**SA WG2 Meeting #S2-150E S2-2202011**

**14 - 25 February, 2022, E-meeting**

**Source: Qualcomm Inc.**

**Title: WT5: Solution for handling large number of devices in a specific area for public safety**

**Document for: Approval**

**Agenda Item: 9.18**

**Work Item / Release: FS\_5MBS\_ph2/Rel-18**

*Abstract of the contribution: This paper introduces a solution to address 5MBS for large amount of devices for public safety.*

# 1. Discussion

## 1.1 Analysis

As part of the FS\_5MBS\_ph2 SID (SP-211645), the following Work Task was agreed:

WT#5. Study whether there are any identified performance issues for high number of public safety UEs, and if yes study necessary enhancements to 5MBS for that scenario.

In order to understand whether there are any fundamental issues to provide Rel-17 5MBS to a high number of public safety UEs, we first need to understand the characteristics and best use of 5G Multicast Services and 5G Broadcast Services.

For 5G Multicast services, the following characteristics can be identified:

- Resources are configured in the RAN only when UEs are camping on a RAN node and on a specific cell.

- RAN has the flexibility to deliver Multicast flows over PTP and PTM.

- Downlink transmission is optimized based on UE feedback in a specific cell.

Given the above characteristics, **5G Multicast solution is quite resource efficient in the following scenarios:**

- Scenarios where UEs that are receiving same 5MBS service are sparse in a relatively large service area.

- Multicast solution allows to only configure RAN nodes and set up resources where those sparse UEs are, as opposed to potentially using resources in a whole service area.

- Multicast solution allows to adapt downlink transmission based on the UEs receiving the 5G Multicast service in a specific cell, based on UE feedback, improving user plane resource utilization. This benefit is smaller once there a a large amount of UEs camping on a same cell.

- Scenarios where a medium size to small amount of devices are receiving the 5MBS service in a specific area.

It is to be noted though that:

- 5G Multicast requires UEs to be in CM-CONNECTED (RRC-Connected in Rel-17 and we can assume RRC-Inactive as well in Rel-18 as part of WT#1), which requires some increase in control plane signalling.

- There is also an increased signalling overhead in case of a large number of devices potentially moving and perform connected mode mobility procedures. For UEs that are only receiving MBS data this is signalling that could be avoided.

For 5G Broadcast services, the following characteristics can be identified:

- Resources are configured in a service area without any consideration for location of potential UEs receiving the broadcast service.

- DL transmission cannot be tailored to the situation of UEs camping on a specific cell.

- Allows for UEs receiving broadcast service from CM-IDLE without any need to perform UE join procedure, i.e. without any control plane signalling.

Given the above characteristics, the following considerations can be made for 5G Broadcast:

**- 5G Broadcast is well tailored for serving a large amount of devices in relatively small area.**

This is due mostly to the fact that the larger the amount of devices in a cell, the less tailored the DL transmission can be mode to the UEs receiving, so the benefit of 5G Multicast is less significant. Also for that scenario all or most RAN nodes would have needed to be configured even for 5G Multicast. On the other hand, there is less control plane signalling required compared to 5G Multicast.

In other words, the benefits brought by the control plane signalling of 5G Multicast become smaller the larger number of devices in a specific area are, and the signalling benefit of 5G broadcast becomes larger.

Note that there is actually a caveat to this analysis, and it is that in many cases the decision to switch a content to broadcast requires many UEs to provide some app level feedback which require UEs to be connected anyways at least before Broadcast service setup. Taking the procedures defined in TS 23.468 and TS 23.173 for GCS and MCPTT respectively, the UE is reporting the ECGI of the serving and neighbouring cell(s), MBMS SAIs, MBSFN Area ID using the MCPTT-1 interface in SIP.

#### *7.5.2.2 Reference point MCPTT-1 (between the MCPTT client and the MCPTT server)*

*The MCPTT-1 reference point, which exists between the MCPTT client and the MCPTT server, is used for MCPTT application signalling for establishing a session in support of MCPTT. The MCPTT-1 reference point shall use the SIP-1 and SIP-2 reference points for transport and routing of SIP signalling. The MCPTT-1 reference point may use the HTTP-1 and HTTP-2 reference points.*

*Reference point MCPTT-1 may also provide the MCPTT server with location information with respect to multicast service availability for the MCPTT client. The TMGI is communicated between the MCPTT server and the MCPTT client using the MCPTT-1 reference point.*

*Information that is reported to the MCPTT server from the MCPTT client shall be configurable at the application layer. This interface may include the area where a UE is currently located, described as ECGI of the serving and neighbouring cell(s), MBMS SAIs, MBSFN Area ID. This information comes from the broadcast by the local cell, e.g. from SIB1 and SIB15 (see 3GPP TS 36.331 [14]) as decoded by the UE.*

*NOTE: This reference point includes the GC1 reference point as described in 3GPP TS 23.468 [10]. It is assumed that the MCPTT server is performing the function of GCS AS. While 3GPP TS 23.468 [10] does not specify GC1 it does include high level descriptions of certain interactions on GC1, including those relating to the availability of multicast delivery for the application client. The MCPTT-1 reference point fulfils the requirements of the GC1 reference point for MCPTT.*

The above procedures require the UE to go to connected mode in order to be able to send SIP signalling to MCPTT AS and in turn assist the MCPTT AS acting as GCS AS in TS 23.468 to decide whether to switch between unicast and broadcast procedures.

