**Title: Informal feedback on companies' position in xRM\_ph2 (TR 23.700-70 v0.4.0)**

# 1 Overall description

TR 23.700-70 v0.4.0 contains 30 solutions covering all KIs except for KI#8. Some solutions contain various options as well like (e.g., using control plane vs. user plane, UPF detection vs. info sending from AS, etc).

To optimize (or consolidate) the input paper for future meetings; companies are requested to provide feedback regarding the solution(s) and/or agreeable principles for various KIs, currently documented in TR 23.700-70 v0.4.0. It also helps to determine the solutions that have majority interest and/or result in significant concerns.

We ask each company to give your view towards this question (one so far). This is not an evaluation for each of the solutions that are currently documented. It is mainly to seek your view on how each key issue can be addressed, based on the input form TR 23.700 so far. Then we will seek a volunteer for each key issue to drive summarizing the input.

**Q1. How should this problem be resolved?**

E.g., list the principles you think are the right approach to resolve this key issue and point to the subclause of TR 23.700-70

E.g., none of the principle suggested defined so far is good enough and why.

**Key Issue #1**

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| Key area | Input from Company - ABC |
| (1a): Active discard by RAN due to FEC (all FEC related Solutions - #1, #2, #3, #4, #21) | [Nokia] – prefer approach where FEC ratio parameter is provided via the CP rather than a UP approach where a FEC ratio parameter is included as PDU Set Information. Note SA4 has a new study item 5G\_RTP\_Ph2 as part of Rel 19. Any new RTP HE extensions, including studying FEC in RTP HE will be part of this SID. This will have to wait for the next 9-12 months for completion[Tencent] prefer to provide FEC ratio parameter via CP.[Lenovo] In general, either confirmed by SA4 or indicated by Application that FEC based discard is allowed, NG-RAN can perform active discard. Whether NG-RAN performs active discard when congestion happens or based on implementation, should be discussed by RAN WG.Meta: 1. RAN should only be allowed to discard PDU of a PDU set in abnormal condition like congestions.
2. During congestion, RAN may discard PDU up to the ratio given by UPF (option 2 of Sol#21). Ratio is dynamically assigned per PDU set by AS during encoding, and this ratio is indicated via inband (N6).
3. The ratio of PDUs that are discarded by RAN needs to feedback to AS via inband in uplink direction. This allows the AS (sender) to combine the RTCP feedback from device and the RAN feedback for bandwidth and FEC allocation.

[MediaTek] UDP traffic over UM bearer is unable to provide the reliability necessary for FEC. Using HARQ feedback with a false alarm (rate 0.1 to 1%), propagates the error further since a transport block can house multiple UDP packets.[InterDigital] We prefer to provide a success ratio to RAN via GTP. Also, information about what source and repair packets are associated should be provided to RAN via GTP. It is important for SA2 to check with SA4 to see if the application needs to distinguish RAN's intentionally dropped FEC packets from congestion related drops. If the application does need to make this distinction, then RAN and SA2 need to coordinate on how the necessary information is provided to the application.Also, we think that a similar question should be asked about congestion related discarding based on FEC information. Information about whether a packet is a source or a repair packet could be sent to RAN via GTP (e.g. per solution #21) and this information could be used by RAN to make packet discarding decisions in congestion situations. When packets are discarded due to congestion, feedback to the application would not be necessary (beyond what is already available in Rel-18).[Qualcomm] We support the idea of active discarding. Both MDS FEC schemes and FlexFEC can be supported. For MDS FEC schemes both static (via control plane) and dynamic redundancy ratio (via user-plane) can be supported. Solution 1 and 21 can be combined along these lines.Ericsson:*In general, all solutions have a large number of ENs where number of such require feedback from other WGs.* *While adding large complexity, the solutions lacking a proof of benefits. All solutions suffer from contradicting the paradigm of how applications on Internet are expected to behave, i.e., react to packet losses by reducing the rate (see <https://datatracker.ietf.org/doc/html/rfc8083>). Hence, given all solutions propose to continuously discard packets by RAN, a properly behaving Internet application will reduce the rate to a level where at some point no service will be provided. Other issues are partly reflected by the ENs.**At this stage we have strong concerns to consider these solutions for conclusions, especially before the feedback on ENs from other WGs is received.*[Huawei]Current solutions are based on/depend on different AL-FEC mechanisms. Thus the target use cases for AL-FEC should be classified firstly. Whether the static FEC ratio from AF is sufficient and achievable and how RAN can easily make use of these information without impact on the application layer needs further collaboration with SA4/RAN2. ENs need to be addressed before conclusion.[vivo] There are following solutions1. CP based #1,#2,#,3,#4, main idea are:
	1. #1 PDU Set content ratio awareness at RAN
	2. #2 Discarding of redundant PDUs (FEC) and reporting
	3. #3 mapping information between FEC transmission ratio and PSI value
	4. #4 Drops the FEC protection packets if the PSIHI indicates the FEC scheme.
2. UP based #21 and UP based include
	1. Alternative1: marking repair packet and the associated source packet;
	2. Alternative2: successful ratio marking

