**3GPP TSG-RAN WG3 Meeting #109-eR3-205726**

**Online, August 17th – 27th 2020**

Agenda Item: 15.2

Source: Ericsson (moderator)

Title: Summary of Offline Discussion on NR QoE Management Solutions

Document for: Approval

# Introduction

**CB: # NRQoE3-Solutions**

**Main part:**

**- LTE-based solution can be used as a baseline?**

**- QoE configuration and report are delivered by RAN as transparent containers or real-time RAN side optimization should be considered? QoE metrics are visible to RAN for NR QoE management?**

**- both management-based and signalling-based solutions should be supported? Reusing Trace mechanism or introducing newly defined procedures? MDT user consent for management based QoE?**

**- a threshold-based and/or event-based mechanism to trigger the start and stop of QoE measurement collection?**

**- NR QoE reports from UE are delivered over a newly defined dedicated SRB type or via UP solution?**

**- The QoE measurement and reporting is supported in RRC\_CONNECTED state only?**

**- Mobility impact: whether inter-RAT and inter-system QoE measurement continuity should be supported? only signalling based QoE measurement is propagated to target node? support of QoE measurement under MR-DC scenario?**

**Additional part:**

**- the enhancement of QoE measurement reports with DC or CA indication of the UE for the measured application session? (E///)**

**- the enhancement of QoE measurement reports with mobility history information? (E///)**

**- network slices should be taken into account? (Samsung, ZTE)**

**- the segmentation of large QoE reports into multiple smaller QoE reports? RAN2 related? (E///)**

**- study a time-based event for activation of QoE measurement to enable the flexibility of QoE measurement activation within a certain predefined period of time? (E///)**

**- Capture agreements as TP for TR, revise/merge and check details, split work, if needed**

**- List open issues for next meeting in the summary**

(E/// - moderator)

Relevant papers:

1. R3-204706 QoE Configuration and reporting (Qualcomm Incorporated)
2. R3-204851 Framework for QoE measurement collection (Nokia, Nokia Shanghai Bell)
3. R3-205181 Initial Consideration On Study of NR QoE (ZTE)
4. R3-205182 TP for FS\_NR\_QoE (ZTE)
5. R3-205200 pCR for TR 38.8xx: NR QoE Management Framework (Ericsson)
6. R3-205201 pCR for TR 38.8xx: NR QoE Measurement Triggering, Configuration, Collection and Reporting (Ericsson)
7. R3-205281 NR QoE measurement overview (Huawei)
8. R3-205283 Potential RAN3 impacts about QoE measurement (Huawei)
9. R3-205359 Discussion on NR QoE solution for various service (CATT)
10. R3-205360 Discussion on NR QoE solution architecture and interface impact (CATT)
11. R3-205370 Some Considerations on QOE Collection in NR (China Telecommunications)
12. R3-205402 Discussion on NR QoE requirements and potential solutions (Samsung)
13. R3-205403 Discussion on NR QoE interface impact and solutions (Samsung)
14. R3-205439 NR QoE management (CMCC)
15. R3-204708 Interworking with LTE QoE (Qualcomm Incorporated)
16. R3-205183 Consideration on slice QoE measurement (ZTE)
17. R3-204707 QoE handling in handover (Qualcomm Incorporated)

# For the Chairman’s Notes

Proposals revised based on the online discussion:

**Proposal 3: RAN3 to study the requirements for QoE report visibility at the RAN.**

**Proposal 5: Send an LS to RAN2 to inform them that UP solution is precluded and the NR QoE reports are carried over CP from RAN3 point of view.**

**Proposal 6: The UE Application layer measurement capability is indicated in the UE Radio Capability Info Indication message.**

**Proposal 9: RAN3 agrees to study:**

* **The mechanisms for RAN releasing QoE measurements;**
* **The mechanisms for handling QoE report delivery at RAN overload.**

