**3GPP TSG-RAN2 Meeting # 124 *R2-2313659***

**Chicago, USA, 13th – 17th Nov, 2023**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **38.300** | **CR** | **0768** | **rev** | **-** | **Current version:** | **17.6.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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|  |
| ***Title:***  | Introduction of R18 QoE enhancement in TS 38.300 |
|  |  |
| ***Source to WG:*** | China Unicom, Huawei, HiSilicon |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_QoE\_enh-Core |  | ***Date:*** | 2023-12-01 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-18 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | Introduction of R18 QoE enhancement in TS 38.300. |
|  |  |
| ***Summary of change:*** | The CR captures the agreements made since RAN2#119-e meeting. (detailed agreements are listed at the end of the CR)Merge the stage-2 CR for Rel-18 NR QoE from RAN3 (R2-2313993\_R3-238103) |
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| ***Consequences if not approved:*** | R18 QoE measurements will not be supported in NR. |
|  |  |
| ***Clauses affected:*** | 3.1, 21.1, 21.2.1, 21.2.3, 21.2.4, 21.3, 21.4, 21.6 (new), 21.7 (new)  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 38.331 CRxxxxTS 38.306 CRxxxx |
| ***affected:*** |  | **X** |  Test specifications |  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications |  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

## 3.1 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1], in TS 36.300 [2] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1] and TS 36.300 [2].

5GC 5G Core Network

--- SKIP UNCHANGED PART ---

QMC QoE Measurement Collection

QoE Quality of Experience

QPSK Quadrature Phase Shift Keying

RA Random Access

RA-RNTI Random Access RNTI

RACH Random Access Channel

RANAC RAN-based Notification Area Code

REG Resource Element Group

RIM Remote Interference Management

RLM Radio Link Monitoring

RMSI Remaining Minimum SI

RNA RAN-based Notification Area

RNAU RAN-based Notification Area Update

RNTI Radio Network Temporary Identifier

RQA Reflective QoS Attribute

RQoS Reflective Quality of Service

RS Reference Signal

RSRP Reference Signal Received Power

RSRQ Reference Signal Received Quality

RSSI Received Signal Strength Indicator

RSTD Reference Signal Time Difference

RTT Round Trip Time

RVQoE RAN visible QoE

SCS SubCarrier Spacing

--- SKIP UNCHANGED PART ---

# 21 Application Layer Measurement Collection

## 21.1 Overview

The QoE Measurement Collection function enables collection of application layer measurements from the UE. The supported service types are:

- QoE Measurement Collection for DASH streaming services;

- QoE Measurement Collection for MTSI services;

- QoE Measurement Collection for VR services.

The QoE measurement collection is supported in RRC\_CONNECTED state, RRC\_IDLE state and RRC\_INACTIVE state.

The QoE Measurement Collection function supports collection of QoE measurements for MBS communication service. The measurement collection is supported for the following two communication service types:

- MBS broadcast.

- MBS multicast.

QoE measurement collection for application sessions delivered via MBS broadcast is supported in RRC\_CONNECTED, RRC\_INACTIVE, and RRC\_IDLE states. QoE measurement collection for the application sessions delivered via MBS multicast is supported in RRC\_CONNECTED state only. Both signalling based and management based QoE measurement collection are supported in NR SA and NR-DC. Further details of NR-DC operation can be found in TS 37.340 [21] and section 21.7.

NOTE: The naming QoE Measurement is used in NG, Xn, and interfaces between the OAM and the gNB. In the Uu interface, the naming application layer measurement is used and it is equal to QoE Measurement.

## 21.2 QoE Measurement Configuration

### 21.2.1 QoE Measurement Collection Activation and Reporting

The feature is activated in the gNB either by direct configuration from the OAM system (management-based activation), or by signalling from the OAM via the 5GC (signalling-based activation), containing UE-associated QoE configuration. One or more QoE measurement collection jobs can be activated at a UE per service type, and each QoE measurement configuration is uniquely identified by a QoE reference.

For signalling-based QoE measurements, the OAM initiates the QoE measurement activation for a specific UE via the 5GC, and the gNB receives one or more QoE measurement configurations by means of UE-associated signalling. The QoE measurement configuration for signalling-based activation includes an application layer measurement configuration list and the corresponding information for QoE measurement collection, e.g., QoE reference, service type, MCE IP address, slice scope, area scope, MDT alignment information, the indication of available RAN visible QoE metrics and assistance information.

For management-based QoE measurement activation, the OAM sends one or more QoE measurement configurations directly to the gNB. The QoE measurement configuration for management-based activation also includes an application layer measurement configuration list and the corresponding information for QoE measurement collection. The gNB selects UE(s) that meet the required QoE measurement capability, area scope and slice scope.