In previous SA4 LS S2-2210181, SA4 replies that video usually relies on Flex-FEC, and #21 Option 1 is related to Flex-FEC so it is preferred. Other solution based on other FEC need to further coordinated with SA4. Also discard based on FEC in UL should not be supported, since the repair packet need to protect the resource packet during N6 transmission.[China Telecom]In our view, the issues contain two aspects: 1) the effectiveness of FEC mechanism for XRM services; 2) How to solve the ENs in current FEC solutions.Therefore, we should first ask SA4 to confirm the efficiency of static FEC ratio (Sol#21, option1) and/or Flexible FEC retransmission (Sol#21, option2). Assuming these two option are all effective for XR services, for static FEC ratio, we prefer to provide such a ratio via CP in this Release; for flexible FEC retransmission, how RAN can distinguish proactively drop FEC packets from congestion related drops, it may be difficult to evaluate. |
| (1b): Alternative PDU Set QoS handling (Sol #6, #7, #19) | [Nokia] – Prefer solution #19 - allow alt-QoS profiles with PDU Set QoS parameters, to enable switching between profiles based on PDU Set information (e.g. media type, or QoS/Alt-QoS Indicator) provided as PDU Set Information to the RAN, and notification of profile switching to the AF. This switch can happen when there is a transition in the media transition over a period of time.[LGE] - Solution #19, Support the Alternative QoS profile to include alternative PDU Set QoS parameter Set(s) with PSDB and PSER and QoS notification via control plane[Tencent] Solution #6 and19# are aligned in some aspects ie.g. media type information and also the idea to extend AQP to include PSDB and PSER. Prefer to capture common principles from solutions.[Lenovo] PDU set QoS parameters should be included in the alternative QoS profile, which enables NG-RAN to perform PDU set based handling based on the alternative PDU set QoS.[MediaTek] No strong views yet.[InterDigital] No strong views yet.[Qualcomm] We support adding PSER, PSDB and PSIHI to AQP. Ericsson: We are OK to enhance AQP with PDU Set QoS Parameters as they are missing, should have been done in Rel-18 already.Additional changes proposed lack proof of benefit and consequently should not be considered.At this stage we have strong concerns to consider these solutions for conclusions, especially before the feedback on ENs from other WGs is received.Based on our current understanding of the documented solutions, we have strong concerns with solutions that propose fundamental change to the 5GS QoS Framework, where a QoS Flow is the smallest entity subject to QoS handling describing packet forwarding for all data mapped on that QoS Flow and there is only one QoS profile at any given time. This is fundamental as it is valid throughout the whole 5GS including NG-RAN. It was deliberately specified in that way enabling different QoS profiles being applicable to separate QoS Flows that carry data with flow with different QoS requirements. No benefits or drivers that would justify such drastic change have been shown.[Huawei]We are supportive on adding PDU Set QoS parameters into alternative QoS profile. Based on the RAN capability of PDU Set handling support, the Alternative QoS profiles can be updated accordingly, i.e., with or without the PDU Set QoS parameters. On the exposure part, this can be discussed together with Key Issue#9.[vivo] We support adding PSER, PSDB to AQP. PHISI is not suitable as alternative QoS.[China Telecom]We are OK to add PDU Set QoS parameters to AQP, so that NG-RAN can perform PDU set based handling based on these alternative PDU Set QoS. |
| (1c): Other PDU set and QoS related topics (Sol #5, #8, #20, #22, #23) | [Nokia] – Solution 8 is a must to provide consistent PDU Set handling between AF and UPF. Also, Solution #23 with PDU Set Group and cross-PDU Set correlation identifier should be considered[LGE] - Solution #23, Agreable for the PDU Set correlation to be taken into account for the RAN discarding decision during congestion.Meta: Supports Solution #23: PDU set discard based on PDU sets correlation info from AS/AF. We propose to keep the solution simple by only considering I and P-frame relationship in this release. The use of B-frame with this solution is Out of scope.[MediaTek] #20 – Adopting NPSDB is contingent upon RAN acceptance.[InterDigital] No strong views yet. [Qualcomm] We support enabling UE and UPF to determine PSI based on PDU Set types (solution 8). We support introducing the nominal PSDB (Solution 20).Ericsson: Ok to provide PDU Set information independent of PDU Set QoS Parameters availability.[Huawei]Solutions under the umbrella are divergent now. In general, cooperation with RAN and SA4 are needed to justify the solutions.Sol #5 and #8: How to detect the PDU Set type for UPF/UE and provide the mapping between PDU Set type and PSI to UPF/UE needs more clarifications. Sol #20: The benefits of introducing this nominal PSDB and then dynamic delay budget adjustment for each PDU Set are not justified. Also the feasibility needs to be checked with RAN WGs. Sol #22: Option#2 is preferred, but the details on the RAN notification should be further clarified. The failure report should be general for any cases that RAN cannot fulfil the QoS parameters instead of depends on UE capability only. Sol #23, the dependency or correlation relationship among PDU sets could be very complex in some cases. Focusing on the simple use case e.g. the GoP scope could be a possible.[vivo]Sol #5 it is possible for RAN to perform other PDU Set handling different from the PDU Set QoS, in this solution is beneficial for that: CN indicates PDU Set marking is possible to the RAN and RAN can request PDU Set marking for other PDU Set handling.Sol #8: How to detect the PDU Set type for UPF/UE is not addressed and many media type are single PDU doesn’t need PDU Set Importance. there is no clear clue about relationship between media type and PSI. e.g. at receiver, I frame and P frame are with same importance for decoding. Need coordinated with SA4. Sol #20 Nominal PSDB try to fix the jitter of PDU set arrival but holding the transfer of the early PDUs and discarding the late arrival PDUs are not expected by the receiver.Sol #22, RAN can indicate to CN that UL PDU Set handling is possible or not after receiving the UL PDU Set QoS. RAN notification in different direction is beneficial for CN to understand the situation and notify AF the situation.Sol #23 the motivation of PDU Set correlation information is good but the correlation of PDU Sets may be multiple to multiple correlation during encoding. Need coordinated with SA4 whether the PDU Set correlation information can be obtained.[China Telecom]For Sol#23, PDU Set Importance is enough to determine the discarding precedence of different PDU Sets in presence of congestion, therefore we prefer PDU Set Correlation is not needed. For other Solutions: No strong views. |
| Do you plan to submit a new solution for this KI? | [Nokia] – Yes - discard notification contribution S2-2401170 was not opened at S2-161 [Tencent] No [Lenovo] YesMeta: YES- for feedback signal from RAN to AS (application) on active discarded ratio.[MediaTek] No[InterDigital] No.[Qualcomm] No.Ericsson: No[Huawei] Yes[vivo] Yes[China Telecom] No |
| What is your preferred conclusion (e.g. solution#, agreeable principles) for this KI? | [Nokia] – Support: 1 – FEC ratio in CP is sent to the RAN, 2 – Solution #19 - Alt-QoS with PDU Set QoS Params and profile switching based on new PDU Set Information (in GTP-U HE from UPF) 3 – AF providing info. on PDU Set Types and PSI mapping to UPF (solution 8) 4 – Discard notification optimization.[LGE] - RAN2 specified discarding PDU Set in the congestion based on the PDU Set Importance in TS 38.300 and SA4 specified the guidance for PDU Set marking in TS 26.522 with the PDU set importance considering PDU set dependencies. Prefer solutions having less impact on legacy.[Tencent]We propose to focus on resolving the ENs and update solutions in Apirl meeting and make evaluation and conclusion in May meeting. [Lenovo]. For 1a, either FEC ratio or source/repair marker should be supported, e.g., solution#21. and For 1b, the basic principle is to add PDU set QoS parameters into alternative QoS profile, e.g., solution#7.Meta: See Meta input above.[MediaTek] #8, There is possible PSI alignment with SA4 TS 26.522 recommendation.[MediaTek] #22, solution to inform the CN of PDU Set support in the RAN. Select ALT 1, since UAI per flow is anticipated to dynamically change.[MediaTek] #23, contingent on SA4 ability to provide PDU Set correlation importance that RAN can interpret to discard since it is not aware of I/P-frames. [InterDigital] For FEC, a minimal solution would be for the UPF to send FEC Information to RAN so that RAN can use the information when making discarding decisions due to congestion. Going further and supporting active discarding requires coordination with RAN and SA4. We support the idea of checking with SA4 and RAN on active discarding. [Qualcomm] For AL-FEC, a combination of solution 1 and 21. For AQP handling for PDU sets: Solution 6 (or the same aspects of solution 19). For other aspects: solution 8 and solution 20.Ericsson: #5 opt 2[Huawei] Support alternative QoS Profile enhancement. Solutions under 1c (e.g. AL-FEC) are valuable to discuss but generally need further clarifications for evaluation, see above.[vivo]1a- Only DL - #21 alternative1: In previous SA4 LS S2-2210181, SA4 replies that video usually relies on Flex-FEC, and #21 Option 1 is related to Flex-FEC; and others are not. Solutions based on other FEC need to further coordinated with SA4 firstly.1b - adding PSER, PSDB to AQP. PHISI is not suitable as alternative QoS. 1C - #5 but only one option is supported, prefer option 2;- #22 but only one option is supported- #23 if SA4 confirms the PDU Set correlation information can be obtained.[China Telecom] See China Telecom input above. |

