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Technical Report

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3GPP

Postal address

3GPP support office address
650 Route des Lucioles - Sophia Antipolis
Valbonne - FRANCE
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet
http://www.3gpp.org

Contents

Foreword

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  - 1 presented to TSG for information;
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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

Introduction

A new SI “Study on NR QoE management and optimizations for diverse services” was approved for Release 17 at the 3GPP TSG RAN #86 meeting in [2]. The SI aims to study the potential RAN side solution for supporting a generic framework for triggering, configuring, collection and reporting of NR QoE measurement for various 5G use cases.

1 Scope

The present document captures the results of study on NR QoE management and optimizations for diverse services in RP-193256 [2]. It identifies to study the framework for triggering, configuring, collection and reporting of NR QoE measurement and study the potential impact on the related interface (e.g. F1, NG, Xn interface).

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP RP-193256: " New SID: Study on NR QoE management and optimizations for diverse services ".

[3] 3GPP TS 26.247: "Transparent end-to-end Packet-switched Streaming Service (PSS); Progressive Download and Dynamic Adaptive Streaming over HTTP (3GP-DASH)".

[4] 3GPP TS 26.114: "IP Multimedia Subsystem (IMS); Multimedia Telephony; Media handling and interaction".

[5] 3GPP TS 26.118: "Virtual Reality (VR) profiles for streaming applications".

[6] 3GPP TS 26.346: "Multimedia Broadcast/Multicast Service (MBMS); Protocols and codecs".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

QoE measurement: An application layer measurement configured by OAM, see details in [3] [4] [5] [6] for different service type.

QoE report: The result of a QoE measurement.

Radio-related measurements: Measurements on the radio layer, whose purpose is to help network to further evaluate and improve the QoE.

Radio-related information: Information other than “radio-related measurements”, e.g. feature info, mobility history info or dual connectivity status. FFS on Radio related information only from UE or RAN node or both.

Editor’s NOTE: The above three definitions may subject to further refinements once further consensus are reached.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

QoE	Quality of Experience
MTSI	Multimedia Telephony Service for IMS
VR	Virtual Reality
MBMS	Multimedia Broadcast and Multicast Service
URLLC	Ultra-Reliable Low Latency Communication

4 General

5 5G services, QoE metrics and UE KPI information

Editor's NOTE: Description of typical 5G services (e.g. VR/AR, URLLC), QoE metrics and UE KPI information for certain services (e.g. latency for URLLC service)

NR QoE supports the Application Layer Measurement Collection functionality.

This functionality enables the collection of application layer measurements from the UE. The supported service types include:

- Streaming services [3];

- MTSI services [4];

- VR [5];

- MBMS [6];

- URLLC related services in addition to VR, the details are FFS.

In addition to the QoE metrics, the radio related measurements and information to assist the NR QoE management functionality are considered. Whether the radio related measurements and information are collected from the RAN node and/or from the UE is FFS.

6 Potential NR QoE solutions and procedures

Editor's NOTE: Description of potential NR QoE solutions and procedures, including but not limited to reuse Trace or MDT Functionality/Framework.

6.1 Signalling-based procedures(FFS)

6.1.1 Signalling-based activation procedures

The procedure is used for activating the QoE measurement configured by OAM and triggered by CN shown in figure 6.1.1-1.

The CN initiates the activation of the QoE measurement configured by OAM, and sends the QoE measurement configuration to the NG-RAN node. UE AS layer sends the QoE measurement configuration to UE application layer.

UE application layer generates the QoE report and sends to the UE AS layer. UE AS layer sends the QoE report to NG-RAN node. Then the NG-RAN node transmits the QoE report to the final destination configured (e.g. TCE/MCE).

Editor's NOTE: the QoE report may also be visible at the NG-RAN node.

