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LTE;
5G;
Telecommunication management;
Quality of Experience (QoE) measurement collection;
Control and configuration
(3GPP TS 28.405 version 18.6.0 Release 18)**



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Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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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.

In the present document, modal verbs have the following meanings:

- shall** indicates a mandatory requirement to do something
- shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

- should** indicates a recommendation to do something
- should not** indicates a recommendation not to do something
- may** indicates permission to do something
- need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

- can** indicates that something is possible
- cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

- will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document
- will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document
- might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

might not indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

is (or any other verb in the indicative mood) indicates a statement of fact

is not (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

Introduction

The present document is part of a TS-family covering the 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Telecommunication management, as identified below:

TS 28.404: "Quality of Experience (QoE) measurement collection; Concepts, use cases and requirements";

TS 28.405: "Quality of Experience (QoE) measurement collection; Control and configuration";

TS 28.406: "Quality of Experience (QoE) measurement collection; Information definition and transport".

One main motivation of mobile network evolution is to improve the user experience, which is why the evaluation of the user experience at the UE side is vital to network operators. This is especially true when the operators provide high bit rate real-time services like streaming services (typically video services), where even intermittent quality degradation is very annoying. Many of these streaming services are a significant part of the commercial traffic growth rate, therefore the focus is on the end users' experience.

Quality of Experience (QoE) information collection provides detailed information at session level on a number of UEs.

The capability to log information within a UE, and in particular the QoE of an end user service, initiated by an operator, provides the operator with QoE information. The collected information cannot be deduced from performance measurements in the mobile network.

The QoE information is information collected by the end user application in the UE.

The QoE information is collected by the management system for analysis and/or KPI calculations.

1 Scope

The present document addresses the mechanisms used for the function Quality of Experience (QoE) measurement collection in 3GPP networks . The measurements that are collected are DASH [6], MTSI [7] and Virtual Reality (VR) (see TS 26.118 [13]) measurements.

The function includes collecting QoE information from UEs frequenting a specified area or an individual UE for a specified end user service/end user service type. The document describes the activation and deactivation of a network request session, UE request session and recording session and also the reporting of recorded information [2].

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 TS 28.404: "Telecommunication management;Quality of Experience (QoE) measurement collection; Concepts, use cases and requirements".
- [3] 3GPP TS 28.308: "Management of Quality of Experience (QoE) measurement collection Integration Reference Point (IRP); Information Service (IS)".
- [4] 3GPP TS 25.331: "Radio Resource Control (RRC) protocol specification".
- [5] 3GPP TS 27.007: "AT command set for User Equipment (UE)".
- [6] 3GPP TS 26.247: "Transparent end-to-end Packet-switched Streaming Service (PSS); Progressive Download and Dynamic Adaptive Streaming over HTTP (3GP-DASH)".
- [7] 3GPP TS 26.114: "IP Multimedia Subsystem (IMS); Multimedia Telephony; Media handling and interaction".
- [8] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) protocol specification".
- [9] 3GPP TS 36.413: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP)".
- [10] 3GPP TS 25.413: "UTRAN Iu interface Radio Access Network Application Part (RANAP) signalling".
- [11] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".
- [12] 3GPP TS 38.413: " NG-RAN; NG Application Protocol (NGAP)".
- [13] 3GPP TS 26.118: "Virtual Reality (VR) profiles for streaming applications".
- [14] Void
- [15] 3GPP TS 28.622: "Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".

3 Definitions of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in 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 TR 21.905 [1].

Network session: A network session is used when a NF requests a UE to perform QoE Measurement Collection for a specified end user service type. Supported end user service types are defined in clause 5.8.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 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 TR 21.905 [1].

DM	Domain Manager
MCE	Measurement Collector Entity
NB	Node B
QMC	QoE Measurement Collection
QoE	Quality of Experience
VR	Virtual Reality

4 Quality of Experience (QoE) measurement collection

4.1 Management based activation in UTRAN

4.1.1 Activation of measurement collection job and reporting of collected information in UTRAN

The parameters for the network request session are sent from the management system to the RNCs that host the cells that are included in the collection job request in the `activateAreaQMCJob` operation [3]. The RNC starts a network request session, with the `Network request session id` [3] given in `activateAreaQMCJob` operation [3]. For the duration of the network request session, the RNC(s) checks for connections where the UE has the `UE Application Layer Measurement Capability` [10]. The `UE Application Layer Measurement Capability` is sent from the UE to RNC (via the core network) in message `INITIAL UE MESSAGE` [10].

When a session is found that has a UE with the `UE Application Layer Measurement Capability`, the RNC starts a UE request session by sending a `MEASUREMENT CONTROL` message [4] to the UE via the NB.