Key Issue #2

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| (2): end-to-end encrypted XRM (Sol #9, #10, #11, #12, #24, #25, #26, #27) | Nokia preferred approach is based on UDP-Connect from UE to AS. Nokia views that MoQ is not mature enough IETF and is too early for 3GPP. Nokia will not support non-secure solution such as UDP-option, ~~PDU set information in GTP-U headers~~. Sol #9, and Sol#10 are based on MoQ. IETF work is not complete and matured enough. Sol#11 complex solution on correlating QUIC and XRM metadata deviating from IETF protocol Sol#12. Better align with IETF/industry solution for security aspect. Sol#24: UDP-Connect (between UPF and AS) is feasible solution. Nokia will support.Sol#25: Adding PDU Set information over GTP-U (between AS and UPF) requires AS to support GTP-u and IPsec which may not take place in actual deployments.Sol#26 UDP-Connect (UPF and AS) is feasible solution. Nokia will supportSol#27: UDP-option is not secure. Lenovo] Solution#9 and 10 are based on MoQ scheme, which enables PSA UPF to acquire PDU set information via metadata as the MoQ relay. The MoQ is still in early stages in IETF and it is not clear yet whether MoQ is a suitable method to convey XR related media. 3GPP SA4 should also provide feedback on the feasibility of using MoQ for XR services. An LS should be sent to SA4 for feedback.Solution 11,12 and 27 are based on RTP over QUIC, which enables PSA UPF to acquire PDU set information via metadata/OFC contained in UDP-option. We see disadvantages with this option as any proxy in the path over N6 between the Application Server and the UPF could change/tamper with PDU set information which would impact handling of PDU-set in the RAN. An also should also be sent to SA4 on the feasibility of using UDP-Options to include PDU-set information as well as to SA3 to identify any security impacts.Solution#24, 25 and 26 are based on supporting a tunneled connection over N6 between th ePSA UPF and AS. Solutions 24 and 26 propose leveraging the Connect-UDP option where PDU set information is included within HTTP Datagrams whereas Solution#26 propose including PDU-set information within GTP-U header. Meta: We support the solution principles in Sol#26, or with Sol#24 with “6.24.3.2/Using Connect-UDP”. In addition, SMF may be configured with the information to establish “Connect-UPF” from UPF to AS proxy without receiving PCC rules from PCF. This is same principle for PDU set QoS in 23.501 … “the SMF may be configured to support PDU Set based QoS Handling without receiving PCC rules from a PCF.”[MediaTek] #9,#10 – Relates to MoQ, which is currently a draft standard. For MoQ to become popular, CDNs would need to adopt a new distribution mode and is therefore far into the future. The usefulness of MoQ would need to be explored by SA4 in the first instance.[InterDigital] We favor some form of a proxy based solution along the lines of solution #26.[Qualcomm] We are supportive of the option to send PDU Set information via the Capsule protocol using HTTP Datagrams (Solution 26). The concept of solution 9 (using a MoQ proxy in the UPF) is interesting but we think it is too early to conclude on this given that the related IETF work is still on-going.Ericsson: Following the principles shown below, we consider solutions #26 and #24 as our preferred ones, although solution #24 should not open the door to an indeterminate number of implementations based on SLA, see below.[vivo] The solutions on the table are more about customising the metadata format for PDU Set info in the external protocol, but they are not sufficient good, since it is 3GPP customised metadata format is probably not complied by OTT.#9#10 IETF defined MoQ metadata format e.g. object, group seems more suitable for the PDU Set info. #24 EN and #26 idea of using some HTTP proxy are not bad but the UE is not aware of interaction between and server and PSA UPF and the interaction cannot forbid the info which are sensitive to UE and bring in UE security concern. And the following need to be fixed. * #24: context ID doesn’t support the the new type metadata.
* #26: forwarding more only allow short header of QUIC cannot support the combination of the HTTP datagram and XRM payload in one UDP.
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| Do you plan to submit a new solution for this KI? | [Nokia] we will submit a solution with UDP-connect starting from the UE because the UE is more suitable (than UPF) to know that an XRM app has started and a related UDP Connect to the AS is needed (The UPF cannot easily detect an XRM app due to traffic being ciphered)[Nokia] we are also planning to resubmit the IPSec based solution as an alternative.[Tencent] No[MediaTek] No[InterDigital] No.[Qualcomm] No.Ericsson: NoHuawei: No[vivo]yes[China Telecom] No |