**Proposal 10: RAN3 to discuss the QoE measurement configuration and reporting in SA, NSA and MR-DC.**

**Proposal 11: NR QoE measurement configuration is maintained in the RRC INACTIVE state.**

**Proposal 12: Mobility support is specified for both signaling- and management-based NR QoE management.**

**Already agreed in the QOE online session:**

**Both the management-based and signalling-based solutions for NR QoE management are supported.**

**UP solution is precluded, and the NR QoE reports are carried over CP from RAN3 point of view.**

**Discuss event- and time-based measurement triggering and stopping, as well as measurement triggering by RAN.**

# Discussion

## The high-level solution

A clear majority of contributions propose to agree/discuss the specification of both the management- and signalling-based solution. On the other hand, paper [9] proposes a completely new solution for time-critical services. Meanwhile, paper [2] proposes to use MDT as baseline for NR QMC.s

**Q1-1: Should both the management-based and signalling-based solutions be specified for NR QoE management?**

|  |  |
| --- | --- |
| **Company** | **Answer** |
| Ericsson | Yes. We further think that we should consider enhancing the management-based solution so that it should be possible to configure measurements for specific UEs.  In our view, the “LTE solution as baseline”:   * Implies specification of signalling and management-based solution; * Implies QMC delivery over SRB1; * Implies QoE report transport over SRB4; * Does not imply the reuse of Trace messages for signalling-based solution.   In addition, both the SID and paper [8] make a distinction between the LTE-based solution (including management-based and signalling-based solution) and the MDT-based solution, meaning that LTE as a baseline does not imply the reuse of Trace messages for NR QoE. |
| Qualcomm | Yes.  Application layer measurement should be RAT agnostic. So, we should make NR QoE similar to LTE for easier interworking.  MDT and LTE QoE are based on trace. If NR QoE continues to be based on trace, it is easier for correlation with radio measurements (MDT). |
| China Telecom | Yes. Both management-based and signalling –based solution shall be supported. |
| ZTE | Yes.  Share the view with QC. |
| CMCC | Yes. NR QoE should support both management-based and signaling-based solutions. |
| China Unicom | Yes.  NR QoE should support both signaling-based and management-based QoE solutions. In addition, any possible enhancement solution could also be studied in SI. |
| Huawei | Yes.  We think both management-based and signalling-based solutions be specified for NR QoE management.  We could also study the feasibility of reusing Trace messages to activate signalling-based QoE measurement. |
| CATT | Yes.  Agree with China Unicom.  Also the RAN trigger signalling based should be studied. |
| Samsung | Yes. LTE solution can be used as a baseline, both management-based and signalling-based solution should be supported.  In addition, enhancements based on LTE solution should be further considered to satisfy the new requirements for diverse use cases in NR. |
| Nokia | Yes, both management-based and signalling-based solutions be specified for NR QoE, and MDT solution seems to be a good baseline. We don't see there is a use case for RAN trigger of the application level measurements, considering that RAN adaptations will be based on post-processed measurements. |

**Summary:**

All companies are in favor of introducing both the management-based and signalling-based solutions for NR QoE management.

**Proposal 1: Both the management-based and signalling-based solutions for NR QoE management are supported.**

The QMC in the LTE signalling-based solution is piggybacked in Trace messages. In that respect, paper [5] proposes to define a dedicated signalling-based solution for NR QoE management, that does not reuse Trace messages. Paper [10] proposes that RAN creates the measurement configuration and sends it to the OAM. Based on the critical mass in the proposals, the following question is formulated:

**Q1-2: What is your view on specifying a dedicated procedure for signalling-based solution?**

|  |  |
| --- | --- |
| **Company** | **Answer** |
| Ericsson | We think that **a dedicated set of procedures** should be defined for signalling-based NR QoE. Trace/MDT and QoE management are two different features and the QoE signalling should not be piggybacked on Trace messages. Moreover, the signalling design for Trace messages is Trace-centric so there would need to be more than a few “bug fixes” to invalidate the mandatory Trace-specific IEs in the existing messages. We should not mandate that the Trace Collection Entity and the entity collecting QoE measurements are the same. |
| Qualcomm | As answered in last question, we think trace based architecture is easier for interworking with LTE and correlation with radio measurements (MDT). |
| China Telecom | Agree with Qualcomm |
| ZTE | The same view as QC. |
| CMCC | Slightly prefer to reuse the existing procedure. |
| China Unicom | As in Q1-1, trace function and MDT mechanism could be considered as one of the possible solutions and other solutions are acceptable in SI stage. |
| Huawei | Firstly, for signalling-based QoE measurement, the main actions are activating and reporting. As commented in last question, we think we could study the feasibility of reusing Tracing message to activate QoE measurement, actually as commented by QC, it is an easy way. |
| CATT | Prefer to use the existing procedures. But maybe additional procedure need to be defined for the new designed solution |
| Samsung | Reusing trace mechanism is preferred, enhancements need to be further discussed with the issues mentioned by Ericsson. |
| Nokia | Agree that reuse of trace mechanism is preferred, with possible enhancements. |