Management-based QoE measurement shall not overwrite a corresponding signalling-based existing configuration. (FFS)

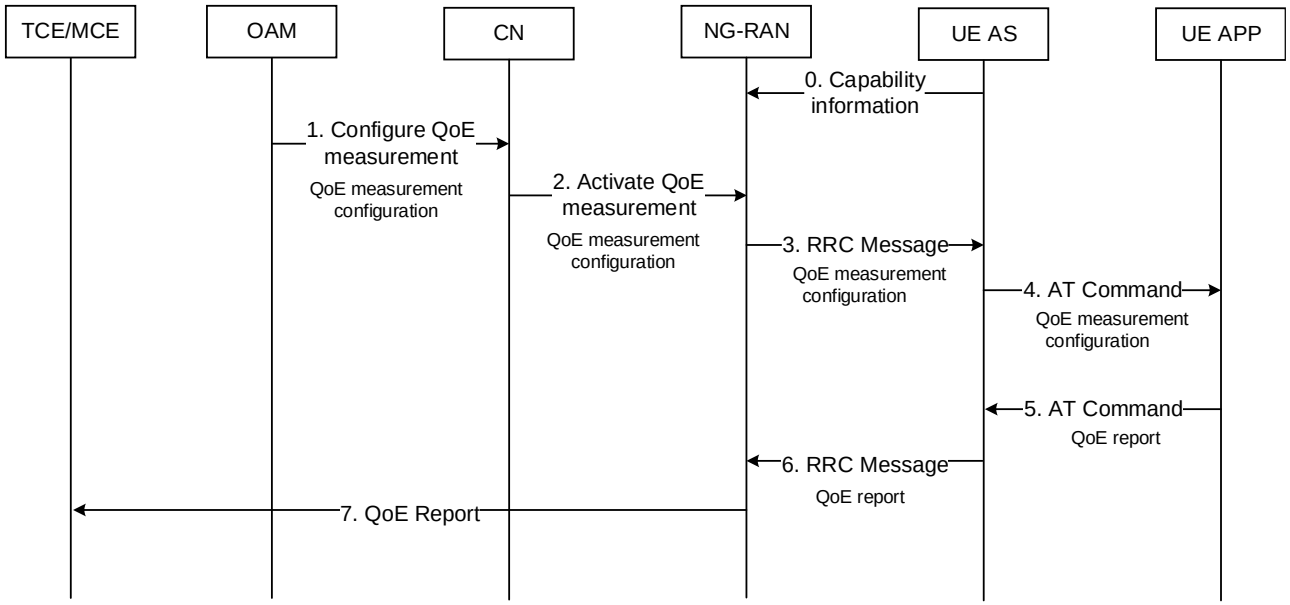

Figure 6.1.1-1 Signalling-based NR QoE activation procedure

6.1.2 Signalling-based deactivation procedures

The procedure is used for deactivating the QoE measurement configured by OAM and triggered by CN shown in figure 6.1.2-1.

The CN initiates the deactivation of QoE measurement, as configured by OAM, and sends the deactivation indication to the NG-RAN node to indicate which QoE measurement should be deactivated. The NG-RAN node checks whether there is an ongoing session pertaining to the QMC (according to the SA4 requirements). The QoE measurement configuration can be deactivated only if there is no such an ongoing session.

The NG-RAN node sends the deactivation indication to UE AS layer, and then UE AS layer sends the deactivation indication to the UE application layer.

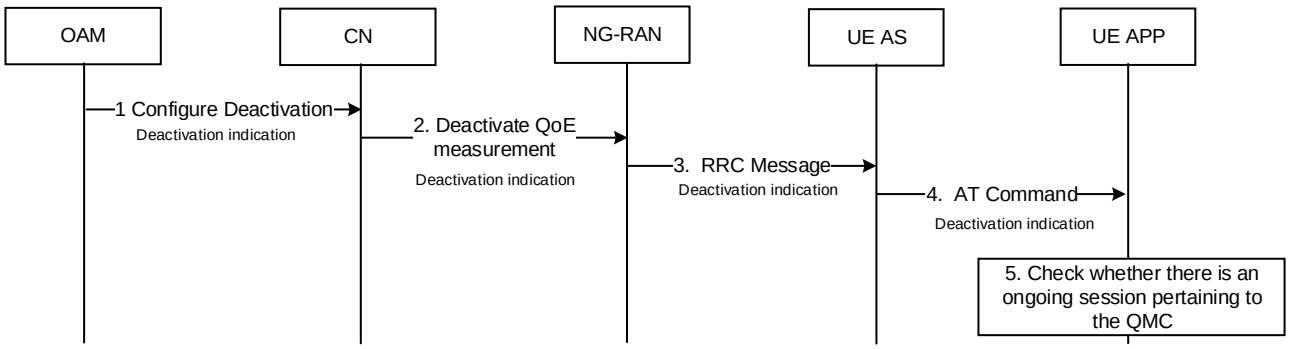

Figure 6.1.2-1 Signalling-based NR QoE deactivation procedure

6.2 Management-based procedures (FFS)

6.2.1 Management-based activation procedures

Editor's NOTE: The section concerns activation of measurement collection job. It needs to be further checked if specific UEs can be targeted by the management based QoE measurement configuration.

