**3GPP TSG RAN WG1 #103-e R1-20xxxxx**

**e-Meeting, October 26 – November 13, 2020**

**Source: Moderator (OPPO)**

**Title: Summary of LS discussion on new PQI support for PC5 communication**

**Agenda item: 5**

**Document for:** **Discussion and Decision**

Introduction

In RAN1#103-e meeting, an LS from SA2 was received on new PQI support for PC5 communication [1]. Several related contributions on discussion and draft reply LS were submitted in this meeting [2]-[5]. As guided by the Chairman, this contribution provides a summary of the submitted contributions, discussion points and outcomes of email discussion during this meeting.

[103-e-AI5-LS-04] For LS in [R1-2007514](file:///C:\3GPP\RAN1_Meetings\Tdocs\2020\R1-2007514.zip), a reply LS is necessary – target 11/2 for email approval – OPPO (name TBD)

Discussion points (phase 1 until 28-Oct)

Based on the submitted inputs [2]-[5], the following questions are devised in order to formulate potential answers to SA2’s questions. Companies are encouraged to provide their inputs below.

Question 1 (AS layer support for new standardized PQI values in Table 1):

**Do you agree, at least from RAN1’s perspective, the new standardized PQIs in Table 1 of [1] can be supported using the existing V2X mechanism (i.e. NR sidelink from Rel-16)? If yes, is there any underlaying assumption for this? If no, which of the New Values in Table 1 can be or cannot be supported?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| ZTE, Sanechips | Yes | New standardized PQIs labelled as New value#1,2,3 can be supported as per 23.287. New standardized PQI labeled as New value#4,5 can be supported under good geometry scenario (e.g. SNR > = 25dB). |
| OPPO | Yes | Based on evaluation results in [2], it can be concluded that the existing V2X mechanism is able to support the new standardized PQIs in Table 1 at least in FR1. |
| Ericsson | Yes | In our view, all 5 new PQI values in Table 1 of LS can be supported. |
| vivo | Conditional Yes | The new PQIs in table 1 can be supported by Rel-16 SL (at least in some deployments), but not in an optimal manner from power saving perspective.  Moderator: It can be clarified in the reply answer to SA2 that the evaluation is based on Rel-16 V2X mechanism. I think it is also commonly known that the power saving aspect of sidelink is currently being worked on in Rel-17. |

Question 2 (AS layer support for new standardized PQI values in Table 2):

**Do you agree, at least from RAN1’s perspective, the new standardized PQIs in Table 2 of [1] can be supported using the existing V2X mechanism (i.e. NR sidelink from Rel-16)? If yes, is there any underlaying assumption for this? If no, which of the New Values in Table 2 can be or cannot be supported?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| ZTE,Sanechips | Yes | The new PQIs can be supported using full bandwidth(100MHz under FR1) for a single UE under a given MCS/rank configuration and good geometric condition(rank2, 25 and 30dB for 16QAM and 64QAM respectively) |
| OPPO | Yes | Based on evaluation results in [2], it can be concluded that the existing V2X mechanism is able to support the new standardized PQIs in Table 2 at least in FR1 with maximum bandwidth allocation. |
| Ericsson | No | Based on our evaluations, it is noted that the maximum data rate that can be supported by NR Rel. 16 is around 400Mbps assuming user bandwidth of 40MHz which is supported by RAN4 for PC5 band. In our view, this is also only theoretically possible with very good channel conditions (~30dB) and single user in the system. Such assumptions are not practically feasible i.e. there will not be any deployment supporting such channel conditions and only one user in the system. In short, PQI values for commercial services (Table 2 in LS) are not feasible.  Moderator: Currently RAN4 defined only spectrum bands dedicated for V2X operation (e.g. ITS band n47). In our understanding, commercial services cannot be carried in those bands and need to be in licensed bands only. For an evaluation result that supports 400Mbps, according to our conversion, this translates into 250,000 bytes per 5ms, which is larger than the default MDBV value for New Value #1 in Table 2. |
| vivo | Conditional Yes | The new PQIs in table 2 can be supported, again only in some scenarios (e.g., high rank UEs with large BW in a light low system), and in a power inefficient manner.  We understand Ericsson’s comment, which is correct from RAN4 perspective. RAN1 may not be the suitable WG to comment the band allocation. Maybe we can reply this LS to RAN4 and asks for comment from RAN4 on this aspect.  Moderator: Same comment reply in Question 1 and reply to Eircsson. |

Question 3 (Maximum MDBV value AS layer can support in Table 2):