| What is your preferred conclusion (e.g. solution#, agreeable principles) for this KI? | [Nokia] IETF MASQUE based tunnelling (UDP-connect) based solution started from the UE (see above). Metadata defined in 3GPP (SA4)[Nokia] No MoQ based solutions as they are less generic and also less mature in IETF[Lenovo] Lenovo preferred option is to introduce a tunnelled connection over N6 between PSA UPF and AS, which enables PSA UPF to obtain PDU set information either via HTTP datagrams or GTP-U header, e.g., solution#24-26Meta: In general, we see the need to define a generic framework from this KI2 to carry additional information from UPF to AS and/or AS to UPF as defined is some solutions related to KI1/KI4/KI5/KI9. See response to these related KIs.[MediaTek] #24, 25 & 26, relate to delivery over a secure N6 tunnel. No strong view on what is encapsulated.[MediaTek] Or [MediaTek] #11,#12, #27 – Contingent on IETF/IANA approving a new set of UDP-options. The security concerns raised in the draft document, particularly regarding UDP options are not covered by DTLS (section 22), and protection against in-transit modification (section 15) needs to be addressed. [MediaTek] But not both (i.e., N6 tunnel or UDP-options)[InterDigital] Tunnelling based solutions along the lines of Solution #26.[Qualcomm] Solution 26.**Ericsson:** #26 and #24 can be merged.These are our agreeable principles:-Metadata needs to be integrity protected, but PDU Set information is not considered privacy sensitive. In addition, identification of the media fetched by an end-user should not be exposed (e.g. through MoQ track id) to avoid privacy violation. -Solutions putting additional requirements on the UPF not related with the goals of the key issue, such as implementing a MoQ relay should be avoided. -Solutions should be applicable to most use cases. We believe MoQ relay works for MoQ framework only.-Solutions based on any number of undefined implementation options (to be agreed by means of SLA), don't provide a basis for a standard. They are not acceptable to us. -Solutions should minimize impact on the UPF and Application Servers.[Futurewei] Sol #26 in UDP-connect forwarding mode can add unencrypted metadata that is efficient but may suffer from lack of protection. Our preference is to use a combination of sol #26 for the transport/forwarding modes and use its secure mode to setup obfuscated metadata (from sol #12). Obfuscated metadata can be transported using sol #26 forwarding modes. (a short offline review of OFS in IETF indicates it is secure, and may considering a full security review later)Notes/context: Bulk encryption of an entire interface (e.g., IPSec) has only modest drops in performance and scales well. TCP with TLS encrypts and paces large chunks (up to 16 KB /10+ packets at a time) to manage cost.. Key takeaway is that as packet (chunk) sizes go down, the cost incurred for encryption/decryption does not reduce proportionally or significantly[Huawei] Media over QUIC based solutions as described in sol#9 and sol#10 are preferred. No CONNECT-UDP (sol#24,#26) based solution, since it doesn’t support transmit the PDU set related info.Reasons: 1. It is preferred not to ask the application server to treat connections with clients from mobile network and fixed network differently, currently for an application service provider the vast majority (90+%) of the XR traffic are transmitted via fixed network, so from a deployment perspective, it would be hard to customize connections specifically for mobile network. MoQ solution(sol#9,10) deal with connections with clients from mobile network and fixed network uniformly, some other tunnel-based solutions like MASQUE tunnel(sol#24,26), GTP tunnel(sol#25), needs additional 3GPP customization from application server side.2. Avoiding additional encapsulation overhead to avoid MTU issue. In MoQ based solution(sol#9,10), no additional encapsulation is needed; in MASQUE tunnel(sol#24,26) and GTP tunnel solutions (sol#25) additional encapsulation header is added which may cause MTU issues.3. The metadata transmitted between UPF and AS should be protected with security, for the UDP option-based solution (sol#11, 12), additional security protection of metadata needs to be designed, or the solutions applies to the case with security domain between UPF and AS.4. If an IETF protocol allows extensions by other SDOs, then normally a vender specific extension with guidance on how the protocol can be extended will be provided, but for MASQUE tunnel protocol (e.g. Proxying UDP in HTTP, RFC9298), there is no such a vender specific extension, so for the MASQUE tunnel-based solution (sol#24,26), IETF extensions are missed.[vivo]There are many solutions on the table. Some feasibility issues are not fixed yet and too early to be considered in the conclusion. Hence, only the following agreeable principles are proposed 1. One possibility is Metadata can be provided by the server and is aware by the PSA UPF. The Metadata should be integrity protected and may be encrypted.
2. The mechanism should forbid the info which bring in security concern of the UE.
3. Only applied to DL traffic.
4. The metadata format supported by IETF is more preferred comparing to 3GPP customised metadata format with regards to the real usage in OTT.

[China Telecom]Maybe no solution is perfect. The UDP option related solution is not feasible and may have impact on SA3, therefore should first be excluded.For Sol#26, our concern is whether and how IETF standardization is required for HTTP proxy is hard to determine.For Sol#9 and Sol#10, since the metadata is always visible to relays, and each PDU Set can be well mapped to an Object of MoQ, we prefer this MoQ solution. |