**Summary:**

One company explicitly proposes to define a dedicated set of procedures for the signaling-based solution. One more company proposes to further discuss the concerns raised by the company in favor of a dedicated set of procedures. The remaining companies seem to prefer the reuse of Trace procedures. However, given that this is the first meeting of an SI and that the concerns have not been discussed in detail, the rapporteur proposes to discuss further the issues raised by the proponents of dedicated procedures.

**Proposal 2: RAN3 to discuss the pros and cons of reusing the Trace procedures or defining dedicated procedures for NR QoE signalling-based management.**

Papers [3], [10] and [14] argue that is preferable that QoE measurement configuration and reports are visible at the RAN. The same seems to be preferred by paper [12]. Meanwhile, paper [1] expresses a preference towards sending the two transparently over the RAN.

**Q1-3: Should the NR QoE measurement configuration and QoE reports be visible at the RAN?**

|  |  |
| --- | --- |
| **Company** | **Answer** |
| Ericsson | Yes, we believe that this is beneficial. |
| Qualcomm | For the services (MTSI, Video, AR, MBMS) with SA4 define QoE metrics, it should be up to gNB implementation to understand the SA4 defined QoE containers.  It should be possible for RAN2/RAN3 to define new QoE containers which are understandable for RAN. |
| China Telecom | Yes. In our understanding, RAN can configure visible measurement/report configuration for some QOE metrics to UE.  The reasons are as follows:   1. some QOE metrics for traffic quality have been defined in SA4 related specifications. XML based QOE configuration/report has good scalability for new traffic. In LTE system, the QoE configuration will be delivered via RRC to the UE as a container according to "measConfigApplicationLayer". For these metrics, the content of QOE measurement/report is invisible at RAN.   S4-180xxxx CR 26  In order to optimize wireless network performance, it is beneficial to define new QOE metrics for radio layer. Therefore, the NW could configure visible measurement/report for some QOE metrics to UE via RRC message. |
| ZTE | It is beneficial, depends on how to define the QoE reports. |
| CMCC | Yes. At least some of the existing QoE metrics defined in SA4 can be considered to be configured and reported visibly at RAN for potential RAN optimizations. |
| China Unicom | Yes.  It is beneficial for RAN optimization to obtain QoE reporting metrics for dedicated service defined in SA4. Detail need further discussion.  Furthermore, 5G service metrics such as URLLC service, reporting to RAN side should be studied. |
| Huawei | We should study the potential impacts and benefits if any, before we rush to any conclusions.  Whether QoE measurement configuration and reports should be visible at RAN was discussed during LTE, and the final conclusion was to take container based mechanism, the reason should also be applicable here, e.g. whether RAN could understand E2E parameters well, any potential privacy issues, etc. |
| CATT | It is better the RAN understanding the QoE report. especially the radio layer related metrics may be used by RAN directly |
| Samsung | Yes. It’s beneficial for network optimization. |
| Nokia | A control-plane based approach should be part of the baseline, which will open up for RAN visibility if needed. However, the solution may still be based on SA4 defined containers. |

**Summary:**

Eight companies are in favor of, at least partial, QoE measurement configuration and report visibility at the RAN. One company thinks this should be up to implementation while one company would like to discuss further.

**Proposal 3: The NR QoE measurement configuration and QoE reports are visible at the RAN.**

## Transport of QoE measurement report

The majority of companies propose the reuse of LTE solution, where the QoE reports are carried over SRB4. This may be understood as an implicit preference towards carrying the QoE reports over a dedicated SRB4. Companies behind the papers [5], [11] and [14] are somewhat more concrete, explicitly capturing the preference towards CP solution in their proposals. Meanwhile, paper [13] discusses the QOE report transport over both CP and UP.