The AT command `+CAPPLEVMC` [5] activates provisioning of measurement reporting from the lower layers to the application within the UE by an unsolicited result code `+CAPPLEVMC`. When information about a measurement report is received in the UE from the network, the unsolicited result code `+CAPPLEVMC` contains the relevant parameters (`service_type`, `start_stop-indication` and `config-file & config-file length` if applicable) that are provided from the lower layers in the UE to the application.

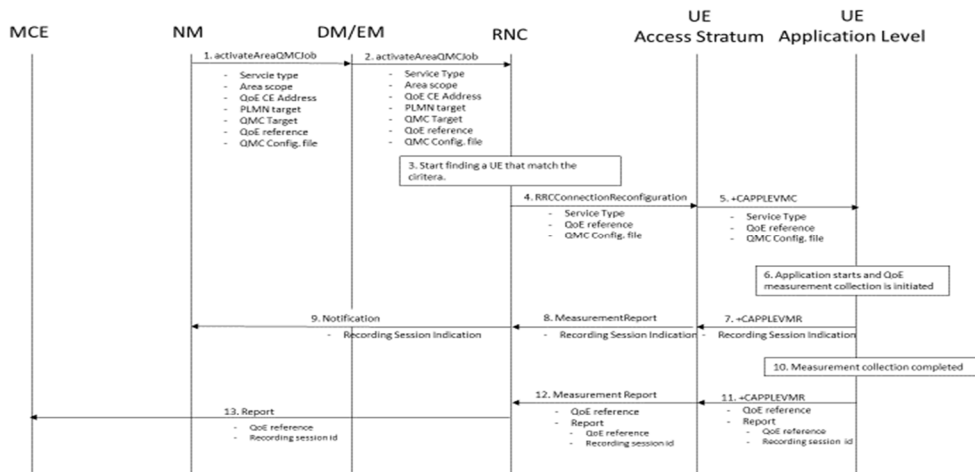


Figure 4.1.1-1: QMC activation and reporting in UTRAN

1. The NM sends `activateAreaQMCJob` to DM/EM that controls the impacted RNC(s), and includes the parameters: `serviceType`, `areaScope`, `qoECollectionEntityAddress`, `plmNTarget`, `qmcTarget`, `qoEReference` and QMC configuration file.
2. The DM/EM forwards `activateAreaQMCJob` to impacted RNC(s), and includes the parameters: `serviceType`, `areaScope`, `qoECollectionEntityAddress`, `plmNTarget`, `qmcTarget`, `qoEReference` and QMC configuration file.
3. The RNC checks for connections where the UE has the UE Application Layer Measurement Capability [10] that match the criteria for `serviceType` in the `activateAreaQMCJob`.
4. When a connection is found that has the UE Application Layer Measurement Capability [10], the RNC start a UE request session and stores the associated `QoECollectionEntityAddress`, sends the message `RRCConnectionReconfiguration` to the UE, and includes the following: `serviceType`, `qoEReference` and QMC configuration file.
5. The access stratum in the UE sends the AT command `+CAPPLEVMC` to application level and includes the following: `serviceType`, `qoEReference` and QMC configuration file.
6. When the application in the `serviceType` starts, the QMC is initiated.
7. The application layer sends the AT command `+CAPPLEVMR` including a recording session indication that a session has started to the access stratum.
8. The UE sends the message `MeasurementReport` including the recording session indication to the RNC.
9. The RNC sends a notification including the recording session indication to the NM.
10. When the QMC is completed, the recorded information is collected in a QMC report [6], [7], including `qoEReference` and `recordingSessionId`. The `qoEReference`, Client Id [6], [7] in the reporting container (that represent the UE request session), and `recordingSessionId` are needed in the QMC collection entity for post processing purposes.
11. The application layer sends the AT command `+CAPPLEVMR` including `qoEReference` and the QMC report to the access stratum.
12. The UE sends the message `MeasurementReport` including `qoEReference` and the QMC report to the RNC.
13. The RNC sends the QMC report to the MCE associated to the `qoEReference`.

4.1.2 Handling of measurement collection at handover in UTRAN

4.1.2.1 Handover between cells within an RNC

When handover is made, the measurement area is checked.

- If the mobile is inside the measurement area after the handover, the RNC sends in an indication that the UE is inside the measurement area in the `RRConnectionReconfiguration` message [4] to the UE. The UE send the `+CAPPLEVMC` AT command [5] to the application to inform that recording shall start if the application becomes active (when the UE moves into the measurement area).
- If the mobile has moved outside the measurement area, there is no indication that the UE is inside the measurement area in the `RRConnectionReconfiguration` message [4] from the RNC to the UE. The UE sends the `+CAPPLEVMC` AT command [5] to the application to inform that recording shall not be started even if the application becomes active.