Key Issue #3

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| (3): Leverage PDU Set QoS information for DSCP marking over N3/N9 in the transport network (Sol #13, #27) | [Nokia] DSCP marking is done per PDU Set based on the PDU Set Importance either as determined by UPF or based on SMF configuration. [Lenovo] It makes sense that PSA UPF marks DSCP values based on PSI value of the PDU set.[MediaTek] #13: DSCP contains drop precedence or importance, but the benefits are not apparent. [MediaTek] #27: Maps to PSI or priority contained in the UDP options metadata (see comment in KI#2).[InterDigital] It makes sense that PSA UPF marks DSCP values based on PSI value of the PDU and whether the PDU is carrying extra information such as an EoB indication. For example, if a PDU is carrying an EDB indication, then we would want to set the DSCP value so that it is less likely that the packet would be dropped in the transport network.[Qualcomm] We can be ok to enable SMF to provide a Transport Level Marking List to UPF that contains a list of PDU Set Importance values, each of which is associated with a DSCP marking (solution 13).Ericsson: The benefits of adding such functionality have not been shown, hence the ‘whether’ part is not addressed. It is emphasized that PSI is not a QoS parameter and thus there is no justification to consider it on the transport in the same way as QoS parameters are considered. The purpose and the need for any functionality based on that KI still remains unknown.[Huawei]We don’t see big benefits on this PSI based DSCP marking due to two reasons:1. DSCP have very few bits and have been well defined/used in current deployment. 5QI was used for DSCP mapping already. Introducing additional factor for DSCP marking requests re-configuration on the DSCP value usage in current deployment in both mobile and backhaul networks.
2. Need to understand how to avoid mis-ordering of packet in one QoS Flow due to different DSCP values are used.

[China Telecom]It makes sense to use PSI value to extend DSCP marking to PDU Set granularity. We are OK to generate multiple DSCP value within one QoS flow based on the Assured Forwarding behavior group (Solution#13). However, we do not need to assign a dedicated DSCP value for PDUs carrying the EOB indication.  |
| Do you plan to submit a new solution for this KI? | [Nokia] No new solution [Tencent] No[Lenovo] Yes. If active discard by RAN due to FEC is considered, PSA UPF may mark different DSCP values based on source/repair packet even for the same PSI value.[MediaTek] No[InterDigital] No[Qualcomm] NoEricsson: NoHuawei: No[vivo]No[China Telecom] No |
| What is your preferred conclusion (e.g. solution#, agreeable principles) for this KI? | **[Nokia] Solution #13 Multiple DSCP markings per QoS Flow.** DSCP marking is done per PDU Set based on the PDU Set Importance either as determined by UPF or based on SMF configuration. Do not prefer DSCP marking based on EoDB (drop of the packet with EoDB may also happen, so it is unnecessary to assign a dedicated DSCP value. Also assigning DSCP for a dedicated PDU brings complexity in UPF).[LGE] - Solution#13, The legacy 5GS considers 5QI, Priority Level and optionally the ARP priority level for the transport level marking. The enhancement in addition to consider the PDU Set Importance based on the mapping information between PSI and DSCP value is sufficient.[Tencent] Sol#13 and Sol#27 are not completely exclusive. Solution#27 is more related to how encrypted XRM traffic can be mapped. We suggest to resolve ENs for both two solutions in April meeting and make a decsion in May meeting.[Lenovo] The basic principle is that PSA UPF marks DSCP value based on PSI, e.g., solution 13. New solution should also be considered in case of active discard by RAN due to FEC[MediaTek] No strong view.**[InterDigital]** Solution #13 Multiple DSCP markings per QoS Flow. DSCP marking is done per PDU based on the PDU Set Importance and based on whether the PDU carries an EoDB indication..[Qualcomm] Ok with solution 13 (Transport Level Marking List option).Ericsson: Given no benefits are shown, there is no justification for introduction of specification changes.[Huawei] The benefits for DSCP enhancement needs further discussion.[China Telecom] We support multiple DSCP values within one QoS flow for PDU Sets of different PSI values. No need to assign dedicated DSCP value for PDUs carrying an EOB indication, even if the PDU with EOB Indication is dropped, no further standardization is required.Considering PSI value to extend DSCP marking is sufficient, FEC related scheme should be decoupled with this KI, otherwise, things will become too complex. |

