5 and intends to use radio resources for A2X communication over PC5 operated by the serving cell, the UE shall proceed with the procedure to initiate A2X communication over PC5 when served by NR or served by E-UTRA for A2X communication over PC5.

Editor's note (pCR C1-232147, UAS\_Ph2): 3GPP TS 38.331 and 3GPP TS 36.331 still need to be updated for A2X communication over PC5.

##### 6.1.3.2.4 Privacy of A2X transmission over PC5

Upon initiating transmission of A2X communication over PC5, if:

a) the A2X service identifier of a A2X service requesting transmission of A2X communication over PC5 is in the list of A2X services which require privacy for A2X communication over PC5 as specified in clause 5.2.3; and

b) the UE is located in a geographical area in which this A2X service requires privacy for A2X communication over PC5 as specified in clause 5.2.3, or the UE is not provisioned any geographical areas in which this A2X services requires privacy for A2X communication over PC5,

then the UE shall proceed as follows:

a) if timer Tdddd is not running, start timer Tdddd and set its timer value as the privacy timer value as specified in clause 5.2.3;

b) upon:

1) getting an indication from upper layers that the application layer identifier has been changed; or

2) timer Tdddd expiry,

then:

1) change the value of the source layer-2 ID self-assigned by the UE for the A2X communication over PC5;

2) if the A2X message contains IP data, change the value of the source IP address self-assigned by the UE for A2X communication over PC5;

3) provide an indication to upper layers that the source layer-2 ID and/or the source IP address are changed;

4) pass the changed source layer-2 ID and destination layer-2 ID, along with the corresponding PQFI down to the lower layer;

5) restart timer Tdddd; and

6) upon stopping transmission of the A2X communication over PC5, stop timer Tbbbb.

#### 6.1.3.3 Reception of broadcast mode A2X communication over PC5

The UE may be configured by upper layers with one or more destination layer-2 ID(s) for reception of A2X messages over PC5. The receiving UE shall determine the PC5 QoS parameters for this broadcast A2X service in the same way described in clause 6.1.3.2.1.2 and shall determine the NR Tx Profile as described in clause 5.2.3, and shall provide:

a) the PC5 QoS parameters;

b) the NR Tx Profile corresponding to the A2X service identifier, if all the A2X service identifier(s) for the given destination layer-2 ID have NR Tx profiles available; and

c) the destination layer-2 ID(s);

to lower layers. When the UE derives new PC5 QoS parameters for a destination layer-2 ID that has been provided to lower layers (e.g., due to a change in application requirements), the UE shall provide the new PC5 QoS parameters for that destination layer-2 ID to lower layers. For each received protocol data unit over PC5, the receiving UE shall check if the destination layer-2 ID of the received protocol data unit matches one of the configured destination Layer-2 IDs. If yes, the UE shall then check whether the protocol data unit type as defined 3GPP TS 38.323 [L] provided by the lower layers for the received packet is set to IP packet or non-IP packet, and pass the protocol data unit to the corresponding upper layer entity.

NOTE: When the PC5 DRX operation is needed based on the provided NR Tx Profile if any, the lower layers use PC5 QoS parameters and the destination layer-2 ID(s) to determine the PC5 DRX parameter values (see 3GPP TS 38.300 [K]) for reception operation over PC5 reference point.

\* \* \* Next Change \* \* \* \*

## X.4 Timers of PC5 broadcast mode A2X communication

Table X.4.1: PC5 broadcast mode A2X communication timers

| TIMER NUM. | | TIMER VALUE | CAUSE OF START | NORMAL STOP | ON  EXPIRY |
| --- | --- | --- | --- | --- | --- |
| Tdddd | | NOTE 1 | Upon initiating transmission of broadcast mode A2X communication over PC5, as described in clause 6.1.3.2.4.  Upon receiving an indication from upper layers that the application layer identifier has been changed while performing transmission of broadcast mode A2X communication over PC5, as described in clause 6.1.3.2.4.  Upon Tdddd expiration while performing transmission of broadcast mode A2X communication over PC5, as described in clause 6.1.3.2.4. | Upon stopping transmission of broadcast mode A2X communication over PC5, as described in clause 6.1.3.2.4. | Change the value of the source layer-2 ID self-assigned by the UE for broadcast mode A2X communication over PC5.  If the A2X message contains IP data, change the value of the source IP address self-assigned by the UE for broadcast mode A2X communication over PC5. |
| NOTE 1 The value of this timer is the privacy timer value which is one of the configuration parameters for A2X communication over PC5 (see clause 5.2), | | | | | |

\* \* \* End of Changes \* \* \* \*