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**Source: Qualcomm Incorporated, Huawei, Nokia, Nokia Shanghai Bell, Tencent, Tencent Cloud**

**Title: Key Issue #8: Evaluation and conclusion**

**Document for: Discussion/Approval**

**Agenda Item: 9.19**

**Work Item / Release: FS\_XRM/Rel-18**

*Abstract of the contribution: This document analyses the solutions submitted for Key Issue #8 and proposes a way forward.*

# 1. Discussion

Solutions number 33, 58, 59, 60 and, partially, 34 address Key Issue #8. All solutions rely on providing some information to the RAN so that it can optimize the setting of the CDRX cycle (most notably, its duration). Such solutions can be summarized as follows:

 - Solution 33. In this solution the RAN and the UPF are provided with UL/DL traffic patterns that then are used to optimize the CDRX cycle duration. The UL/DL traffic patterns include, e.g., the periodicity and/or the frequency of the UL and DL bursts and traffic descriptions (to describe the type of traffic). Such information may be provided to the RAN either by the AF (via NEF/PCF and SMF) or by the UPF (via GTP-U header extension). The UPF may receive the information from the AF (via NEF/PCF and SMF) or can derive it based on statistical analysis (e.g., as described in Solution 12).

- Solution 34 has two parts, and the first one is focusing on how to provide CN assistance information to the RAN to that it can optimize the CDRX cycle duration. The 3rd party application function provides session identifier, traffic patterns (frame rate, dynamic GOP, maximum frame size) and traffic profile (UE driven vs. server driven DL traffic) in a way similar to the External Parameter Provisioning of Rel-15. The UDM stores the XRM Communication Patterns and the SMF can retrieve the “SMF associated” information and use it to derive the CN assisted RAN information.

- Solution 58 proposes to provide the Application Packet periodicities and jitter ranges/averages on a per application flow manner to the RAN. Such information can be provided as part of the TSCAI (Time Sensitive Communication Assistance Information) in a semi-static way (over CP). In case of dynamic corrections of the periodicity values, corrections can be indicated in-band (i.e., via the AS-UPF-RAN in the PDU Set information – See Solution 8).

- Solution 59 categorizes the information to be sent to the RAN in essential (PDU Set boundaries, i.e., indication of first PDU of the PDU set, last PDU of the PDU set, sequence number of the PDU within the PDU Set), assistance information (traffic periodicity, jitter statistics, PDU set size as well as priorities, dependencies, and validity times of the PDU sets). The information is provided to the RAN at PDU session establishment/modification via CP signaling.

- Finally, Solution 60 proposes to provide the RAN with the end of burst indication via in-band signaling over GTP-U header. Such information is sent by the UPF which can get it explicitly from the AS or can generate it locally based on other mechanisms.

In order to be useful, the information received by the RAN needs to describe the expected traffic behavior in terms of bursts because a burst would include the information associated to multiple frames and/or video slices for XRM services. Providing information that is only related to PDU Set does not value to the solutions that are already discussed for Key Issue 4 and 5 and does not help to address Key Issue 8 because a PDU Set includes the information of only one frame or video slice. In addition, from the point of view of XRM services, the concept of Application Packet is equivalent to the concept of burst, which, essentially, represent a group of multiple PDU Sets sent at approximately the same time and that should be delivered to UE with the same deadline.

Semi-static information, such as burst periodicity should be provided via CP signaling at QoS Flow establishment/modification, while dynamic information, such as indication of beginning and end of burst, should be provided via in-band signaling (GTP-U header).

# 2. Text Proposal

It is proposed to agree the following changes vs. TS 23.700-60:

>>>>BEGINNING OF CHANGES<<<<

## 3.1 Terms

For the purposes of the present document, the terms 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].

**PDU Set**: A PDU Set is composed of one or more PDUs carrying the payload of one unit of information generated at the application level (e.g., a frame or video slice for XRM Services, as used in TR 26.926 [27]). In some implementations all PDUs in a PDU Set are needed by the application layer to use the corresponding unit of information. In other implementations, the application layer can still recover parts all or of the information unit, when some PDUs are missing.

**Multi-modal Data**: Multi-modal Data is defined to describe the input data from different kinds of devices/sensors or the output data to different kinds of destinations (e.g., one or more UEs) required for the same task or application. Multi-modal Data consists of more than one Single-modal Data, and there is strong dependency among each Single-modal Data. Single-modal Data can be seen as one type of data.

NOTE 1: This definition was taken from TR 22.847 [6].

**Tactile Internet:** A network (or network of networks) for remotely accessing, perceiving, manipulating, or controlling real or virtual objects or processes in perceived real time by humans or machines.

NOTE 2: This definition is based on IEEE SA P1918.1 [7].

**Data Burst:** A set of multiple PDUs generated and sent by the application in a short period of time.

NOTE: A Data Burst can be composed by one or multiple PDU Sets.