Key Issue #4

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| (4): Traffic detection and QoS flow mapping for multiplexed data flows (Sol #8, #9, #12, #14, #15, #27, #28, #29) | [Nokia] - Support Solution #29 – including extension of traffic flow description information from AF and expansion of PDR PDI to detect unencrypted multiplexed sub-streams so they can be mapped to different QoS flows. Support mapping of PDUs within a media sub-stream that do not belong to PDU Sets (lone PDUs) to a separate QoS flow if requested by the AF. Also support encrypted multiplexed data flows by extending the flow description information so that the AF can target its QoS requirements to a specific encrypted sub-stream.The above involves extending the PDR’s Packet Detection Information and Packet Filter Set to include Application Layer fields such as the first byte of UDP, SSRC, Payload Type.[Lenovo] There’re mainly two types of traffic detection and QoS flow mapping for multiplexed data flows. Solution#28 proposes to perform QoS flow mapping based on existing parameters (e.g., PSI). Other solutions introduce new parameters for QoS flow mapping, e.g., track ID, OFC, stream info, media type, QSC-ID etc. Solutions proposing the AF to include protocol details (e.g. payload type, SSRC info) would require feedback from SA4 to clarify whether XR application server implementation would not alter these parameters regularly.Solutions proposing to leverage UDP-Options field would require feedback from SA4 and SA3 as also clarified in solutions for KI#2.It is also necessary to evaluation whether solutions described in KI#2 could also be applicable for this Key Issue as well.Meta: The principle of carrying the “priority” signal as part of the metadata over N6 (based on Solution #27: Differentiated Handling for Transporting Encrypted XRM traffics Using Metadata over N6).However, the transport mechanism to carry the “priority” signal can be defined as part of the solution selection for KI#2 (via Sol#26, #24/Connect-UDP.)[MediaTek] #9, #12, #27 – Refer to previous comments[MediaTek] #14 – A QUIC encrypted packet may not have a unique ID, since it is possible to have multiple stream IDs and multiple connection IDs for every source and destination. [MediaTek] #15 - Coarse granularity can be achieved with #28 / #29[InterDigital] We support extending the PDR’s Packet Detection Information and Packet Filter Set to include Application Layer fields such as PSI, the first byte of UDP, SSRC, Payload Type or UDP options. Ericsson:Agree to KI: applications may need to multiplex different types of streams on a single transport connections |
| Do you plan to submit a new solution for this KI? | [Nokia] - No. Solution updates should be sufficient.[Tencent] No, plan to update solution and resolve ENs[MediaTek] No[InterDigital] No[Qualcomm] No.Ericsson: Yes. The need of extending the packet filter set has not been assessed. It is possible to multiplex streams in a single transport connection using MP-QUIC and steer the streams to QoS flows with the Rel-18 packet filters. In-band assistance can facilitate traffic differentiation and reduce the interactions needed between the 5GC and the AF[Huawei] No[vivo]Yes[China Telecom] No. Solution updates should be sufficient. |
| What is your preferred conclusion (e.g. solution#, agreeable principles) for this KI? | [Nokia] - Solution #29 - For (S)RTP based traffic: Support extension of traffic flow description information from AF to PCF and onwards and Packet Detection Information (PDI) in PDRs and UE QoS rules so that individual sub-streams and other protocols (RTCP, data channel, ...) multiplexed into the same transport layer traffic flow can be detected and mapped to dedicated QoS flows as required. Each QoS flow can be provided either “ordinary” or PDU Set based QoS handling. Protocol Description (PD) and PDU Set detection logic can also be used to map lone PDUs in a sub-stream to a separate QoS flowif requested by the AF. (Update to Sol#29)For end-to-end encrypted traffic (e.g., QUIC connections): Support identification of individual sub-streams so that they can be mapped to dedicated QoS flows similarly to the (S)RTP case. (Update to Sol#29)[LGE] - Solution #29, The AF to provide QoS requirements for the identified protocol/stream and the 5GS to identify multiplexed stream for transport protocols with existing fields are agreeable. The AF/AS providing additional information that is dependent to specific transport protocol or providing PSI is not preferred.[Tencent] We plan to update and complete Sol#15 in April meeting to resolve ENs. Meanwhile, we see that principle of Sol#15 is close to Sol#29. There are still quite a lot of open issues remain for quite several solutions captured. We propose to focus on resolving ENs in April meeting and carry out evaluation in May meeting.[Lenovo] If the XR media are not fully e2e encrypted. It is preferred that flow mapping based on existing parameters (e.g., PSI) shall be considered (solution28). Besides, stream ID may be considered for QUIC transmission.Meta: See Meta input above[MediaTek] #28, PDR is based on the PSI field in RTP HE that aligns with SA4 TS 26.522[MediaTek] #29, PDR rules extended to include protocol and payload type contained in the RTP HE[InterDigital] We support extending the traffic flow description but want to clarify that it should be possible to the same OR different QoS Flows.[Qualcomm] Solution 29 and solution 15 (QUIC connection ID option).Ericsson: The solution should not be coupled or dependent on the solution for PDU Set handling for encrypted traffic (e.g. KI#2). Good if the same technology is used, but the solution should be valid for XRM applications and all type of multiplexing applications. Preferably one solution is selected both for encrypted and unencrypted traffic.To be agreeable, the solution shall not compromise the 5GS user plane performance. For that, any extension to the packet filters, should be very simple. If 5-tuple is determined not to be enough for media stream differentiation, we should consider adding to the packet filters the QUIC CID, which is also sent in clear. If needed, the packet filter could be extended instead with a simple additional filter e.g. a stream code. This added element is provided in the packet filter by the AF in the QoS request and in-band by the application to assist 5GC to differentiate the traffic. For example, solutions #12, #14, #17 are based on this principle. To reduce the AF-5GC interactions, the solution should not require that the AF requests are sent per multiplexed stream. The selection of the technology for in-band collaboration requires further discussion. There are still ENs that need to be solved and some solutions could not be discussed in last meeting.[Huawei]Applications could use different protocols. Thus flexibility of the solution should be considered. For QUIC multiplexing, sub-flow detection based on QUIC connection id, QUIC stream ID, track information from MoQ protocol is preferred but details need further discussion. For others, sub-flow detection based on the UDP payload including RTP/RTCP header field in Sol#29 is preferred. [vivo] Identify which stream info can be used for detection needs to coordination with SA4.[China Telecom]For unencrypted RTP streams, Sol#29 seems to be the most feasible solution. Payload Type field and/or SSCR field, M bit + PT corresponding to Packet Type, these are sufficient to distinguish multiplexed sub-streams. We think the first byte of UDP is not mandatory to provide, it can be optional.For encrypted traffic, Sol#15 is preferred. We’d better separate this KI from KI#2 conclusions, and in a higher level, focus on using QUIC connection ID for encrypted sub-streams identification and QoS flow mapping.For the usage of PSI value (Sol#28), it requires further feedback from SA4. |