The procedure is used for activating the QoE measurement configured and triggered by OAM shown in figure 6.2.1-1.

The OAM sends the QoE measurement configuration to NG-RAN node. NG-RAN finds multiple qualified UEs that meet the criteria (e.g. area scope, application layer capability, service type, etc.) or a single specific UE. NG-RAN node sends the QoE measurement configuration to the AS layer of the specific UE or each qualified UE. UE AS layer sends the QoE measurement configuration to UE application layer. When a session starts, the application layer in UE checks the criteria (e.g. cell list, service type, etc.), if the criteria are met, start QoE measurement and reporting.

FFS whether multiple QoE measurements could be configured for a UE at the same time.

UE application layer sends the QoE report to the UE AS layer. UE AS layer sends the QoE report to NG-RAN node. Then the NG-RAN node transmits the QoE report to the final destination configured (e.g. the MCE).

Editor's NOTE: the QoE report may also be visible at the NG-RAN node. (to be confirmed)

Management based QoE configuration should not override signalling based QoE configuration.(FFS)

Regarding Management-based configuration towards an individual specific UE, the following needs to be considered:

- The OAM is currently not capable of sending the QoE measurement configuration for a specific UE towards its serving gNB when the targeted UE becomes RRC connected. This is because OAM is not informed about when a specific UEs served by a certain gNB become RRC connected.
- There is currently no UE identifier available in OAM which can be used to identify an UE connected to a certain gNB.
- Although it is acknowledged that QoE measurement configuration towards an individual specific UE is already possible using signalling based configuration (via the CN), it should be noted that OAM can issue per-user policies for which the feedback in terms of user experience is required.

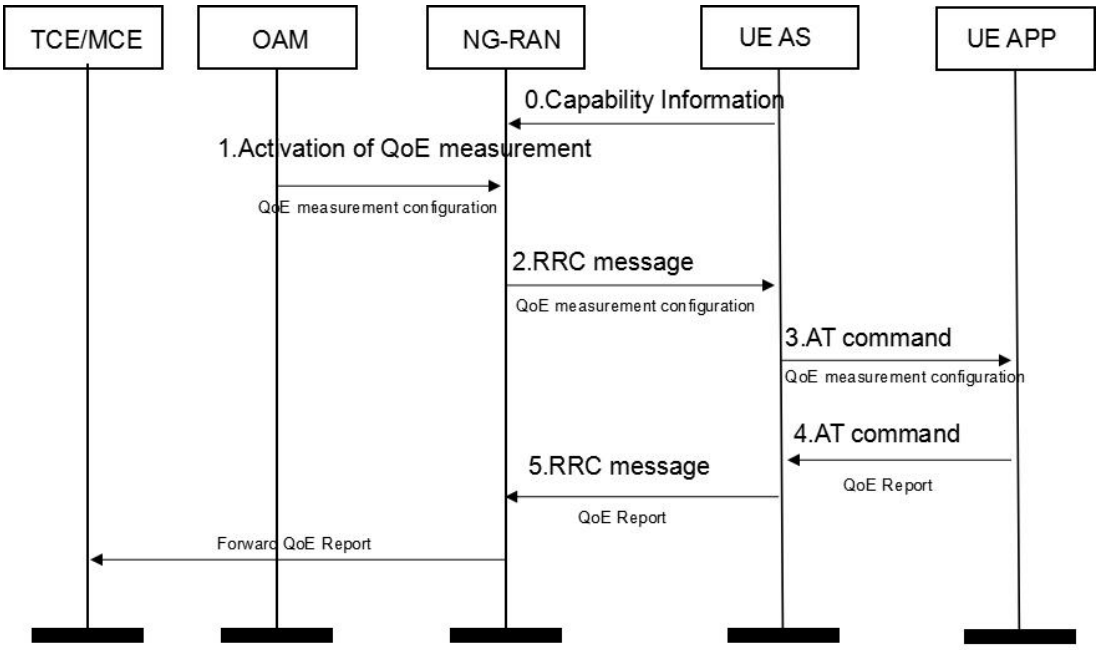

Figure 6.2.1-1 Management-based NR QoE activation procedure

6.2.2 Management-based deactivation procedures

Note: The section concerns deactivation of measurement collection job.

