**3GPP RAN3 #114bis-e R3-221005**

E-meeting, 17 – 26 January, 2022

Online

Agenda Item: 9.3.5.1

Source: Ericsson

Title: SoD on CB: # 13\_F1-UDelay

Document for: Discussion, Decision

# Introduction

**CB: # 13\_F1-UDelay**

**- Solution 1: Ericsson, ZTE, CATT, Nokia, Nokia Shanghai Bell**

**- Solution 3 variant (use dedicated polling and add feedback delay in DDDS): Samsung, Verizon Wireless, Intel Corporation, Huawei, CMCC, KDDI**

**- Compare the solutions and make the decision if agreeable**

(E/// - moderator)

Summary of offline disc [R3-221005](file:///C%3A%5CUsers%5Cz00274494%5CDownloads%5CInbox%5CR3-221005.zip)

# For the Chairman’s Notes

Propose the following:

**There is no consensus on the fact that the accuracy issues identified by some companies for Solution 1 require a change of the standard in favour of new solutions, e.g. Solution 3 variant**

**There is no consensus on whether Solution 3 offers sufficient benefits to be captured in the standard**

**There is no consensus of agreeing to changes to the current standard to improve F1-U delay accuracy**

# Discussion

In RAN3#114 the method to measure the F1-U delay was further discussed. At RAN3-114bis a number of solutions were put forward:

* **Solution 1**: Reuse current polling function and DDDS reporting. No update is needed.
* **Solution 2**: Based on current polling function and DDDS reporting, add NR-U sequence number in DDDS.
* **Solution 3**: Use a dedicated polling function, and enhance DDDS reporting by adding NR-U sequence number. When the received dedicated polling equals to 1, DU feeds back the DDDS with NR-U sequence number immediately for F1-U delay measurement. The F1-U delay is (T4-T1)/2, where the inner DU feedback delay is negligible.
* **Solution 3 variant:** Use a dedicated polling function, and enhance DDDS reporting by adding feedback delay result. When the received dedicated polling equals to 1, DU feeds back the DDDS with feedback delay time for F1-U delay measurement. The F1-U delay is (T4-T1-feedback time)/2.

In [1] it is argued that the requirements and definitions from SA5 on Average delay over F1-U measurements are captured in TS28.552, section 5.1.3.3.2, as follows:

*Start of excerpt from TS28.552*

##### 5.1.3.3.2 Average delay DL on F1-U

a) This measurement provides the average (arithmetic mean) GTP packet delay DL on the F1-U interface. The measurement is calculated per PLMN ID and per QoS level (mapped 5QI or QCI in NR option 3) and subcounters per S-NSSAI.

b) DER (n=1)

c) This measurement is obtained as: the time when receiving a GTP packet from the gNB-DU at the egress GTP termination, minus time when sending the same packet to gNB-DU at the GTP ingress termination, minus feedback delay time in gNB-DU, obtained result is divided by two.. The measurement is performed per PLMN ID and per QoS level (mapped 5QI or QCI in NR option 3) and per S-NSSAI.

d) Each measurement is a real representing the mean delay in 0.1 millisecond. The number of measurements is equal to the number of PLMNs multiplied by the number of QoS levels or multiplied by the number of S-NSSAIs.
 [Total No. of measurement instances] x [No. of filter values for all measurements] (DL and UL) ≤ 100.

e) The measurement name has the form DRB.PdcpF1DelayDl\_Filter,
Where filter is a combination of PLMN ID and QoS level and S-NSSAI.
Where PLMN ID represents the PLMN ID, QoS representes the mapped 5QI or QCI level, and SNSSAI represents S-NSSAI.

f) GNBCUUPFunction

g) Valid for packet switched traffic

h) 5GS

i) One usage of this measurement is for performance assurance within integrity area (user plane connection quality).

NOTE : The NR RAN container (DL USER DATA/ DL DATA DELIVERY STATUS) carried in the GTP-U packet over the F1-U interface is used for the measurement.

*End of excerpt from TS28.552*

With the above, [1] emphasizes that F1-U delay measurements are an averaging process where it is not necessarily needed that measurements shall be taken at an exact point in time.