Application layer measurement configuration received by the gNB from OAM or CN is encapsulated in a transparent container, which is forwarded to a UE as Application layer configuration in the *RRCReconfiguration* message (there can be multiple configurations in the same message). Application layer measurement reports received from UE's application layer are encapsulated in a transparent container and sent to the network in the *MeasurementReportAppLayer* message, as specified in TS 38.331 [12]. The UE can send multiple application layer measurement reports to the gNB in one *MeasurementReportAppLayer* message. In order to allow the transmission of application layer measurement reports which exceed the maximum PDCP SDU size, segmentation of the *MeasurementReportAppLayer* message may be enabled by the gNB. An RRC identifier conveyed in the RRC signalling is used to identify the application layer measurement configuration and report between the gNB and the UE. The RRC identifier is mapped to the QoE reference in the gNB, and the gNB forwards the application layer measurement report to MCE together with the QoE reference. The gNB can release one or multiple application layer measurement configurations from the UE in one *RRCReconfiguration* message at any time. The UE may additionally be configured by the gNB to report when a QoE measurement session starts or stops for a certain application layer measurement configuration.

### 21.2.2 QoE Measurement Collection Deactivation

The QoE Measurement Collection deactivation permanently stops all or some of the QoE measurement collection jobs towards a UE, resulting in the release of the corresponding QoE measurement configuration(s) in the UE. The deactivation of QoE measurement collection is supported by using UE-associated signalling. A list of QoE references is used to deactivate the corresponding QoE measurement collection job(s).

Upon reception of the QoE release message in an application layer measurement configuration, the UE discards any unsent application layer measurement reports corresponding to the released application layer configuration. The UE discards the reports received from application layer when it has no associated application layer measurement configuration configured.

The network can replace a QoE measurement configuration with another one by deactivating an existing QoE measurement configuration and activating another QoE measurement configuration of the same QoE measurement configuration type.

### 21.2.3 Handling of QMC during RAN Overload

The QoE measurement collection pause/resume procedure is used to pause/resume reporting of one or multiple QoE measurement configurations in a UE in RAN overload situation.

The gNB can use the *RRCReconfiguration* message to temporarily stop the UE from sending application layer measurement reports associated with one or multiple application layer measurement configurations. When the UE receives the QoE measurement collection pause indication, the UE temporarily stores application layer measurement reports in AS layer. When the UE receives the QoE measurement collection resume indication, the UE sends the stored application layer measurement reports to the gNB.

For a QoE measurement configuration, the assistance information provided by the OAM may be considered by the gNB for deciding whether to pause/resume the measurement reporting of certain QoE measurement configurations in case of RAN overload.

### 21.2.4 QoE Measurement Handling in RRC\_IDLE and RRC\_INACTIVE States

If the UE enters RRC\_INACTIVE, the UE AS configuration for the QoE is stored in the UE Inactive AS context.

If the UE enters RRC\_IDLE state, the UE releases all application layer measurement configurations except the application layer configurations explicitly indicated by the gNB as applicable in RRC\_IDLE and RRC\_INACTIVE states.

For application measurement configurations applicable in RRC\_IDLE and RRC\_INACTIVE states, the UE continues on-going QoE measurement collection when entering RRC\_IDLE or RRC\_INACTIVE state, and also when returning to RRC\_CONNECTED state. The UE may also start QoE collection according to the stored QoE configuration while in RRC\_IDLE or RRC\_INACTIVE state. The UE keeps the application layer measurement configurations but does not start new QoE sessions when it is outside of the area scope for QoE configurations in RRC\_IDLE and/or RRC\_INACTIVE state. The UE stores the application layer measurement reports generated while in RRC\_IDLE and/or RRC\_INACTIVE state in the AS layer. The gNB can retrieve the application layer measurement reports/configurations and session status indication by configuring SRB4 or SRB5 after it receives application layer measurement reports/configurations availability indication. The UE can send idle/inactive application layer measurement reports to the gNB only when it has moved to RRC\_CONNECTED state due to other reasons.

Upon UE’s transition from RRC\_IDLE to RRC\_CONNECTED, the gNB serving the UE should ensure that it does not release an already configured signaling-based QoE measurement configuration for the sake of configuring a new management-based QoE measurement configuration.

### 21.2.5 Per-slice QoE Measurement

When a service is provided within a configured slice, the QoE Measurement for this service type can also be configured together with the corresponding slice scope, so that the user experience of this service can also be evaluated on a per-slice basis. Multiple QoE measurement configurations can be configured for the same service type, and each configuration can pertain to different slices, where each QoE measurement configuration is identified with a QoE reference.