4.1.2.2 Handover between RNCs

The figure 4.1.2.2-1 and the text below describes the handling at handover between RNCs.

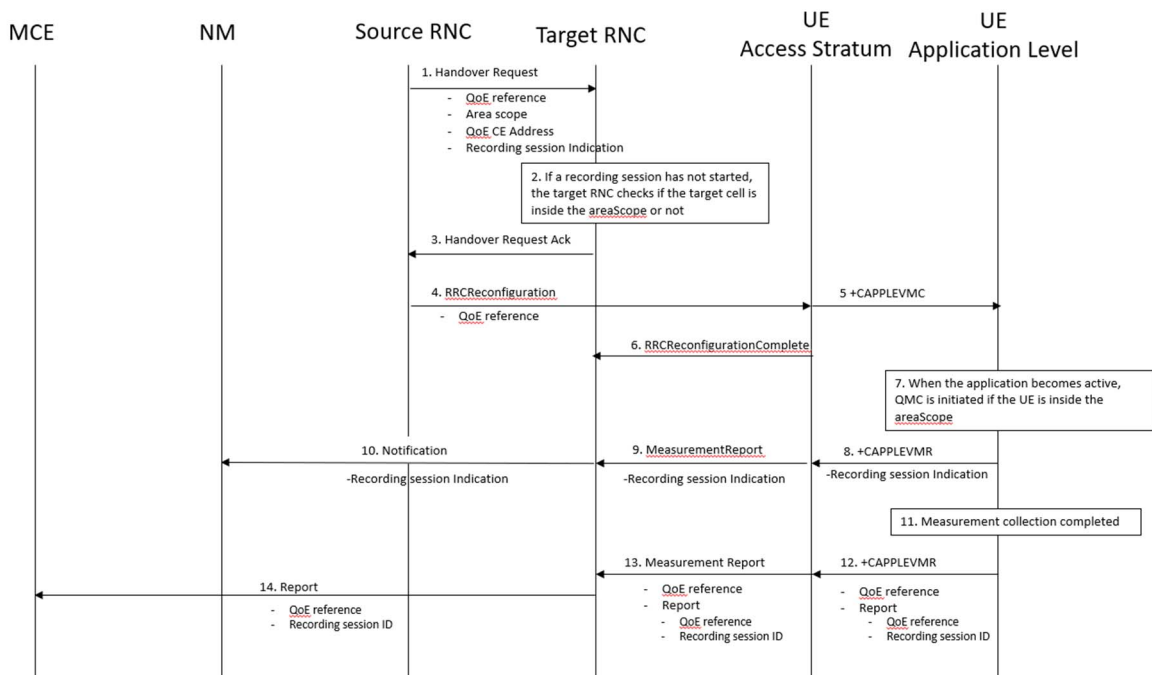


Figure 4.1.2.2-1: Handling of QMC activation in case of handover in UTRAN

1. Source RNC sends the message `HandoverRequest` to Target RNC and includes `areaScope`, `qoECollectionEntityAddress` and a recording session indication indicating whether a recording session has started.
2. If a recording session has not started, the target RNC checks if the target cell is inside the `areaScope` or not.
3. The target RNC sends the message `Handover Request Ack` to the source RNC.
4. The source RNC sends the message `RRCReconfiguration` to the UE.
5. The access stratum in the UE sends the AT command `+CAPPLEVMC` to application level.
6. The UE sends the message `RRCReconfigurationComplete` to the RNC.
7. When the application becomes active, QMC is initiated if the UE is inside the `areaScope`.

8. The application layer sends the AT command +CAPPLEVMR including a recording session indication to the access stratum.
9. The UE sends the message `MeasurementReport` including the recording session indication to the RNC.
10. The RNC sends a notification including the recording session indication to the NM.
11. When the QMC is completed, the recorded information is collected in a QMC report [6] and [7] including `qoEReference` and `recordingSessionId`. The `qoEReference`, `Client Id` [6] and [7] in the reporting container (that represent the UE request session) and `recordingSessionId` are needed in the `QoE` collection entity for post processing purposes.
12. The application layer sends the AT command +CAPPLEVMR including `qoEReference` and the QMC report to the access stratum.
13. The UE sends the message `MeasurementReport` including `qoEReference` and the QMC report to the RNC.
14. The RNC sends the QMC report to the MCE associated to the `qoEReference`.