Key Issue #5

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| (5): QoS handling with dynamic traffic characteristics (Sol #12, #16, #30) | [Nokia][Lenovo] Solution 12 is more focused on solving the objectives of KI#2 but also proposes to include traffic characteristics information within UDP-Options. The use of UDP-Option requires feedback from SA4.Solution 16, focuses on instructing the UE to use a higher QoS in the uplink so as to transmit high burst size packets.Solution 30 focuses on the AF notifying the core network of dynamic traffic characteristics change and configuring the UPF to detect dynamic change in traffic characteristics.Meta: The principle to allow AS to indicate dynamic upgrade of QoS handling over N6 (see Solution #16: AS based trigger of data boost handling with reflective QoS).The transport mechanism to carry the “boost” signal can be defined as part of the solution selection for KI#2 (via Sol#26, #24/Connect-UDP.)[MediaTek] #30 – We fail to understand the benefits derived from knowing the burst size?[InterDigital] Same view as meta in the sense that we think that it would be good to proceed with the principles of Solution #16. Also, we see some benefit with adjusting the assumed delay budget based on the PDU Set size.[Qualcomm] Various aspects are still unclear, e.g. for solution 16 the protocol to be used for including the metadata and how to protect against tampering/replay attacks should be clarified.[Huawei] Sol#30: Burst related traffic characteristics provided to RAN to enable RAN to get aware of the traffic characteristics to increase the radio resource efficiency. Sol#16: Reusing the reflective QoS feature to adapt to the dynamic UL traffic characteristics could be beneficial for the efficient radio resource scheduling. Clarifications on the pre-establishment of low/high quality QoS Flows and the how UPF behaves once receiving the metadata from the AS are needed.[China Telecom]For Sol#16, we see the benefit of reusing the reflective QoS feature to adapt to the dynamic UL traffic characteristics. But further clarifications are required.For Sol#30, we see the benefit of providing burst size so that the NG-RAN can perform better radio resource management. And how UPF identifies the data burst requires SA4’s coordination. |
| Do you plan to submit a new solution for this KI? | [Nokia] - Yes, resubmit the solution which sends in-band the Time To Next Burst[Tencent] NoLenovo] Yes[MediaTek] No[InterDigital] No[Qualcomm] No.Ericsson: Yes, to support in-band (N6/N3) update of changed periodicity.Huawei: No[China Telecom] No |
| What is your preferred conclusion (e.g. solution#, agreeable principles) for this KI? | [Nokia] A basic principle for this KI is that solutions do not violate QoS/Policy architecture mechanisms and especially authorization.[Tencent] Sol#12 and Sol#16 proposals are not exclusive and we think both can be considered for normative work.[Lenovo] The solution propose should allow the RAN to be notified of traffic characteristics change before the PDU-set with high burst size/file size is received at the RAN. The network should be aware if dynamic change of traffic characteristic will occur in an XR session so as the UPF could detect a change. Another approach is that the AF indicates the traffic characteristic dynamic change via either UP or CP. New RTP extension header may be introduced for traffic characteristic dynamic change. This requires feedback from SA4.Meta: See Meta input above[MediaTek] #16 – Contingent on SA4 guidance. Selection of pre-recorded media files (like DASH/HLS) based on the metadata carried in the UDP options field where there is security concern highlighted in KI#2.[InterDigital] Same view as Meta, the principles of Solution #16.[Qualcomm] None of the solutions is agreeable at this stage from our perspective.[Huawei]: Sol #30. Further discussion are needed on Sol#16.[vivo]: Coordination with RAN is needed. [China Telecom] Coordination with SA4 and RAN is needed. |

Key Issue #6

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| (6): L4S for non-3GPP access networks and intermediate 5GS nodes (Sol #17) | [Nokia] Support Solution #17 with a mechanism ensuring that the ECN markings are forwarded between the inner and outer IP layers, .[MediaTek] No strong views.[InterDigital] No strong views.[Charter] Support Solution #17.[CableLabs] Support Sol #17[China Telecom] No strong views. |
| Do you plan to submit a new solution for this KI? | [Nokia] No. Solution updates should be sufficient.[Tencent] No [Lenovo] No[MediaTek] No[InterDigital] No[Qualcomm] No[Charter] No plan of submitting a new solution, although will provide updates to current solution (see S2-2402797 that was not handled at SA2#161).[CableLabs] No, only solution updates[vivo]no[China Telecom] No |
| What is your preferred conclusion (e.g. solution#, agreeable principles) for this KI? | [Nokia] - Solution #17 with proper updates as described above.[Tencent]Solution#17 looks fine to us and we suggest to work further on it during April meeting to resolve ENs firstly. Pre-evaluation or interim conclusion can also be made in this meeting if no new solutions submitted for “beauty contest” and the ENs are resolved.[Qualcomm] The solution is not complete and especially the UE and 5G-RG impacts are not clear enough yet to conclude. Therefore we cannot give a final view at this stage. We are clearly not supportive of the option that the UE provides congestion information in GRE. We are generally not convinced of the need to support L4S marking for congestion in N3IWF and TNGF. If there is strong interest in this, we can be ok to support L4S marking by N3IWF and TNGF but we do not see the need to perform L4S marking in the UPF for the case of N3IWF and TNGF congestion.[Charter] preferred conclusion:* Wireline (i.e., 5G-RG and W-5GAN) and wireless (i.e., N3IWF and TNGF) nodes support L4S on a per QoS Flow basis (i.e.,L4S-enabled QoS flows) in the uplink and/or downlink direction and may be used for GBR and non-GBR QoS flows as proposed in Sol #17, clause 6.17.2.
* Support ECN marking for L4S in the IP header performed by N3IWF/TNGF/W-5GAN/5G-RG as proposed in Sol #17, clause 6.17.2.

Note: If the AP supports ECN marking for L4S, the appropriate 3GPP specified node (i.e., UE, N3IWF and TNGF) shall copy the ECN marking to the inner IP header as illustrated in clause 6.17.2.[CableLabs] For wireline access, ECN marking for L4S should be supported (i) in the wireline nodes through the W-AGF (for DL) and the 5G-RG (for UL), and (ii) in the 5G-RG. For untrusted/trusted access, ECN marking for L4S should be supported in the AP through the N3IWF/TNGF.[Huawei] Solution should reuse the existing R18 signalling procedure to enable the L4S for ECN marking is preferred. Aadditional enhancement to 5G-RG is fine if justified.[vivo]Separate different options before conclusion, so far it is not clear in the solution Agreeable principle: No UE impact in wireless; No RG Impact in wireline. |

Key Issue #7

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| (7): Support for PDU Set in non-3GPP access (Sol #18) | [Nokia] Support Solution #18.[MediaTek] No strong views.[InterDigital] Support Solution #18.[Qualcomm] We can be ok to support Solution 18.[Charter] Support Solution #18.[CableLabs] Support Sol #18[China Telecom] No strong views. |
| Do you plan to submit a new solution for this KI? | [Nokia] - No.[Tencent] No[InterDigital] - No[Qualcomm] No[Charter] has no plan of submitting a new solution for this KI.[CableLabs] No, only solution updates[China Telecom] No |
| What is your preferred conclusion (e.g. solution#, agreeable principles) for this KI? | [Nokia] Solution #18[Tencent]Solution#18 looks fine to us and we suggest to work further on it during April meeting e.g. see if any updates are needed. Pre-evaluation and interim concusion can also be made in this meeting if no new solutions submitted for “beauty contest”.[Lenovo] The standard impacts of PDU set based handling for NG-RAN can be reused for non-3GPP. Besides, leverage PDU Set QoS information for DSCP marking over IPsec Child SA should also be considered for the untrusted/trusted non-3GPP access.[InterDigital] Solution #18, we agree with Lenovo that it would be good to leverage PDU Set QoS information for DSCP marking over IPsec Child SA should also be considered for the untrusted/trusted non-3GPP access[Qualcomm] We are ok with solution 18.[Charter] preferred conclusion:* Mapping of PDU Set-enabled QoS profile to corresponding access resources.
* Supporting PDU Set based QoS handling.
* Supporting utilizing Protocol Description sent by SMF for PDU Set identification (i.e., in the scenarios when SMF sends over N1 to 5G-RG as illustrated in clause 6.18.3).