The procedure is used for deactivating the QoE measurement triggered by OAM shown in figure 6.2.2-1. FFS the procedure used for deactivation the QoE measurement due to RAN overload.

OAM sends the deactivation indication to NG-RAN node to indicate which QoE measurement should be deactivated,

The NG-RAN node checks whether there is an ongoing session pertaining to the QMC (according to the SA4 requirements). The QoE measurement configuration can be deactivated only if there is no such an ongoing session. If the NG-RAN node determines that the QoE measurement configuration is to be deactivated, then NG-RAN node sends the deactivation indication to the UE AS layer, and UE AS layer sends it to the application layer in UE. The details are FFS.

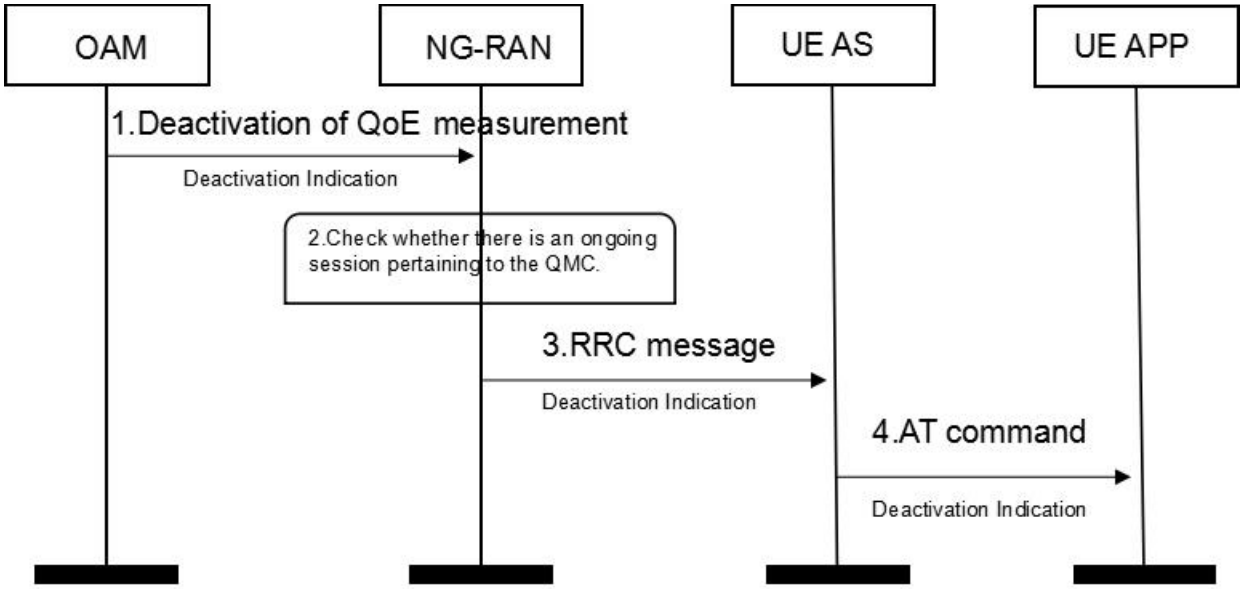

Figure 6.2.2-1 Management-based NR QoE deactivation procedure

6.3 QoE measurement triggering and stopping

QoE measurement triggering and stopping can be realized using time-based and/or threshold-based criteria, configured by the OAM. Time-based QoE measurement triggering and stopping in NR is achieved by reusing mechanisms specified in LTE for the start and stop of QoE measurements. Threshold-based QoE measurement triggering and stopping allows to start and stop QoE measurement when given thresholds are passed.

Meanwhile, RAN is not allowed to intervene, i.e. pause, activate or de-activate an ongoing QoE measurement collection unless instructed otherwise by the OAM.

6.4 Release of QoE measurement configuration

An NG-RAN node can issue a release of QoE measurement configuration for UEs previously configured for QoE measurement reporting, provided that the session for which the QoE measurements are reported is completed.

Editor's NOTE: FFS whether RAN is allowed to release an ongoing QoE measurement reporting; to be confirmed by RAN2.