The UE includes the network slice identifier inside the QoE report container when reporting QoE measurement reports.

## 21.3 QoE Measurement Continuity for Mobility

QoE measurement collection continuity for intra-system intra-RAT handover is supported, with the Area Scope parameters configured by the OAM, where the network is responsible for keeping track of whether the UE is inside or outside the area scope. A UE continues an ongoing QoE measurement even if it leaves the area scope, unless the network indicates to the UE to release the application layer measurement configuration.

For the handover, the source gNB may transmit the information related to one or more application layer measurement configurations of the UE to the target gNB via XnAP or NGAP. For signalling-based QoE, the service type indication, QoE reference, and, optionally, the MCE IP address, measurement configuration application layer ID, MDT alignment information, area scope, slice support list for QMC, available RAN visible QoE metrics and measurement status are passed to the target gNB. For management-based QoE, the service type indication, measurement configuration application layer ID, the MCE IP address and QoE measurement status are passed to the target gNB. For RRC\_INACTIVE state mobility, QoE measurement configuration(s) of a specific UE can be retrieved from the gNB hosting the UE context when it resumes to the RRC\_CONNECTED state.

For signalling-based QoE, at handover to a target gNB that supports QoE measurement collection, the target gNB decides which of the application layer measurement configurations should be kept or released, e.g., based on application layer measurement configuration information received from the source gNB in Xn/NG signalling.

For QoE sessions pertaining to data flows received via MBS broadcast, QoE measurement collection may continue during the RRC\_INACTIVE and RRC\_IDLE.

QoE measurements for ongoing sessions should be continued when switching between MBS multicast and unicast transmission modes.

When the UE resumes the connection with a gNB that does not support QoE, the UE releases all application layer measurement configurations.

QoE measurement collection continuity for intra-system inter-RAT handover is supported.

For intra-5GC handover from E-UTRA to NR, the UE releases the LTE QoE configuration if received from the source RAT and the UE applies NR QoE configuration(s) if received from the target RAT.

For intra-5GC handover from NR to E-UTRA, the UE releases all NR QoE configuration(s) if received from the source RAT, and the UE applies the LTE QoE configuration if received from the target RAT.

## 21.4 RAN Visible QoE Measurements

RAN visible QoE measurements are configured at the UE by the gNB, where a subset of configured QoE metrics is reported from the UE to the gNB as an explicit IE readable by the gNB. The RAN visible QoE measurements can be used by the gNB for network optimization. The RAN visible QoE measurements are supported for the DASH streaming and VR services. The gNB configures the RAN visible QoE measurement of all or some of the available RAN visible QoE metrics, where the indication of metric availability is received by the gNB as part of management-based or the signalling-based QoE configuration. The set of available RAN visible QoE metrics is a subset of the metrics configured as part of QoE measurement configuration encapsulated in the application layer measurement configuration container. RAN visible QoE measurements and encapsulated QoE measurements can be configured together or separately. RAN visible QoE measurements can only be configured if there is a corresponding QoE measurement configuration for the same service type configured at the UE. The gNB may modify a RAN visible QoE configuration by releasing it and configuring the UE with a new RAN visible QoE configuration pertaining to the same QoE reference. In this case, the new RAN visible QoE configuration applies immediately, i.e., even during the same application session.

Multiple simultaneous RAN visible QoE measurement configurations and reports can be supported for RAN visible QoE measurements, and each RAN visible QoE measurement configuration and report is identified by the same measurement configuration application layer ID as the corresponding QoE measurement configuration and measurement report. After receiving the RAN visible QoE measurement configuration, the UE RRC layer forwards the configuration to the application layer, indicating the service type, the measurement configuration application layer ID and, optionally, the reporting periodicity for RAN visible QoE. The application layer sends the RAN visible QoE measurement report associated with the measurement configuration application layer ID to the UE's AS layer. The PDU session ID(s) and QoS Flow IDs per PDU session ID corresponding to the service that is subject to QoE measurements can also be reported by the UE along with the RAN visible QoE measurement results.

If there is no reporting periodicity defined in the RAN visible QoE configuration, the UE sends both RAN visible QoE measurement reports and the QoE measurement reports to the gNB in the same *MeasurementReportAppLayer* message, except when QoE measurement reporting pause indication is received (e.g., in case of RAN overload). When a QoE measurement collection is paused, if there is no reporting periodicity defined in the RAN visible QoE configuration, the encapsulated QoE reports are stored at the UE's RRC layer, but the RAN visible QoE reports continue to be reported to the gNB with the reporting periodicity configured for encapsulated QoE reporting. The RAN visible QoE measurements can be reported with a reporting periodicity different from the one of the corresponding encapsulated QoE measurements, when a dedicated RAN visible QoE reporting periodicity is configured by the gNB. The UE Application layer can measure the RAN visible QoE metrics based on this reporting periodicity.