[1] goes on to argue that Solution 1 is sufficiently good because it allows to collect F1-U delay measurements without errors, under the assumption that the polling DL PDUs are signalled when traffic conditions are such to avoid confusion between the polled DDDS and other DDDS otherwise received.

**Companies are invited to provide their view on whether Solution 1 allows to collect F1-U delay measurements without errors, under the assumption that the DL PDUs with Report Polling Flag are signalled when traffic conditions are such to avoid confusion between the polled DDDS and other DDDS otherwise received**

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| --- | --- |
| Company | Comment |
| Ericsson | Yes, Solution 1 allows this.It needs to be clarified that when a DL PDU containing a Report Polling Flag is received by the gNB-DU, the gNB-DU has to immediately reply with a DDDS. Failure to do so would compromise flow control performance. For example, if the gNB-DU delays signalling of the DDDS and the gNB-CU-UP is not informed of e.g. the desired buffer size, the gNB-CU-UP would have to either 1) signal DL traffic without knowing the desired buffer size of the gNB-DU or 2) buffer more traffic at PDCP level, creating a large queue of packets in need to be transmitted later. Both these options negatively impact flow control, hence a good implementation would signal the polled DDDS immediately.With the above in mind, with Solution 1, the gNB-CU only needs to signal a DL PDU with Report Polling Flag when traffic is not excessively high, i.e. when there is a small probability of confusion between the polled DDDS and other DDDS otherwise received. Given that F1-U delay calculation is an averaging process, any delay value erroneously derived will be averaged out. Namely a too short delay measurement will have a small weight in the average calculation. |
| Samsung | Solution 1 may lead to the wrong measurement and can not work under high-traffic situation.For the immediate reporting issue, DU can not report the DDDS immediately when overload at DU is encountered. For the solution that DDDS is only been polled when the traffic is not high, the node needs to confirm the traffic status firstly and then to start F1-U delay measurement. If there is no DDDS reporting at that time period, UP needs to do the polling to check the traffic status before starting F1-U delay measurement, which leads to heavy signaling overhead. On the other hand, if the traffic keeps at a near-saturated level, the delay can not be measured for this QoS level. Thus, when receiving QoS monitoring from CN, RAN can not feedback the delay measurement due to high traffic.For the error measurement, it results in low accuracy when DU sends one DDDS before receiving the DL User Data with polling from CU-UP. For the case that DU sends DDDS frequently, the number of too short delay measurement can be high. So the average delay result is still not accurate. |
| Intel Corporation | No, we think Solution 1 is not sufficient enough. If you look at the formula in SA5 requirement, for each sample, "Feedback Delay" is taken into account and those samples are averaged to get the final value. From SA5 requirement, it is clear that "Feedback Delay" has to be properly accounted for each sample measurement.And the current polling feature could potentially create very wrong result on calculating F1-U delay, because DU does not indicate in the DDDS which the DL User Data of polling that it corresponds to. If DU started to delay sending DDDS when polled, then it is possible that CU who just polled may think the next DDDS it received (which corresponds to the previous polling) is the one that corresponds to the DL User Data that it just polled. So, either DU needs to indicate which DL User Data in the DDDS (if the current polling flag is used), or DU needs to indicate Feedback Delay time explicitly (if new flag is used), in order to calculate each sample value correctly according to SA5 requirements and formula. |
| Huawei | Agee with Samsung and Intel above.It is clear that solution 1 is not workable. |
| Nokia | We cosigned [1] in favour of solution 1, and agree with the arguments brought by E/// above. We believe solution 3 would represent over-engineering of the user plane for the purpose of delay measurement. On our side we also take into account that F1-U (fronthaul interface) is supposed to be well dimensioned in order to avoid delay increases due to load. Also, the available capacity on the F1-U TNL is monitored by other means, e.g. via SON TNL load reporting over E1. So from an overall system point of view, we remain in support of solution 1, i.e. no need to change the current specification.  |
| KDDI | We don’t agree with Ericsson’s comment neither. We share the view with Samsung and Intel above. |
| Verizon | Agree with Samsung and Intel. Solution 1 has accuracy issues because of mismatch of DDDS and the DL PDU. Also the values can be very different for different vendor implementations making it very hard for operators to make sense of the reported F1-U delays.  |
| CMCC | Solution 1 has accuracy issues with the same reason as explained by Samsung and operators |
| ZTE | Agree with Ericsson, and it should noted in SA5’s specification, the requirement is still for average delay of F1-U and not require for precise one. And it is in the Specification that SA5 described based on legacy mechanism in NG-U.  |
| CATT | Similar view with E/// .Solution 1 is enough for the SA5 requirement |
| Ericsson replies | The moderator would like to flag that the question has not been answered appropriately. The question states the following conditions:**under the assumption that the DL PDUs with Report Polling Flag are signalled when traffic conditions are such to avoid confusion between the polled DDDS and other DDDS otherwise received**While many companies took into account the scenario of high traffic and DU overload. We do not understand the comment from Samsung: *“For the solution that DDDS is only been polled when the traffic is not high, the node needs to confirm the traffic status firstly and then to start F1-U delay measurement.”*The node hosting PDCP has ALWAYS knowledge of traffic intensity in DL, so this comment seems to be not applicable. |