**Q2: Do you agree that NR QoE reports should be carried over CP, and, more specifically, over a newly defined dedicated SRB type, e.g. SRB4?**

|  |  |
| --- | --- |
| **Company** | **Answer** |
| Ericsson | Yes. |
| Qualcomm | Yes, over CP. As to SRB type, it is up to RAN2 to decide. |
| China Telecom | Yes. The NR QOE reports shall be carried over CP. In our understanding, The current QOS framework defined in TS23.501, any DRB shall associate with a PDU session in CN side. Therefore, the current mechanism cannot support to configure a dedicated DRB for QOE measurement |
| ZTE | Yes. Share the view with QC. |
| CMCC | Yes, as long as no advantages can be identified for UP solutions. |
| China Unicom | Yes, SRB type, size and priority should be studied. |
| Huawei | Yes. |
| CATT | Yes |
| Samsung | Yes. We prefer to follow LTE solution, over CP. |
| Nokia | Yes, CP solution is preferred. SRB type is RAN2 realm. |

**Summary:**

All 10 companies are in favor of carrying the NR QoE reports over the CP. are in favor of, at least partial, QoE measurement configuration and report visibility at the RAN, where 3 companies think that the SRB type should be studied further or in RAN2,

**Proposal 4: The NR QoE reports are carried over an SRB.**

**Proposal 5: Send an LS to RAN2 to inform them that NR QoE reports are carried over an SRB.**

## Measurement configuration and reporting

Paper [1] proposes that UE Application layer measurement capability is included into UE Radio Capability Info Indication message.

**Q3-1: Should the UE Application layer measurement capability be included into UE Radio Capability Info Indication message?**

|  |  |
| --- | --- |
| **Company** | **Answer** |
| Ericsson | Yes, this is in line with the LTE approach. |
| Qualcomm | Yes, 5GC needs the information to configure signalling based QoE. |
| China Telecom | yes |
| ZTE | YES. the UE Radio Capability Info Indication procedure has been supported in current specification. |
| CMCC | Yes. |
| China Unicom | Yes. |
| Huawei | Yes. |
| CATT | Yes |
| Samsung | Yes. |
| Nokia | Yes |

**Summary:**

**Proposal 6: The UE Application layer measurement capability is indicated in the UE Radio Capability Info Indication message.**

Papers [3], [6] and [14] propose to consider in NR QoE measurements the radio network layer measurements and radio layer configuration information. Some examples include mobility history information, CA and DC configurations, HO type used during the application session etc.

**Q3-2: Should radio network layer measurements and radio layer configuration information be considered in NR QoE measurements?**

|  |  |
| --- | --- |
| **Company** | **Answer** |
| Ericsson | Yes. We think that the inclusion of information and measurements pertaining to the radio network layer is necessary in order to provide to the recipient of the measurements a complete view about the causes of QoE deterioration. |
| Qualcomm | No. The QoE and MDT (with radio measurements) can be correlated based on timestamp, location info, trace ID etc. |
| China Telecom | Yes, see our view in Q1-3 |
| ZTE | Yes, it is benefit for post-process analysis in the server. However, the detail RAN measurements (both RAN node side and UE side) need to be further investigated, which is related to Issue3 in CB # NRQoE2-Services. |
| CMCC | Yes. Radio network layer measurements and reporting can help RAN identify whether QoE degradation is caused by RAN, which could be beneficial. |
| China Unicom | Yes, radio layer measurements and application layer measurements are critical for RAN side to identify the cause of performance degradation. |
| Huawei | Not sure. We think they are independent. |
| CATT | Yes, especially for some latency sensitive service. |
| Samsung | Yes.  It’s beneficial for quickly identifying network issues. |
| Nokia | Agree with Huawei and QC that QoE is an independent concept and should probably remain RAT agnostic. It may still be made possible to combine information during post-processing. |

**Summary**

Seven companies are in favor of including radio network layer measurements and radio layer configuration to NR QoE reports, while 3 companies are against. Given that the issue can be considered essential, the proposal is derived based on the operator and majority view:

**Proposal 7: The radio network layer measurements and radio layer configuration information are reported in NR QoE management.**

Papers [6], [10] discuss measurement triggering and stopping. For example, event- and time-based triggering, as well as triggering by RAN are considered.