6.5 QoE measurement handling at RAN overload

In case of RAN overload in standalone connectivity, RAN can stop new QoE measurement configurations, release existing QoE measurement configurations and pause QoE measurement reporting. FFS for details under EN-DC/MR-DC operation.

6.6 Support for Mobility

Seamless mobility is a key functionality in NR and its impacts should be measurable at the application layer. To enable measuring the impact of the mobility on the application and users' QoE, it is required to support QoE measurements in mobility scenarios at least for signalling based QoE.

Editor's NOTE: Management-based activation to be further checked.

In LTE, to support the QoE measurement in mobility scenarios, the QoE configuration is forwarded from the source eNB to the target eNB as part of *Trace Activation* IE over X2 interface. The same IE is sent over S1 interfaces for mobility scenarios when the X2 interface is not established between the source and target.

In NR, to support mobility for QoE measurements in CONNECTED state, the QoE measurement configuration transfer is supported on the Xn and NG interfaces, inside the *Trace Activation* IE. To support keeping QoE measurement configuration in INACTIVE state mobility, QoE measurement configuration for a UE can be fetched from the node hosting the UE Context.

In addition, the SA4 requirements for QoE measurements stipulate that the client shall check the QoE configuration only when a session starts. This means that the client shall continue the QoE measurements for an ongoing session even if the UE moves out of the configured area. The SA4 requirements are RAT-independent and shall therefore be applied to the mobility solution for QoE measurement in NR, as well.

Editor's NOTE: the solutions enabling the fulfilment of the SA4 QoE requirements are FFS.

Editor's NOTE: FFS whether inter-RAT and/or inter-system mobility for QoE measurements should be supported.

Editor's NOTE: FFS whether, and under which conditions, the target node may decide the subsequent handling of management based QoE configuration.

6.7 RAN visible QoE information reporting by UE

Editor's NOTE: This section describes the potential procedure for UE to report RAN visible QoE information.

Editor's NOTE: It is FFS whether RAN awareness of QoE information is useful, and whether UE reporting is needed.

QoE aware by gNB enables close loop QoE optimization by RAN. It is too complicated for gNB to understand the real QoE metrics. RAN visible QoE information is simplified QoE information abstracted from QoE metrics by UE. gNB uses the RAN visible QoE information for close loop QoE optimization. Figure 6.7-1 shows the message flow for RAN visible QoE information reporting.

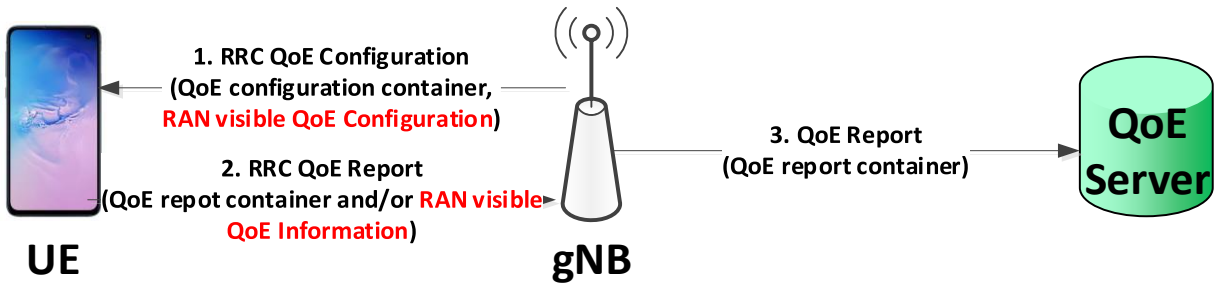

Figure 6.7-1: RAN visible QoE informationreporting

1. gNB sends the RAN visible QoE configuration to UE, may along with the QoE measurement configuration container transmited from CN or OAM.

2. UE receives and applies the RAN-visible QoE configuration and/or QoE measurement configuration container. The RAN visible QoE Configuration may be so that the corresponding RAN visible QoE information can be a unique score or a combination of scores reflecting the QoE metrics useful for RAN (such as buffer level). The encoding of RAN visible QoE configuration and RAN visible reporting is FFS. The RAN-visible report is

provided from the application layer of the UE to the UE's RRC layer by means of an AT command. The UE's RRC layer then includes the RAN-visible report, along with the QoE report container, but as a separate IE, in the MeasReportAppLayer IE, and sends it to the RAN.

3. gNB reads the RAN visible QoE information and/or forwards the QoE report container to QoE server accordingly.

