**3GPP TSG-RAN2 Meeting # 117-e *R2-220xxx***

**Online, 21 Feb - 3 Mar, 2022**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.300** | **CR** | **0424** | **rev** | **-** | **Current version:** | **16.8.0** |  |
|  | | | | | | | | |
| *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:*** | 38.300 CR for Introduction of QoE measurements in NR | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | China Unicom, Huawei, HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_QoE-Core | | | | |  | ***Date:*** | | | 2022-03-10 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *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 can be 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)* | |
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| ***Reason for change:*** | | CR for introduction of QoE measurements in NR. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | The CR captures the agreements made since RAN2#113b-e meeting and RAN3#113-e meeting. The CR introduces stage-2 description of Application Layer Measurement Collection feature. | | | | | | | | |
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| ***Consequences if not approved:*** | | QoE measurements will not be defined. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1, X (New) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS 38.331 CRxxxx  TS 38.306 CRxxxx | | |
| ***affected:*** | |  | **X** | Test specifications | | | |  | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

# 3 Abbreviations and Definitions

## 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

5GS 5G System

5QI 5G QoS Identifier

A-CSI Aperiodic CSI

AKA Authentication and Key Agreement

AMBR Aggregate Maximum Bit Rate

AMC Adaptive Modulation and Coding

AMF Access and Mobility Management Function

ARP Allocation and Retention Priority

BA Bandwidth Adaptation

BCH Broadcast Channel

BH Backhaul

BL Bandwidth reduced Low complexity

BPSK Binary Phase Shift Keying

C-RNTI Cell RNTI

CAG Closed Access Group

CAPC Channel Access Priority Class

CBRA Contention Based Random Access

CCE Control Channel Element

CD-SSB Cell Defining SSB

CFRA Contention Free Random Access

CHO Conditional Handover

CIoT Cellular Internet of Things

CLI Cross Link interference

CMAS Commercial Mobile Alert Service

CORESET Control Resource Set

CP Cyclic Prefix

CPC Conditional PSCell Change

DAG Directed Acyclic Graph

DAPS Dual Active Protocol Stack

DFT Discrete Fourier Transform

DCI Downlink Control Information

DCP DCI with CRC scrambled by PS-RNTI

DL-AoD Downlink Angle-of-Departure

DL-SCH Downlink Shared Channel

DL-TDOA Downlink Time Difference Of Arrival

DMRS Demodulation Reference Signal

DRX Discontinuous Reception

E-CID Enhanced Cell-ID (positioning method)