**What is the maximum MDBV value can be supported using the existing V2X mechanism (i.e. NR sidelink from Rel-16)? Is there any underlying assumption for this maximum MDBV value? Is there any further evaluation needed in RAN1 to derive the maximum MDBV value, and if yes, what should be evaluated?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| ZTE,Sanechips |  | The evaluation in x8233 is reasonable to us. Yet the derived TBsize from our perspective is  2.5703\*270\*12\*12\*2 = 199866.6bits (2 symbol overhead)  The MDBV is therefore 24983 bytes per 2ms |
| OPPO |  | According to evaluation results in [2], the maximum MDBV value that can be supported using the existing V2X mechanism is at least 36,897 bytes per 2ms in FR1 with maximum bandwidth allocation. |
| Ericsson | Yes | In our view, further evaluation is needed to derive the maximum MDBV value. However, before deriving the maximum MBDV, the assumption on channel conditions and scenario should be settled. It is to be noted in RAN1 that extreme configurations for NR should not be used for the evaluations and typical deployment scenario should be considered. |
| vivo |  | The maximum data rate can be supported using the Rel-16 SL is around 2Gbps for FR1 and 4Gbps for FR2, assuming 256QAM, rank-2 transmission, lowest overhead, maximum BW are used, without retransmissions. Of course this is not realistic – further evaluation are necessary. |

Moderator observation: It seems there is a wide range of evaluation results provided by different company and there seem to be no common assumption among companies. It is suggested to continue with the evaluation in RAN1 until the next meeting.

Proposed reply LS answers / outcome (phase 2 until 02-Nov)

Based on observation of comments and inputs collected in Section 2, it is suggested RAN1 provides a response to SA2 according to the followings in this meeting and continue with evaluation until the next meeting for Q2 in the received LS.

For Q1 in the received LS (R1-2007514), proposed reply answer:

“*Based on RAN1’s evaluation, it is concluded that the existing V2X mechanism defined in Rel-16 is able to support the new standardized PQIs in Table 1 and 2 over PC5 interface.*”

For Q2 in the received LS (R1-2007514), proposed reply answer:

“*RAN1 is currently conducting performance evaluation to derive a maximum MDBV value that can be supported by existing V2X mechanism for the indicated PDB and PER in Table 2. RAN1 will provide this value once it is available*.”

**Question: Are the above proposed reply answers for Q1 and Q2 acceptable? If not, which one is not acceptable and any suggested modification?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
|  |  |  |

Summary of contribution inputs

In [2], simulation results were provided for Q1 and Q2. Based on the provided simulation results, the following observations and conclusions are drawn.

***Observation 1: For Public Safety services in Table 1, the most stringent PER requirement of 10-6 in New value #4 can be supported at least when UE is in a good geometric condition (e.g. SNR above 25 and possibly even below).***

***Observation 2: For commercial services in Table 2, the most stringent PER requirement of 10-4 in New value #1 can be supported at least when UE is in a good geometric condition (i.e., SNR=25dB for 16QAM and SNR=30dB for 64QAM).***

***Conclusion 1: Based on the above provided simulation results and observations for performance evaluation of PS and commercial services, it can be concluded that the existing V2X mechanism is able to support these two services with new standardized PQIs over PC5 interface at least in FR1 with maximum bandwidth allocation.***

***Observation 3: It is observed the maximum MDBV value that can be supported by the AS layers using the existing V2X mechanism is when MCS=16 with 64QAM modulation with a maximum of 4 transmissions per TB and 30kHz SCS. The equivalent TB size is 295,176 bits. This translate into a maximum MDBV value of at least 36,897 bytes per 2ms.***

***Conclusion 2: Based on the above provided simulation results and observation, it can be concluded that the maximum MDBV value that can be supported by using the existing V2X mechanism is at least 36,897 bytes per 2ms in FR1 with maximum bandwidth allocation.***

In [3], draft answers were provided as followed.

***Answer (to Q1):*** *From RAN1 perspective, the new Standardised PQI in Table 1 and Table 2 in the LS can be supported using Rel-16 SL. However, it is worth noting that the Rel-16 SL is not optimal from power consumption perspective. RAN1 is developing power saving mechanism for sidelink in Rel-17. In this stage, RAN1 cannot conclude whether the new Standardised PQI in Table 1 and Table 2 can be supported for UEs with battery constraint.*

***Answer (to Q2):*** *From RAN1 perspective, the maximum data rate can be supported using the Rel-16 SL is around 2Gbps for FR1 and 4Gbps for FR2, assuming 256QAM and rank-2 transmission are used. However, the PDB and PER may not be guaranteed in these peak data rates. RAN1 has not yet evaluated the maximum MBDV value that can be supported with the indicated PDB and PER in Table 2.*

In [4], draft answers were provided as followed.