6.8 Radio-related measurements and information for QoE

In order for the network to further evaluate and improve the QoE, RAN could also trigger radio-related measurements towards a certain UE, based on the QoE measurement configuration received from the OAM. For triggering the measurements an existing mechanism, e.g. MDT procedure can be used.

The radio-related QoE measurements are reported for all types of supported services, and they include MDT-like measurements and, potentially, additional measurements related to the radio interface. If new radio-related measurements, with respect to what is currently specified in MDT, are required for NR QoE management, these additional radio-related QoE measurements will be specified as a part of MDT measurements. Since the application-related QoE measurements are only collected when the application session is ongoing, the same requirement holds for radio-related QoE measurements, as well.

Besides radio-related measurement results, radio-related information may also be reported. Radio-related information may be reported even when radio-related measurements are not triggered over the radio.

Both of the radio-related measurement results and radio-related information, if reported, should be aligned and correlated with the QoE report, using e.g. trace ID.

Editor's NOTE: Whether other information, e.g. time stamp could be used for correlation is FFS.

6.9 Per slice QoE measurement

6.9.1 Scenario and requirements

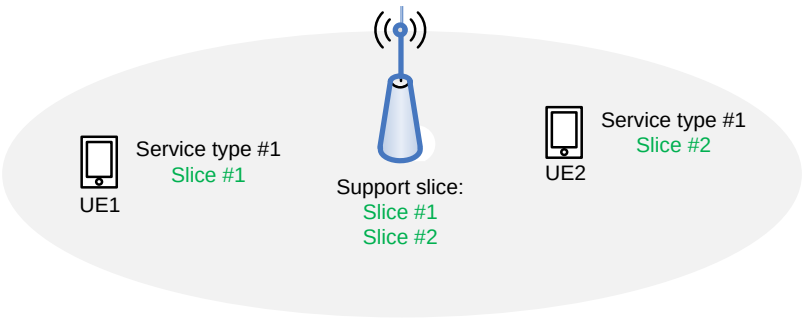

Figure 6.9.1-1: An example of the same service type served by different slices

Figure 6.9.1-1 is an example of the same service type served by different slices. As shown in the figure, UE1 is served by Slice #1 and UE 2 is served by Slice #2. If the Service Level Agreement (SLA) of Slice #1 and Slice #2 are different, QoE of UE1 and UE2 should be different for the same service type.

Collecting QoE per slice is beneficial for both management system (e.g. OAM) and network functions (e.g. UDM, NWDAF, etc.). The requirements of per slice QoE measurement in 5G includes:

- slice SLA maintenance and enforcement in OAM.
- slice experience analysis and prediction in NWDAF.
- better slice selection decision in NSSF.

6.9.2 Solution

6.9.2.1 Configuration

The Slice Scope information should be included in the QoE configuration.

Editor's NOTE: The Slice Scope in the QoE configuration is FFS.

6.9.2.2 Mapping

Editor's NOTE: The mechanism to support mapping of QoE report and slice identification is FFS.

6.9.2.3 Reporting

The slice identification should be included in the QoE report.

Editor's NOTE: The slice identification in the QoE report is FFS.

7 Potential Impacts on NR specifications

Editor's NOTE: Description of potential Specification impact, according to the potential solutions of NR QoE.

8 Conclusion

Annex <X>:

Change history

Change history							
Date	**Meeting**	**Tdoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2020.08	RAN3 109-e	R3-205723	-	-	-	TR skeleton	0.0.0
2020.08	RAN3 109-e	R3-205725	-	-	-	Introduction of supported service types	0.1.0
2020.11	RAN3 110-e	R3-207185	-	-	-	RAN visible QoE information reporting by UE	0.2.0
2020.11	RAN3 110-e	R3-207186	-	-	-	radio related measurements and information	0.2.0
2020.11	RAN3 110-e	R3-207187	-	-	-	QoE measurement triggering, reporting and releasing	0.2.0
2020.11	RAN3 110-e	R3-207192	-	-	-	Per slice QoE measurement for NR QoE	0.2.0
2020.11	RAN3 110-e	R3-207213	-	-	-	Signalling-based signalling for NR QoE	0.2.0
2020.11	RAN3 110-e	R3-207225	-	-	-	Management based signalling for NR QoE	0.2.0
2020.11	RAN3 110-e	R3-207217	-	-	-	Mobility Support for NR QoE	0.2.0