Conclusion:

The majority of comments received do not answer the question asked. What these comments however point out is that:

6 companies sustain that Solution 1 has accuracy issues for F1-U delay measurements in cases of high traffic and DU overload and therefore an improvement is needed

4 companies sustain that Solution 1 is sufficiently good and therefore that no standardization impacts are needed

**There is no consensus on the fact that the accuracy issues identified by some companies for Solution 1 require a change of the standard in favour of new solutions, e.g. Solution 3 variant**

In [2] it is argued that Solution 1 is subject to errors. Such errors are due to cases when, after ignaled the DL PDU containing the Report Polling Flag, the gNB-CU-UP receives a DDDS that does not correspond to the polled DDDS, but to one DDDS ignaled by the gNB-DU earlier than the polled DDDS.

Namely, the delay measurement resulting from such error case would give a shorter delay than the correct value.

To address these issues, [2] and [3] propose to follow “Solution 3 Variant”, where:

* A dedicated polling function is added to the DL PDU
* The F1-U SN of the polling DL PDU is added to the DDDS generated by the gNB-DU after reception of the new Polling Flag
* The gNB-DU is not subject to requirements to signal the DDDS immediately after receiving the polling flag

**Companies are invited to provide their views on whether Solution 3 variant is beneficial and needed for the F1-U delay calculation**

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| Company | Comment |
| Ericsson | No, Solution 3 Variant is not needed and it has negative impacts on flow control.As explained above, if the gNB-DU does not transmit a DDDS immediately after the reception of a polling flag, DL flow control performance are degraded. This is because the DDDS contains mandatory information used by the gNB-CU-UP for flow control (namely this information cannot be omitted). It is intuitively understandable that if the feedback from the gNB-DU concerning the number of PDUs successfully delivered, the desired buffer size, etc, is delayed, the gNB-CU-UP cannot react dynamically to changes of traffic conditions and with that it cannot properly adapt DL traffic to traffic/channel conditions. Hence Solution 3 variant has a negative impact on flow control.Additionally, Solution 3 variant (just like solution 3) adds new functionalities that are unnecessary, given that Solution 1 (not requiring changes) can work equally well, if used appropriately. |
| Samsung | We prefer Solution 3 variant with the following reasons:• High accuracy: Exact and accurate DU feedback delay is reported to CU if the received dedicated polling flag is set to 1. CU does the measurement based on the method defined in TS 28.552. This solution solves the issue that inaccurate measurement results come from the DU who can not do the immediate feedback.• High efficiency: DU adds DU feedback delay in DDDS only when the received dedicated polling flag for F1-U delay measurement purpose equals 1. Otherwise, DU reports the current DDDS without DU feedback delay for the normal polling function.• No reporting burden: There is no time limitation for DU reporting, so it does not lead to the burden for DU to do DDDS reporting. • Workable at both high traffic and low traffic situation: There is no traffic status limitation for this solution. It avoid the heavy signaling overhead to check traffic status and the case that when receiving QoS monitoring request from CN, DU can not report delay result due to high traffic.For the flow control issue, based on current mechanism, the DU can not feedback the DDDS immediately when the traffic is high. So there is no flow control problem for delayed DDDS reporting. The mandatory information such as desired buffer size in DDDS is the result at the DDDS sending time instead of the Polling receiving time, so the information is not delayed and there is no impact on flow control for Solution 3 variant.To sum up, Solution 3 variant is a workable solution for both high traffic and low traffic situation to do the high accurate and efficient measurement without immediate reporting burden. |
| Intel Corporation | Agree with Samsung and also see the above comments.  |
| Huawei | Agree with Solution 3 variant.Solution 3 variant just does not require the DU responds DDDS immediately. It does not mean the DU is forbidden to do that. |
| KDDI | We also agree with Samsung and Intel, no negative impacts. |
| Verizon | We agree with the benefits of Solution 3 variant (high efficiency, accuracy and no reporting burden). We do not see any negative impact of Solution 3 on flow control as there is no restriction imposed on DU DDDS response i.e., DU can time its DDDS response (sooner or later) as needed depending on flow control implementation.  |
| CMCC | The benefits of solution 3a as explained in the co-source paper are acknowledged. We didn’t see any restriction or negative impacts for solution 3a |
| Ericsson | We would like to re-iterate that the use case the proponents of Solution 3 are bringing is one where the DDDS is delayed. This option creates issues to flow control because a delayed DDDS does not reflect the current flow status. Hence Solution 3 may, in some cases, achieve a more accurate delay measurement collection for **\*some\*** delay samples, but it totally degrades flow control. The latter drawback is in our view much worst than having a few delay samples with less accuracy, which, by the process of averaging, will be flattened out. |