>>>>NEXT CHANGE<<<<

# 7 Overall Evaluation

## 7.X Evaluation for Key Issue #8

Solutions number 33, 58, 59, 60 and, partially, 34 address Key Issue #8. All solutions rely on providing some information to the RAN so that it can optimize the setting of the CDRX parameters (e.g., the DRX cycle). Such solutions can be summarized as follows:

 - Solution 33. In this solution the RAN and the UPF are provided with UL/DL traffic patterns that then are used to optimize the CDRX cycle duration. The UL/DL traffic patterns include, e.g., the periodicity and/or the frequency of the UL and DL bursts and traffic descriptions (to describe the type of traffic). Such information may be provided to the RAN either by the AF (via NEF/PCF and SMF) or by the UPF (via GTP-U header extension). The UPF may receive the information from the AF (via NEF/PCF and SMF) or can derive it based on statistical analysis (e.g., as described in Solution 12).

- Solution 34 has two parts.

The first part focuses on how to provide CN assistance information to the RAN to that it can optimize the CDRX cycle duration. The 3rd party application function provides session identifier, traffic patterns (frame rate, dynamic GOP, maximum frame size) and traffic profile (UE driven vs. server driven DL traffic) in a way similar to the External Parameter Provisioning of Rel-15. The UDM stores the XRM Communication Patterns and the SMF can retrieve the “SMF associated” information and use it to derive the CN assisted RAN information.

The second part focuses on how the UE may be configured with multiple CDRX configurations and that the UE may choose to move from one CDRX configuration to another or may choose to modify a CDRX configuration parameter based on the traffic pattern that is being used. This might be useful in situations where the UE is aware of a traffic pattern starting or beginning before it can be detected by the network.

- Solution 58 proposes to provide the Application Packet periodicities and jitter ranges on a per application flow manner to the RAN. Such information can be provided as part of the TSCAI (Time Sensitive Communication Assistance Information) in a semi-static way (over CP). In case of dynamic corrections of the periodicity values, corrections can be indicated in-band (i.e., via the AS-UPF-RAN in the PDU Set information – See Solution 8).

- Solution 59 categorizes the information to be sent to the RAN in essential (PDU Set boundaries, i.e., indication of first PDU of the PDU set, last PDU of the PDU set, sequence number of the PDU within the PDU Set), assistance information (traffic periodicity, jitter statistics, PDU set size as well as priorities, dependencies, and validity times of the PDU sets). The information is provided to the RAN at PDU session establishment/modification via GTP-U header and/or CP signaling (NGAP). In general, information provided to NG-RAN for the purpose of KI#4/5 is also leveraged for improved power savings.

- Finally, Solution 60 proposes to provide the RAN with the end of burst indication via in-band signaling over GTP-U header. Such information is sent by the UPF which can get it explicitly from the AS or can generate it locally based on other mechanisms.

>>>>NEXT CHANGE<<<<

# 8 Conclusions

## 8.X Interim Conclusion for Key Issue #8

The following information, to be provided to the NG-RAN at PDU Session Establishment/Modification via an NGAP Message, is taken as baseline for normative work:

- Periodicity for UL and DL traffic of the QoS Flow. In addition to integer periodicity values, non-integer values associated to, e.g., 45FPS, 60 FPS, 90FPS, 120FPS, shall be supported. Such information shall be exchanged by re-using/extending the TSCAI/TSCAC definitions in TS 23.501 clause 5.27.2.1.

Editor’s Note: If the PDU sets with the Periodicity (e.g., 45FPS, 60 FPS, 90FPS, 120FPS) are mapped into different QoS Flows, it is FFS whether the same Periodicity still exists and whether the same Periodicity can be used for the UL and DL traffic of each QoS Flow.

NOTE 1: The above information can be provided to the 5GC by the AF via an NEF API. The 5GC can further derive, or be configured, with such information. How 5GC derive the information can be discussed in normative work.

- Traffic jitter information associated with each periodicity.

NOTE 2: How 5GC derive the information can be discussed in normative work.

The AF may provide the following information to 5GC and assist the UPF to detect the end of Data Burst:

- An indication of end of Data Burst marker.

NOTE 3: Whether this based on indication of only one media unit within each data burst or based on RTP extension header or both can be discussed in normative work.

The following information for DL traffic, to be provided to the NG-RAN with in-band signaling via GTP-U header, is taken as baseline for normative work:

- Optional, End of Data Burst indication in the header of the last PDU of the Data Burst.

NOTE 3: It is assumed that the PDU with the End of data burst indication is received by the NG-RAN after all other PDUs of the Data Burst.

The UPF detects the end of a Data Burst the and marks the End of Data Burst indication over GTP-U based on information provided by the AS (e.g., “End” in the RTP extended header when only one media unit (e.g. NAL Unit) within each data burst).

NOTE 4: RAN may detect the end of a Data Burst based on implementation (e.g., by using a timer) in some other scenario (e.g. dynamical number of media units in each burst).

>>>>END OF CHANGES<<<<