5G Broadcast is not well tailored for sparse UE reception of 5MBS compared to 5G Multicast.

For the reasons described in the 5G Multicast analysis.

Based on above analysis, it is clear that 5G Multicast solution and 5G Broadcast solution have quite different characteristics and become “optimal” under quite different scenarios. **It would be quite a mistake to modify the 5G Multicast solution to tailor a scenario the 5G Broadcast already covers well, and vice versa**.

Therefore, the question is more about when and how to decide whether to use 5G Broadcast or 5G Multicast to deliver content to a multitude of devices. On a large scale:

**The more sparse the UEs receiving a same content are, the larger the service area, the more attractive using 5G Multicast is.**

**The more concentrated in an area the UEs receiving a same content are, the more attractive using 5G Broadcast may become.**

# Proposal

It is proposed to add the following solution to the TR 23.700-47.

\*\*\* Start of changes \*\*\*

## 6.0 Mapping of Solutions to Key Issues

Editor's note: This clause describes the mapping between solutions and key issues.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Key Issues | | | |
| Solutions | 1  MBS session reception in RRC Inactive | 2  MOCN network sharing | Z |  |
| 1 | X |  |  |  |
| 2 |  | X |  |  |
| X |  |  | X |  |
|  |  |  |  |  |
|  |  |  |  |  |

\*\*\* Next change \*\*\*

## 6.X Solution X: Public Safety services offered over both Broadcast and Multicast transport

### 6.X.1 Description

#### 6.X.1.1 General

5G Broadcast and 5G Multicast services cater and are optimal in different scenarios:

- The more sparse the UEs receiving a same content are, the larger the service area, the more attractive using 5G Multicast is.

- The more concentrated in an area the UEs receiving a same content are, the more attractive using 5G Broadcast may become.

This solution consists on identifying areas of concentrated number of UEs for which 5G Broadcast services would be the optimal transport, areas of sparse UEs receiving the same public safety service for which multicast transport would be useful. Configuring Broadcast service and Multicast service for the same public safety service, and allow the UE to decide whether to receive the public safety MBS content via broadcast service if available, or multicast session.

Editor´s note: This solution requires that UEs provide accurate location information to the GCS AS to enable the GCS AS to determine where UEs are concentrated. Those location reports require that UEs are in connected state and may lead to capacity bottlenecks. It is ffs if this problem can be mitigated.

#### 6.X.1.2 Functional description

NOTE 1: The use of GCS AS in reference to this solution refers to stage-2 procedures defined in TS 23.468 and are used for public safety IMS procedures defined in SA6 specifications for GC-1/MCPTT-1 interface. The interface between GCS AS and 5GC is not restricted to be MB2 only. Possible enhancements to other interfaces e.g. xMB, Nmb8 and Nmb10 are possible.

NOTE 2: The term GCS AS is currently used in EPS only and not same in the context of this solution, the name to be used in 5GS only architecture is FFS.

The functional description of the solution is as follows:

1. GCS AS requests to establish a Broadcast service in a "Broadcast" Frequency Service Area (FSA) to 5GC via MBS Session Start for Broadcast procedure (see TS 23.247 [4] clause 7.3.1), where the Broadcast FSA is an identified area where of concentrated large number of UEs.

2. GCS AS also requests to establish a Multicast Service in a "Multicast" Service Area to 5GC via MBS Session Creation Procedure (see TS 23.247 [4] clause 7.1.1.2 or 7.1.1.3), where the Multicast Service Area is an identified area for Public Safety service that is larger than the Broadcast FSA. Multicast and Broadcast service areas may overlap.

3. GCS AS configures the UE with both the Multicast service information (with its respective MBS session ID/TMGI) and the Broadcast service information (with its respective MBS Session ID/TMGI) and indicates to the UE that they correspond to the same public safety service. This can for example be done by allowing to include 2 TMGIs instead of one in service description that is sent to the UE in SIP.

Editor's Note: whether the indication to the UE is needed/feasible is FFS.

4. Both Broadcast FSA (as in Service announcement) and Multicast Service Area (as part of Service announcement or NAS signaling) may be known to UE.

5. The UE may join the Multicast session based on the received information from the GCS AS.

5. When UE is in Broadcast FSA, and the UE detects the Broadcast Service is available, the UE enables reception of Broadcast MBS session ID, and if already joined ignores reception of Multicast MBS session ID internally.

Editor's Note: This procedure is ffs as the multicast reception provides higher quality and the network is not aware that the UE drops data and will continue to apply procedures for multicast distribution to the UE and reserve related resources.