Conclusion:

6 companies believe that Solution 3 variant is beneficial

1 company believes that Solution 3 has negative impacts

1 companies stated in the first question that “solution 3 would represent over-engineering of the user plane”

**There is no consensus on whether Solution 3 offers sufficient benefits to be captured in the standard**

In light of the above:

**Companies are required to provide their view to whether any correction to the standard are deemed needed in order to fulfil the requirements on F1-U delay calculation.**

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| --- | --- |
| Company | Comment |
| Ericsson | No changes are needed to fulfil the F1-U measurement collection requirements.  |
| Samsung | Prefer to enhance the DL USER DATA and DDDS to support accurate and efficient measurement as Solution 3 variant. That is to add F1-U Delay Measurement Report Polling in DL USER DATA, and add DU Feedback Delay Result in DDDS. |
| Intel Corporation | A standardized solution is required to meet the SA5 requirement and calculate each sample value according to the formula.  |
| Huawei | Support to specify a standard solution to fix this issue. |
| KDDI | We share the view with Samsung and Intel. |
| Verizon | We have an issue here of inaccurate F1-U delay calculation that needs a standardized solution. It is particularly important for operators who want to offer delay critical services. Solution 3 variant helps fix the problem.  |
| CMCC | A standard solution is needed to fix the issue |
| ZTE | No change for the mechanism calculation of average F1-U delay unless SA5 require precise one. One possible solution is RAN3 to send LS to SA5 to clarify the requirement. Alternative way is companies can direct provide contribution in SA5. |
| CATT | Currently, there is no requirement foreseen. |

Conclusions:

6 companies see the need for standardization changes to improve F1-U delay measurements

3 companies believe that there is no need for standardization changes.

1 company hinted in question 1 that “solution 3 would represent over-engineering of the user plane” and it is in support of Solution 1. With that the moderator understand that the company believes no standard impacts are needed

**There is no consensus of agreeing to changes to the current standard to improve F1-U delay accuracy**

# Conclusion, Recommendations [if needed]

If needed

# References

1. R3-220443, F1-U delay measurement (Ericsson, ZTE, CATT, Nokia, Nokia Shanghai Bell)
2. R3-220769, Discussion on F1-U Delay Measurement for QoS Monitoring (Samsung, Verizon Wireless, Intel Corporation, Huawei, CMCC, KDDI)
3. R3-220770, Correction of F1-U delay measurement for QoS monitoring (Samsung, Verizon Wireless, Intel Corporation, Huawei, CMCC, KDDI)