3GPP TSG SA WG4 128 S4-241368

Jeju, Korea, 20 - 24 May, 2024

Title: LS Reply to SA2 LS on Application-Layer FEC Awareness at RAN

Response to: LS (S2-2405064/[S4-240873](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/TSGS4_128_Jeju/Docs/S4-240873.zip)) from SA2

Release: Release 19

Work Item: FS\_XRM\_Ph2, FS\_5G\_RTP\_Ph2

Source: SA WG4

To: SA WG2,

Cc: RAN WG2, RAN WG3

**Contact Person:**

Name: Liangping Ma

Tel. Number:

E-mail Address: lpma AT qti DOT qualcomm DOT com

**Send any reply LS to: 3GPP Liaisons Coordinator,** [**mailto:3GPPLiaison@etsi.org**](mailto:3GPPLiaison@etsi.org)

Attachments: None

**1. Overall Description:**

SA4 thanks SA2 for the LS on Application-Layer FEC Awareness at RAN (S2-2405064/S4-240873) and would like to provide the feedback as follows:

Questions for SA4:

* *SA2 understands that different AL-FEC mechanisms exist (e.g., maximum-distance separable (MDS) schemes like RaptorQ and Reed-Solomon, FlexFEC, etc.) and is discussing for which AL-FEC mechanisms to enable AL-FEC awareness at RAN. Can SA4 identify commonly used AL-FEC mechanisms (not necessarily 3GPP defined), which should be supported for AL-FEC awareness at RAN from SA4's perspective?*
* **SA4 Answer:**

There are two types of AL-FEC: MDS or near-MDS codes, and non-MDS codes. Both MDS codes and non-MDS codes are commonly used in the industry. For example, the MTSI service specified in 3GPP TS 26.114 supports FlexFEC. From SA4’s perspective, both types of codes may be supported. For non-MDS codes, e.g., FlexFEC and ULPFEC, the exact dependency between the source packets and the parity packets needs to be known to be able to identify a sufficient set of packets for the reconstruction of the original, uncoded information. Please refer to the SA4 TR 26.822 Clause 6.5 for more details on the AL-FEC codes.

* Does SA4 see a need (from a general application perspective) to support both static and dynamic redundancy ratios (i.e., the ratio of AL-FEC information) for AL-FEC awareness at RAN?

**SA4 Answer:**

Both static and dynamic redundancy ratios are used by the industry and may be supported. There are AL-FEC schemes in which the redundancy ratio is fixed based on code construction. Furthermore, dynamic redundancy ratios may be more beneficial in practice since applications often appeal to dynamic AL-FEC control in combination with retransmissions and congestion control mechanisms to ensure robust and efficient adaptation to network conditions.

* *Does SA4 see a need for the application layer to distinguish RAN’s intentionally dropped obsolete FEC packets from congestion related drops, and related to this, the need for specific application behaviour, e.g., to reduce the sending rate? The background to this question is the following:*

**SA4 Answer:** For the current congestion control mechanisms for real-time communication of which SA4 is aware, SA4 sees a need for the application layer to distinguish RAN’s intentionally dropped obsolete FEC packets from congestion related drops, and the need, depending on the operating point, for reducing the sending rate. In the RFC’s for real-time communication SA4 have reviewed, all packet losses should be considered as a signal of network congestion. When the RAN is enabled by a sender application to intentionally drop obsolete FEC packets, the RAN should indicate the action of intentionally dropping obsolete FEC packets to the application, so that the application can respond to intentional drops of obsolete FEC packets differently than to congestion related drops. 3GPP SA4 recommends notifying IETF about this system behaviour.

* *Some companies in SA2 commented that transport protocols or applications need to reduce their sending rate in response to packet losses.*

**SA4 Answer:** Please see the previous answer.

* *Other companies argued that there is no need for reducing the sending rate when NG-RAN discards obsolete AL-FEC PDUs as long as NG-RAN can still meet the QoS characteristics of the other QoS flows in the same cell (i.e., because there is no fairness issue in this case).*

**SA4 Answer:**

* + When the network is in congestion, SA4 sees a need for reducing the sending rate in general.
  + When the network is not in congestion, if the RAN discards obsolete AL-FEC PDUs, SA4 thinks that it may be okay to not reduce the sending rate. However, in this uncongested case SA4 sees that there is a need for the RAN to inform the application if packets are intentionally discarded. Note, the congestion control also needs to consider packet losses and congestion on N6 (e.g., paths through the Internet).
  + SA4 will study under FS\_5G\_RTP\_Ph2 the benefits for the applications and the implications specifically with congestion control when the NG-RAN discards obsolete AL-FEC PDUs when the network is not in congestion.

Questions for RAN2 and SA4:

* *One solution (solution #3 in TR 23.700-70) proposed that an application may signal the required content ratio for a PDU Set (i.e., the required ratio of PDUs of a PDU Set needed by the receiver to reconstruct the original content) by first providing a mapping between content ratio levels and PDU Set Importance (PSI) values in the control plane to 5GS and by then using the PSI in the GTP-U header and the mapping received to determine the content ratio per PDU Set at NG-RAN. Does SA4 consider this a feasible option?*

**SA4 Answer:** This solution would change the semantics of the PSI field defined in TS26.522 and this is not advisable upon a first review. However, the general principle of indexing AL-FEC redundancy ratios (but not using PSI) for signalling optimization may be considered for further study.

**2. Actions:**

**To SA2:**

**ACTION:** SA4 kindly asks SA2 to consider the answers above.

**3. Date of Next TSG SA WG4 Meetings:**

SA4#129-e 19th August – 23rd August 2024 Online

SA4#130 18th Nov – 22nd Nov 2024 Orlando, FL, USA