***Answer (to Q1):*** *From RAN1 perspective, the new standardized PQIs for public safety (Table 1 in R1-2007514) can be supported. However, the new PQIs for commercial use cases (Table 2 in R1-2007514) are very challenging from RAN1 perspective. Assuming the largest UE channel bandwidth currently supported in the RAN4 specifications for PC5 bands, i.e. 40MHz, and the most extreme configuration of NR SL (60kHz numerology, 2 layers transmissions, lowest overhead for control signalling and reference signals), the maximum data rate that could be achieved is around 375Mbps. RAN1 notes that delivering such data rate is only possible with deployment scenarios which are practically infeasible (i.e. high SINR requirements of >30dB and dedicating the entire system bandwidth to single user i.e. no more than single user can be active in a cell simultaneously). Therefore, from RAN1 point of view, PQIs for commercial services are quite challenging using a typical NR SL configuration and deployment scenarios (larger cells with multiple users), if not impossible.*

***Answer (to Q2):*** *RAN1 has not yet investigated the maximum MBDV value that AS layer can support. RAN1 will further perform evaluations and it is noted in RAN1 that extreme configurations for NR should not be used for the evaluations and typical deployment scenario will be considered.*

In [5], draft answers were provided as followed.

* ***For question 1:***
  + ***The new standardized PQIs for ‘New value#1’, ‘New value#2’, and ‘New value#3’ in Public Safety Table can be supported in AS layers from Rel-16.***
  + ***The new standardized PQIs for ‘New value#4’, and ‘New value#5’ in Public Safety Table include PERs which are beyond what AS layers in Rel-16 are designed to support.***
  + ***The new standardized PQIs for ’New value#1’, ‘New value#2’ in commercial service Table can be supported in AS layers from Rel-16.***
* ***For question2:***
  + ***The maximum MDBV value AS layers can support is 1.3 Mbytes with a 10ms PDB assumption, and 0.65 Mbytes with a 5ms PDB assumption.***

References

1. [R1-2007514](C:\\3GPP\\RAN1_Meetings\\Tdocs\\2020\\R1-2007514.zip) LS on new PQI support for PC5 communication SA2, OPPO
2. [R1-2008233](file:///C:\3GPP\RAN1_Meetings\Tdocs\2020\R1-2008233.zip) Discussion on reply LS on new PQI support for PC5 communication OPPO
3. [R1-2008645](file:///C:\3GPP\RAN1_Meetings\Tdocs\2020\R1-2008645.zip) Draft Reply LS on new PQI support for PC5 communication vivo
4. [R1-2008745](file:///C:\3GPP\RAN1_Meetings\Tdocs\2020\R1-2008745.zip) [Draft] LS on new PQI values for PC5 communication Ericsson
5. [R1-2008788](file:///C:\3GPP\RAN1_Meetings\Tdocs\2020\R1-2008788.zip) On new PQI support for PC5 communication Huawei, HiSilicon

Appendix (Questions from SA2 in [1])

SA2 is studying the PC5 direct communication on the SID of 5G ProSe, which is covering Public Safety and commercial cases. SA2 has assumption the existing V2X mechanism is reused, on top of that, the following new Standardized PQIs for Public Safety and commercial in Table 1 and Table 2 are proposed to be introduced for PC5 communication.

**Table 1: New Standardized PQIs for Public Safety**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| PQI  Value | Resource Type | Default Priority Level | Packet Delay Budget | Packet Error  Rate | Default Maximum Data Burst Volume | Default  Averaging Window | Example Services |
| New value#1 | GBR | 1 | 150 ms | 10-2 | N/A | 2000 ms | Mission Critical user plane Push To Talk voice (e.g. MCPTT) |
| New value#2 |  | 2 | 200 ms | 10-2 | N/A | 2000 ms | Non-Mission-Critical user plane Push To Talk voice |
| New value#3 |  | 2 | 200 ms | 10-3 | N/A | 2000 ms | Mission Critical Video user plane |
| New value#4 | Non-GBR | 1 | 120 ms | 10-6 | N/A | N/A | Mission Critical delay sensitive signalling (e.g. MC-PTT signalling) |
| New value#5 |  | 6 | 400 ms | 10-6 | N/A | N/A | Mission Critical Data (e.g. example services are the same as 5QI 6/8/9) |

**Table 2: New Standardized PQIs for commercial service**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **PQI**  **Value** | **Resource Type** | **Default Priority Level** | **Packet Delay Budget** | **Packet Error**  **Rate** | **Default Maximum Data Burst Volume** | **Default**  **Averaging Window** | **Example Services** |
| New value#1 | Delay Critical GBR | 5 | 5ms | 10-4 | 20000 bytes | 2000 ms | Interactive service - consume VR content with high compression rate via tethered VR headset |
| New value#2 |  | 6 | 10ms | 10-4 | 20000 bytes | 2000 ms | interactive service - consume VR content with low compression rate via tethered VR headset;  Gaming or Interactive Data Exchanging; |

Q1): SA2 kindly asks RAN1 whether these new Standardised PQIs can be supported in AS layers.

In addition, MDBV values can be changed according to application requirements to override the default MDBV. For Example, for commercial service, to support required data rate of 10Gbps, the maximum MBDV value set by the application can be 12.5M byte.

Q2): SA2 kindly asks RAN1 what is the maximum MBDV value AS layer can support with the indicated PDB and PER in Table 2.