[CableLabs] For wireline access, PDU Set based QoS handling should be supported in the wireline nodes through the W-AGF (for DL) and the 5G-RG (for UL). For untrusted/trusted access, PDU Set based QoS handling should be supported in the non-3GPP access through the N3IWF/TNGF (for DL) and the UE (for UL).[Huawei]: Generally supportive on non-3GPP supporting, but solution should reuse the existing R18 signalling procedure to enable the PDU Set based handling.[vivo] Separate different options before conclusion, so far it is not clear in the solution Agreeable principle:* No UE impact in wireless
* No RG Impact in wireline
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Key Issue #8

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| (8): Enhancement for UE with the tethered devices (Sol #--) |  |
| Do you plan to submit a new solution for this KI? | [Nokia] yes, need to take into account NAT in the UE applying on tethered traffic (IP address indicated by the device in e.g. sdp may not be accurate if mechanisms like STUN /ICE are not used)NAT in UPF may also need to be considered[Tencent] Yes,we have a proposal submitted in Jan meeting but not handled. Plan to update it and submit to April meeting.[Lenovo] Yes. New solution proposes Tethered policy for UE to map non-3GPP QoS parameters into 3GPP QoS parameters, which assists UE to identify and map UL traffic from tethered devices to the corresponding QoS flow and DRB.[MediaTek] No[InterDigital] Yes. We will at least resubmit S2-2402966 from the Athens meeting. We plan on proposing a merge with another company’s solution prior to the TDoc deadline.[Qualcomm] No[Huawei] No[vivo]no[China Telecom] No |
| What is your preferred conclusion (e.g. solution#, agreeable principles) for this KI? | [Nokia] The normative work will address issues with “stand-alone” tethered devices i.e. application is running in a tethered device and UE act as an IP GW/relay for traffic to/from device (the UE is unaware of XRM application). For this purpose the normative work will at least address issues related with NAT between the tethered device and the XRM AS;[Tencent] Not sure if it is the right time to decide preferred solution as no solution is agreed yet. Propose to discuss & capture solutions in April meeting and make decsion in May.[Lenovo] The basic principle is that UE should be configured to identify and map UL traffic from tethered devices to the corresponding QoS flow and DRB[InterDigital] The solution should work in the presence of NAT, allow the UE to map traffic to an UL flow, and allow the UE to convey how much delay should be assumed on the tethered link so that the network can adjust the PDB accordingly.[Qualcomm] We do not see the need for any further enhancements in this area.[Huawei] Clarifications are needed why current IP tuple cannot be used for differing devices.[vivo] Postpone the agreeable principle and see solution firstly[China Telecom] No solutions in current TR. No strong views. |

Key Issue #9

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| (9): Enhancement for XR related network information exposure (Sol #19) | [Nokia] – See plan for new solutions below.[LGE] - Solution#19, The AF subscription for the Alternative PDU Set QoS notification and the exposure via control plane is agreeable.Meta:1. We believe any solution for exposure of event for an application can only be scaled if that information is sent via inband (N6).
2. Therefore, we support the principle of Sol#19, section “6.19.3.2, Procedures of network information exposure via user plane”.
3. In this sense, Information exposure via user plane should be a generic feature that can be re-used to expose other information from network (UPF) to AS. For example, this framework can be reused to send rate throttling information from network back to AS for initial codec selection (as described in this paper – not opened [S2-2402980](https://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_161_Athens_2024-02/Docs/S2-2402980.zip)).

[MediaTek] No strong views.[InterDigital] No strong views.Ericsson: The solution has ENs that require feedback from other WGs and thus it is premature to consider it. It also lacks evaluation against already supporting functionalities, i.e., against the baseline.[China Telecom]We support to reuse the UPF direct notification method to expose QNC. The delay for QNC reporting through UP is smaller than that through CP.Whether PSI can be associated with priority order requires SA4’s feedback. |
| Do you plan to submit a new solution for this KI? | [Nokia] - Yes, one or more contributions (solutions) on exposure of PDU Set Loss Rate (PSLR) measurements and PDU Set Delay (PSD) measurements.[Tencent] NoMeta: will resubmit a version of this paper ([S2-2402980](https://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_161_Athens_2024-02/Docs/S2-2402980.zip)) with the main idea to allow network information to be exposed to AS via inband.[MediaTek] No[InterDigital] No.[Qualcomm] NoEricsson : NoHuawei: No[vivo] Yes, exposure the DL PDU Set delay can be considered[China Telecom] No |
| What is your preferred conclusion (e.g. solution#, agreeable principles) for this KI? | [Nokia] – Exposure of PSD and PSLR measurements to the AF. Exposure from RAN via the UPF should be justified especially if control plane actions are required.[Tencent] Right now there is only 0.5 solution captured which in general ok to us and there is EN left to be resolved as part of Sol#19. We are open to more solutions for this Key Issue and also expect to reslove the EN in as early as possible.Meta:1. Exposure from network to AS is done via inband (N6)
2. Protocol to be used to carry information over N6 is based on solution to be decided for KI#2. In other words, solution for KI#2 should be extensible to allow this type of information in addition to conveying the PDU set information from AS.

[Qualcomm] We do not see the need for any further enhancements in this area.Ericsson: We do not see justification to introduce more solutions in that area.[Huawei] We support QoS notification be exposed by the user plane (i.e. RAN->UPF->AF/AS) to enable application to get valid bandwidth. (Sol#19)[vivo] Postpone the agreeable principle and see solution firstly[China Telecom] We support UP based QNC to expose information to AF in low latency. |