**Q3-3: Should RAN3 discuss/introduce event- and time-based measurement triggering and stopping, as well as measurement triggering by RAN?**

|  |  |
| --- | --- |
| **Company** | **Answer** |
| Ericsson | Yes. We think it is beneficial to monitor the QoE metrics at certain events. Since the RAN has a close view on the radio situation, we think that RAN should also be able to trigger the QoE measurements. |
| Qualcomm | Yes. |
| China Telecom | The event- and time-based measurement triggering and stopping is applicable only to the QOE metrics for radio network layer measurements |
| ZTE | Yes. |
| CMCC | Yes. |
| China Unicom | Yes. The event- and time-based measurement triggering and stopping is needed for RAN side. |
| Huawei | Partially yes. We think we could discuss the reporting mechanism, e.g. event or periodic, but for RAN triggering QoE measurements, we think it is out of SI scope. |
| CATT | Yes, we agree study the event- and time-based measurement triggering and stopping, and RAN trigger the QoE. |
| Samsung | Yes.  QoE measurements are more valuable for operators when UE is in bad coverage (e.g. high interference) or special coverage (e.g. high speed scenario), event- trigger is beneficial for those scenarios as well. |
| Nokia | This may not necessarily be part of RAN functionality. Event-triggered reporting may be defined in SA4. |

**Summary:**

Eight companies are in favor of event- and time-based measurement triggering and stopping, as well as measurement triggering by RAN. Given a wide support for RAN-based measurement triggering and stopping, it is proposed to discuss this issue further.

**Proposal 8: RAN3 to discuss event- and time-based measurement triggering and stopping, as well as measurement triggering by RAN.**

Papers [6] and [7] discuss measurement release, as well as reporting handling at RAN overload.

**Q3-4: Should RAN3 discuss/introduce the mechanisms for releasing QoE measurements and QoE report delivery at RAN overload?**

|  |  |
| --- | --- |
| **Company** | **Answer** |
| Ericsson | Yes. We think that the network should be able to e.g. release a measurement or pause the reporting at overload. This is essential for measurement flexibility. |
| Qualcomm | Yes |
| China Telecom | Yes. The NW could release the QOE measurement based on its RRM policy. |
| ZTE | Yes for releasing a measurement with signalling based mechanism.  For QoE delivery at RAN overload (e.g. via SRB4 with suspend action), we would prefer to wait for RAN2’s progress. |
| CMCC | Yes for potential RAN triggered QoE measurement. |
| China Unicom | Yes. RAN side should trigger or release QoE measurement an reporting for flexibility management. |
| Huawei | This could be discussed. |
| CATT | Yes. |
| Samsung | Yes.  At RAN overload, UE may suffer bad QoE, so the QoE reports during this time are more important and valuable for operators.  We prefer to pause or reconfigure the reporting at overload instead of stopping QoE measurement. |
| Nokia | Yes |

**Summary:**

Nine companies are in favor of discussing/introducing the mechanisms for releasing QoE measurements and for QoE report delivery at RAN overload. One company proposes that release is applied only for signalling-based solution, and that QoE report delivery at overload should be discussed in RAN2.

**Proposal 9: RAN3 to study the mechanisms for:**

* **QoE releasing QoE measurements, and**
* **QoE report delivery at RAN overload.**

Papers [7], [8] and [11] discuss the QoE management support for SA, NSA and MR-DC.

**Q3-5: Should RAN3 discuss/introduce the QoE management support for SA, NSA and/or MR-DC?**

|  |  |
| --- | --- |
| **Company** | **Answer** |
| Ericsson | Yes, we think this is beneficial. Multi-connectivity has an impact on QoE and this should be considered in QoE management. |
| Qualcomm | Yes |
| China Telecom | Yes. NR QOE shall consider the support for MR-DC. |
| ZTE | Application layer QoE measurements is agnostic to SA/NSA/MR-DC.  If we support QoE related RAN measurements, the measurements should be supported for SA/NSA/MR-DC. |
| CMCC | Yes. |
| China Unicom | Yes. |
| Huawei | Yes |
| CATT | Yes |
| Samsung | Agree with ZTE, we should firstly discuss whether QoE measurements in RAN side should be supported. If yes, we can go to NSA/MRDC. |
| Nokia | Not sure whether the question is clear. SA/NSA/MR-DC should be transparent for QoE management, so in that sense QoE management will support SA/NSA/MR-DC. |

**Summary:**

Seven companies explicitly state that QoE managements should be supported for SA, NSA and MR-DC. Three companies think that the measurements areagnostic to SA/NSA/MR-DC. However, the multi-connectivity setup used for the UE and for the application session may have an impact on measurement and report handling.