EHC Ethernet Header Compression

ETWS Earthquake and Tsunami Warning System

FS Feature Set

GFBR Guaranteed Flow Bit Rate

HRNN Human-Readable Network Name

IAB Integrated Access and Backhaul

I-RNTI Inactive RNTI

INT-RNTI Interruption RNTI

KPAS Korean Public Alarm System

LDPC Low Density Parity Check

MDBV Maximum Data Burst Volume

MCE Measurement Collection Entity

MIB Master Information Block

MICO Mobile Initiated Connection Only

MFBR Maximum Flow Bit Rate

MMTEL Multimedia telephony

MNO Mobile Network Operator

MPE Maximum Permissible Exposure

MT Mobile Termination

MTSI Multimedia Telephony Service for IMS

MU-MIMO Multi User MIMO

Multi-RTT Multi-Round Trip Time

NB-IoT Narrow Band Internet of Things

NCGI NR Cell Global Identifier

NCR Neighbour Cell Relation

NCRT Neighbour Cell Relation Table

NGAP NG Application Protocol

NID Network Identifier

NPN Non-Public Network

NR NR Radio Access

P-MPR Power Management Maximum Power Reduction

P-RNTI Paging RNTI

PCH Paging Channel

PCI Physical Cell Identifier

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

PLMN Public Land Mobile Network

PNI-NPN Public Network Integrated NPN

PO Paging Occasion

PRACH Physical Random Access Channel

PRB Physical Resource Block

PRG Precoding Resource block Group

PS-RNTI Power Saving RNTI

PSS Primary Synchronisation Signal

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

PWS Public Warning System

QAM Quadrature Amplitude Modulation

QFI QoS Flow ID

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

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

SCS SubCarrier Spacing

SD Slice Differentiator

SDAP Service Data Adaptation Protocol

SFI-RNTI Slot Format Indication RNTI

SIB System Information Block

SI-RNTI System Information RNTI

SLA Service Level Agreement

SMC Security Mode Command

SMF Session Management Function

S-NSSAI Single Network Slice Selection Assistance Information

SNPN Stand-alone Non-Public Network

SNPN ID Stand-alone Non-Public Network Identity

SPS Semi-Persistent Scheduling

SR Scheduling Request

SRS Sounding Reference Signal

SRVCC Single Radio Voice Call Continuity

SS Synchronization Signal

SSB SS/PBCH block

SSS Secondary Synchronisation Signal

SST Slice/Service Type

SU-MIMO Single User MIMO

SUL Supplementary Uplink

TA Timing Advance

TCE Trace Collection Entity

TPC Transmit Power Control

TRP Transmit/Receive Point

UCI Uplink Control Information

UL-AoA Uplink Angles of Arrival

UL-RTOA Uplink Relative Time of Arrival

UL-SCH Uplink Shared Channel

UPF User Plane Function

URLLC Ultra-Reliable and Low Latency Communications

V2X Vehicle-to-Everything

VR Virtual Reality

Xn-C Xn-Control plane

Xn-U Xn-User plane

XnAP Xn Application Protocol

*<Next modification>*

# X Application Layer Measurement Collection

## X.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 streaming services;

- QoE Measurement Collection for MTSI services.

- QoE Measurement Collection for VR services.

Both signalling based and management based QoE measurement collection are supported.

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

## X.2 QoE Measurement Configuration

### X.2.1 QoE Measurement Collection Activation and Reporting

The feature is activated in the NG-RAN either by direct configuration from the OAM system (management-based activation), or by signalling from the OAM via the Core Network (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 Core Network, and the NG-RAN node 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 and the indication of available RAN visible QoE metrics. Each application layer measurement configuration is encapsulated in a transparent container. The NG-RAN node forwards the corresponding QoE measurement configuration(s) to the UE in a downlink RRC message containing *AppLayerMeasConfig*, as specified in TS38.331 [12].

For management-based QoE measurement activation, the OAM sends one or more the QoE measurement configurations to the NG-RAN node. The QoE measurement configuration for management-based activation also includes an application layer measurement configuration list and the corresponding information for QoE measurement collection. Each application layer measurement configuration is encapsulated in a transparent container. The NG-RAN node selects UE(s) that meet the required QoE measurement capability, Area Scope and Slice Scope.

The UE reports QoE measurement results to the NG-RAN node in an uplink RRC message, as specified in TS38.331[12]. The NG-RAN node transmits the QoE report and the corresponding QoE Reference ID to the MCE.

The QoE measurement collection is handled by application layer measurement configuration and measurement reporting, supported in RRC\_CONNECTED state only. 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 higher 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. A *measConfigAppLayerId* 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. The application layer measurement report is forwarded to OAM together with the QoE Reference. 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.

### X.2.2 QoE Measurement Collection Deactivation

QoE Measurement Collection deactivation permanently stops all or some of 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 Reference is used to deactivate the corresponding QoE measurement collection job(s).

Upon reception of QoE release command 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 configuration with another one by deactivating an existing measurement and configuring another measurement of the same configuration type.

### X.2.3 Handling of QMC during RAN Overload

QoE Measurement Collection pause/resume procedure is used to pause/resume the reporting for all QoE reports or to pause/resume QoE reporting per QoE configuration in a UE in RAN overload situation.

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

### X.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 the application layer measurement configurations.

### X.2.5 Per-slice QoE Measurement

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

The UE includes the slice ID inside the QoE report container when reporting QoE measurement.