The gNB can release one or multiple RAN visible QoE measurement configurations from the UE in one *RRCReconfiguration* message at any time. If the encapsulated QoE configuration is released, the corresponding RAN visible QoE configuration shall be released as well.

The RAN visible QoE configuration can be transferred from the source gNB to the target gNB upon mobility and from the old gNB to the new gNB during context retrieval. The target gNB or the new gNB can generate a new RAN visible QoE configuration based on the available RAN visible QoE metrics received and can send the new RAN visible QoE configuration to the UE during handover or the RRC resume procedure.

## 21.5 Alignment of MDT and QoE Measurements

The radio-related measurements may be collected via immediate MDT for all types of supported services for the purpose of QoE analysis. The MCE/TCE performs the correlation of the immediate MDT measurement results and the QoE measurement results collected at the same UE.

The following is supported:

- Alignment between a signalling-based QoE measurement and a signalling-based MDT measurement. In this case, the signalling-based QoE configuration sent to the gNB includes the NG-RAN Trace ID of the signalling-based MDT measurement.

- Alignment between a management-based QoE measurement and a management-based MDT measurement.

The UE configured with QoE measurements sends an indication to inform the gNB about the start or the stop of a QoE measurement session of configured QoE measurements. The gNB can activate the MDT measurements that are to be aligned with the QoE measurements performed by the UE upon/after receiving the QoE measurement session start indication from the UE. The gNB may activate the MDT measurements upon/after receiving the MDT activation message from the OAM. The gNB can deactivate the aligned MDT measurements according to an OAM command which may, e.g., be triggered by the session stop indication.

The gNB includes time stamp information to the QoE measurement reports to enable the correlation of corresponding measurement results of MDT and QoE at the MCE/TCE. In addition, the gNB includes the MDT session identifiers (Trace Reference and Trace Recording Session Reference) in the corresponding QoE measurement report.

21.6 QoE Measurement Collection in High Mobility Scenarios

QoE measurements can be confined to high mobility state of the UE and/or to HSDN cells.

21.7 Support for RAN visible QoE measurements and reporting in NR-DC

Either the MN or the SN can generate and send a RAN visible QoE configuration to the UE. The gNB that has initially configured a UE in NR-DC with an RVQoE configuration can modify and release the RAN visible QoE configuration as long as the UE is connected to this gNB. The gNB that configures the encapsulated QoE measurements to UE is referred to as the RAN visible QoE-configuring gNB, and the peer node is referred to as the non-RAN visible QoE-configuring gNB. Upon mobility, the RAN visible QoE-configuring gNB may be changed.

The UE may send RAN visible QoE reports to the network using either SRB4 or SRB5. In addition, the gNB that received a RAN visible QoE report can forward the report to the other gNB (the SN or the MN). QoE reports and RAN visible QoE reports pertaining to the same QoE Reference can be sent over the same SRB or they can be sent over different SRBs.

The RAN visible QoE-configuring gNB can configure RAN visible QoE measurements at a UE without a priori knowledge about which gNB(s) will provide the bearer(s) for a future application session. During the lifetime of an application session, to ensure that the RAN visible QoE reports are sent to the gNB(s) that provide the bearer(s) which carry the data flow(s) associated with the RAN visible QoE measurement result in a RAN visible QoE report, the gNB receiving the RAN visible QoE reports determines the bearer(s) used to deliver the application session data flow(s) and the associated gNB (s). The determination may be based on the PDU session ID(s) and the QoS flow ID(s) indicated in a received RAN visible QoE report.

When the RAN visible QoE-configuring gNB receives a RAN visible QoE measurement report and determines that the non-RAN Visible QoE-configuring gNB provides at least one bearer for the application session, the RAN Visible QoE-configuring gNB indicates that to the non-RAN Visible QoE-configuring gNB. The non-RAN Visible QoE-configuring gNB can then, if needed, indicate to the RAN visible QoE-configuring gNB its preference with respect to the reporting path for the subsequent RAN visible QoE reports and its preferred RAN visible QoE configuration parameters.

If a gNB receives a RAN visible QoE report from a UE in NR-DC, and determines that the bearer(s) for the application session data flow(s) is (are) also provided by the other gNB, or only, provided by the other gNB, the gNB that received the RAN visible QoE measurement report may forward the received RAN visible QoE report to the other gNB. The RAN visible QoE reports can be transferred between the MN and the SN via the RRC TRANSFER message. The RAN visible QoE configuration may also be modified or released.