**Proposal 10: RAN3 to discuss the QoE management support for SA, NSA and/or MR-DC.**

Paper [7] proposes that QoE measurement and reporting is supported in RRC\_CONNECTED state only.

**Q3-6: How should NR QoE measurements and reporting be handled in different RRC states?**

|  |  |
| --- | --- |
| **Company** | **Answer** |
| Ericsson | We think that QoE measurement and reporting should of course be supported in CONNECTED state. We also think that the measurement configuration should not be released during the INACTIVE state, because we should avoid configuring the UE again and again every time it switches back to CONNECTED state. |
| Qualcomm | Application runs in AP (application processor) and is agnostic to RRC states. RRC state is managed by modem. QoE is measurement in application layer and therefore should be independent of RRC states. |
| China Telecom | Agree with Ericsson. Both Connected and inactive state should be supported |
| ZTE | QoE measurement configuration and reporting should of course be supported in CONNECTED state. Whether UE needs to record during INACTIVE state is pending to RAN2 discussion. |
| CMCC | Agree with Ericsson. |
| China Unicom | QoE measurement and reporting should be minimize the impact for RRC CONNECTED state and INACTIVE state. For RRC IDLE state, how to support QoE measurement and reporting is not clear. |
| Huawei | Yes. QoE measurement and reporting is supported in RRC\_CONNECTED state only. We also think if a UE is sent to INACTIVE state, it is better not to release QoE measurement if configured. |
| CATT | Yes agree with E/// |
| Samsung | Of course, QoE measurements and reporting should be handled in RRC connected state.  For inactive state, we think mobility in inactive state should be considered. |
| Nokia | No doubt for need to support connected and inactive state. IDLE mode is a good question, and probably needs RAN2 feedback. |

**Summary:**

Nine companies state that QoE managements should be supported during RRC CONNECTED and INACTIVE states. One company states that the issue is independent of RRC states. Two companies think that the support for IDLE state is unclear.

**Proposal 11: NR QoE measurements and reporting are supported for RRC CONNECTED and INACTIVE states.**

## NR QoE management at mobility

Paper [6] proposes that RAN3 should study the required information to be exchanged between RAN nodes to support QoE measurement handling upon mobility. Papers [8] and [17] propose mobility support only for signalling-based solution.

**Q4: Should RAN3 specify mobility support for both signalling- and management-based NR QoE management?**

|  |  |
| --- | --- |
| **Company** | **Answer** |
| Ericsson | Yes. The mobility impact on QoE is very important, regardless of QoE management solution agreed. |
| Qualcomm | Yes. |
| China Telecom | Yes. In addition, the NR QOE management during 4G/5G HO should be also supported. |
| ZTE | Yes. |
| CMCC | Yes. |
| China Unicom | Yes. Mobility is important for NR QoE management. |
| Huawei | Partially Yes, we think mobility is supported for signalling-based only, for simplicity purpose. |
| CATT | Yes |
| Samsung | Yes. The mobility both in RRC\_CONNECTED and RRC\_INACTIVE should be considered, mentioned in Q3-6 |
| Nokia | Yes |

**Summary:**

Nine companies are in favor of mobility support for both signalling- and management-based NR QoE management. One company proposes the support for signalling-based solution only.

**Proposal 12: Mobility support is specified for both signalling- and management-based NR QoE management.**

## Other non-essential issues – to be discussed at a later stage

* Interface impact - as proposed by [10], the interface impact (proposals in e.g. [13]) should be discussed only after the solution(s) have been chosen, and the rapporteur will follow that approach.
* Proposals regarding real-time NR QoE management, discussed in [10] and [13].
* Inter-RAT mobility discussed in papers [6] and [15].
* Slice-related proposals from [3], [12] and [16].
* Segmentation of QoE reports over RRC in [6].