## X.3 QoE Measurement Continuity for Mobility

The QoE Measurement Collection continuity for intra-system intra-RAT mobility 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 should continue an ongoing measurement even if it leaves the Area Scope, unless the network indicates to the UE to release the QoE configuration.

For RRC\_CONNECTED state mobility, the source NG-RAN node may transmit the QoE measurement configuration(s) and/or the information related to the configuration(s) of a specific UE to the target NG-RAN node via XnAP or NGAP. For signaling-based QoE, QoE Reference, MCE IP Address, Measurement Configuration Application layer ID, MDT Alignment Information, Area Scope, Slice Scope and Measurement Status are passed to the target node. For management-based QoE, Measurement Configuration Application Layer ID, MCE IP Address and Measurement Status are passed to the target node. For RRC\_INACTIVE state mobility, QoE measurement configuration(s) of a specific UE can be restored from the node hosting the UE context when it resumes to RRC\_CONNECTED state. Multiple sets of QoE measurement configurations should be supported during mobility.

For signalling based QoE, at handover to a target gNB which supports QoE, the target gNB decides which application layer measurement configurations to keep and which to release, e.g. based on application layer measurement configuration information received from the source gNB in Xn/NG signalling.

When the UE resumes the connection in a gNB not supporting QoE, the UE releases all application layer measurement configurations.

## X.4 RAN Visible QoE Measurements

RAN visible QoE measurements are configured by the NG-RAN node, where a subset of QoE metrics is reported from the UE as an explicit IE readable by the NG-RAN node. RAN visible QoE measurements (e.g., RAN visible QoE metrics, RAN visible QoE values) could be utilized by the NG-RAN node for network optimization. RAN visible QoE measurements are supported for the DASH streaming and VR services. The NG-RAN node configures the RAN visible QoE measurement to collect all or some of the available RAN visible QoE metrics, where the indication of metric availability is received from the OAM or CN. The set of available RAN visible QoE metrics is a subset of the metrics which are already configured as part of QoE measurement configuration encapsulated in the transparent container. The PDU session ID(s) 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.

RAN visible QoE measurements can be reported with a reporting periodicity different from the one of regular QoE. If there is no reporting periodicity defined in the RAN visible QoE configuration, RAN visible QoE reports should be sent together with the legacy QoE reports.

RAN visible application layer measurement is supported only for streaming and VR services. The gNB can use RAN visible application layer measurement configurations to instruct the UE to collect application layer measurements for RRM purposes. Multiple simultaneous RAN visible application layer measurements configuration and reports can be supported for RAN visible application layer measurement, and each RAN visible application layer measurement configuration and report is identified by the same *measConfigAppLayerId* as the application layer measurement configuration and measurement report. gNB configures the required RAN visible QoE metrics in the RAN visible application measurement configuration for the UE to report. After receiving the RAN visible application layer measurement configuration, the UE RRC layer forwards the configuration to the application layer, indicating the service type, the RRC identifier and the periodicity. RAN visible application layer configuration can only be configured if there is a corresponding application layer measurement configuration for the same service type configured at the UE. The application layer sends the RAN visible application layer measurement report associated with the RRC identifier to the UE’s AS layer. UE can send both RAN visible application layer measurement reports and the application layer measurement reports to the gNB in the same *MeasurementReportAppLayer* message. gNB can release one or multiple RAN visible application layer measurement configurations from the UE in one RRC message at any time.

The UE still reports the configured RAN visible application layer measurements, even though the corresponding non RAN visible application layer measurement reporting is paused.

## X.5 Alignment of MDT and QoE Measurements

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 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 NG-RAN node 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 for QoE measurements can send to the NG-RAN node a Session Start Indication or a Session End Indication to inform the NG-RAN node about the start or the end of a session of configured QoE measurements. The NG-RAN node can activate the MDT measurements that are to be aligned with the QoE measurements performed by the UE upon/after receiving the Session Start Indication from the UE. The NG-RAN node may activate the MDT measurements upon/after receiving the MDT activation message from OAM. The NG-RAN node can deactivate the aligned MDT measurements according to OAM command which may, e.g., be triggered by the Session End Indication.

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