6. When the UE is outside Broadcast FSA, and in Multicast Service area the UE receives MBS service in multicast mode. If not already joined, the UE initiates UE join procedure for the Multicast Session.

### 6.X.2 Procedures

#### 6.X.2.1 GCS AS configuration of both Broadcast and Multicast Services



Figure 6.X.2.1-1 GCS AS configuration of both Broadcast and Multicast Services

Figure 6.X.2.1-1 shows the order of procedure execution for a GCS AS to provide a same public safety service via broadcast session in a specific service area and via Multicast session in a larger service area.

NOTE: In Figure 6.X.2.1-1 the 5GC CP (control plane) denotes for simplicity all transport 5GC NFs relevant to MBS procedures, e.g. MB-SMF, MB-PCF, SMF, AMF, NRF, etc.

1. In order to establish a Multicast session, the GCS AS initiates MBS Session Creation as defined in either TS 23.247 [4] clause 7.1.1.2 (for case without PCC) or TS 23.247 [4] clause 7.1.1.3 (for case with PCC). The GCS AS receives Multicast Session information.

2. The GCS AS may provide to UE(s) the Multicast session information necessary for the UE to join the Multicast session (i.e. TMGI for Multicast session).

3. UE may trigger UE join and Session establishment procedure (see TS 23.247 [4] clause 7.2.1) using the TMGI for Multicast provided by GCS AS.

4. When there is MBS data the GCS AS initiates MBS Session Activation for the Multicast TMGI (see TS 23.247 clause [4] 7.2.5.2). Step 4 may occur in parallel with steps 5 to 7.

5. The GCS AS may decide to establish a Broadcast session in a specific service area, e.g. based on UE reports in GC1/MCPTT-1 interface and detection of large number of UE receiving the same public safety service in a same area.

6. Based on the decision of step 5, the GCS AS initiates MBS session start for broadcast procedure as defined in TS 23.247 [4] for a Broadcast TMGI.

7. The GCS AS provides to UEs the information for broadcast reception, including the TMGI allocated for the Broadcast session.

8. A UE that has received both the Broadcast session information (including TMGI for Broadcast session) and Multicast session information (including TMGI for Multicast session) for the same service, determines whether to receive the public safety data via broadcast session or multicast session.

8.a. If the UE detects that the Broadcast session is available, UE enables reception of Broadcast for the TMGI allocated for the broadcast session, and if already joined ignores reception of Multicast internally. The UE may ignore a paging with the TMGI allocated for the Multicast session.

8.b. If the UE does not detect that Broadcast session is available, and the UE joined the multicast MBS session in step 3, when it receives paging during MBS session activation for the TMGI allocated for Multicast, the UE follows the behavior defined in TS 23.247 [4] clause 7.2.5.

#### 6.X.2.2 UE switching from Broadcast Reception to Multicast Reception

When a UE that is receiving public safety data via Broadcast session detects that it has moved to a cell that is not providing the broadcast session, i.e. the UE detects it has stepped out of the Broadcast service data, the UE proceeds as follows:

1. If the UE had not joined yet the corresponding Multicast session, the UE triggers MBS join and Session establishment procedure (see TS 23.247 [4] clause 7.2.1.3) using the TMGI allocated for Multicast session.

2. If the UE had already joined the corresponding Multicast session, the UE follows the procedures defined in TS 23.247 [4].

#### 6.X.2.3 UE switching from Multicast Reception to Broadcast Reception

When a UE that is receiving public safety data via Multicast session detects that it has moved to a cell that is providing the broadcast session, i.e. the UE detects it has stepped inside of the Broadcast service area, the UE proceeds as follows:

1. While the UE is in CM-CONNECTED receiving the Multicast data, the UE should maintain this Multicast reception if still available. This avoids ping pongs when the UE steps in and out of the Broadcast service area.

2. Following a CM-CONNECTED to CM-IDLE transition, the UE may decide to receive public safety data via Broadcast session, e.g. at next Broadcast Session Start.

Editor's Note: Details are FFS, e.g., whether UE needs to trigger the leave procedure defined in TS 23.247, clause 7.2.2 after it determines to use broadcast.

### 6.X.3 Impacts on services, entities and interfaces.

On GCS AS:

- Decision of delivery method, between multicast, broadcast and unicast with potentially different service areas.

- Use of on UE reports in GC1/MCPTT-1 interface for decision.

- Configuration of UE of both Broadcast and Multicast session for same service.

On UE:

- Receive configuration from GCS AS of both Broadcast session with a TMGI and Multicast session with another TMGI for the same public safety service.

- Decide between reception of public safety data over Broadcast session of over Multicast session.

- Trigger switch from broadcast reception of public safety data and multicast reception of public safety data.

- Trigger switch from multicast reception of public safety data and broadcast reception of public safety data.

On 5GC and NG-RAN:

- No impacts.

\*\*\* End of changes \*\*\*