4.1.3 Deactivation of measurement collection job in UTRAN

4.1.3.1 Forced deactivation in UTRAN

If the operator technician or the management application wants to deactivate a measurement collection job before the pre-set time has expired, the management system sends the `deactivateQMCJob` operation [3] to the RNC. The RNC sets the network request session to ended, but does not delete the `UE request session id` and the `Collection Entity Address` parameters [3], as the UE still may send reports which shall be send to the collection centre. For UE request sessions which have reported that a recording session is started, the RNC sends the `MeasurementControl` message [4] with the `DeactivateJob` request to relevant UEs. The Access stratum sends +CAPPLEVMC AT command [5] to the application with the `DeactivateJob` request. The application stops the recording session and stops recording of the requested information. The `UE request session id` and the `Collection Entity Address` parameters [3] in the RNC are deleted when the UE request session is ended.

4.1.3.2 Deactivation of recording session in UTRAN

Regardless of whether the pre-set time has elapsed or not, the recording session continues to be active until the session for the application is ended.

4.2 Management based activation in LTE

4.2.1 Activation of measurement collection job and reporting of collected information in LTE

The parameters for the network request session are sent from the management system to the eNBs that host the cells that are included in the collection job request in the `activateAreaQMCJob` operation [3]. The eNB starts a network request session, with the `Network request session id` [3] given in `activateAreaQMCJob` operation [3]. For the duration of the network request session, the eNB(s) checks for connections where the UE has the `QoE-MeasReport` capability [8] for collection of streaming services or the `QoE-MTSSI-MeasReport` capability [8] for collection of MTSSI services. The UE capability is sent from the UE to eNB via the core network in message `UE CAPABILITY INFO INDICATION` [9].

When a session is found that has a UE with the wanted UE capability, the eNB starts a UE request session and sends a `RRConnectionReconfiguration` [8] to the UE.

The AT command +CAPPLEVMC [5] activates provisioning of measurement reporting from the lower layers to the application within the UE by an unsolicited result code +CAPPLEVMC. When information about a measurement report is received in the UE from the network, the unsolicited result code +CAPPLEVMC contains the relevant parameters

(service_type, start_stop-indication and config-file & config-file length if applicable) that are provided from the lower layers in the UE to the application.

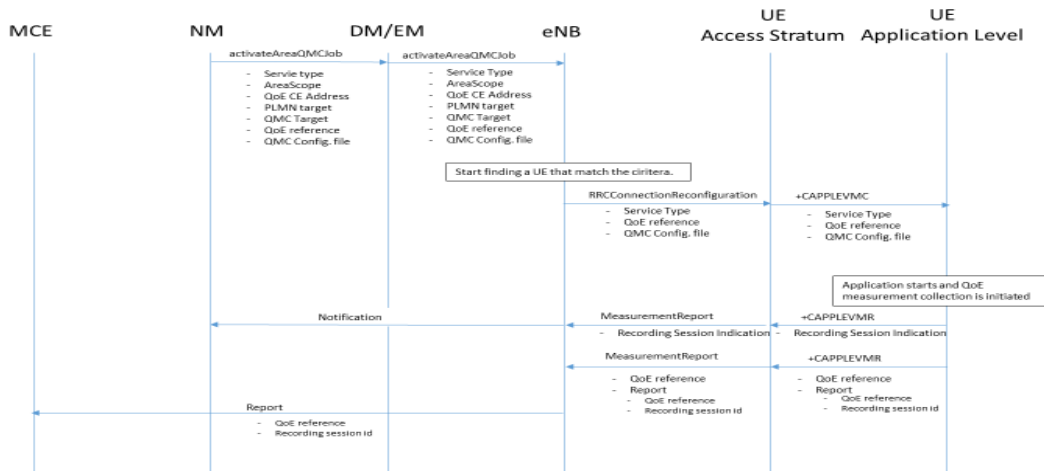


Figure 4.2.1-1: QMC activation and reporting in LTE

1. The NM sends `activateAreaQMCJob` to DM/EM that controls the impacted eNB(s), and includes the parameters: `serviceType`, `areaScope`, `qoECollectionEntityAddress`, `plmnTarget`, `qoETarget`, `qoEReference` and QMC configuration file.
2. The DM/EM forwards `activateAreaQMCJob` to impacted eNB(s), and includes the parameters: `serviceType`, `areaScope`, `qoECollectionEntityAddress`, `plmnTarget`, `qoETarget`, `qoEReference` and QMC configuration file.
3. The eNB checks for connections where the UE has the UE capability [9] that match the criteria for `serviceType` in the `activateAreaQMCJob`.
4. When a connection is found that has the wanted UE capability [9], the eNB starts a UE request session and stores the associated `qoECollectionEntityAddress`, sends the message `RRCConnectionReconfiguration` to the UE, and includes the following: `serviceType`, `qoEReference` and QMC configuration file.
5. The access stratum in the UE sends the AT command `+CAPPLEVMC` to application level and includes the following: `serviceType`, `qoEReference` and QMC configuration file.
6. When the application in the `serviceType` starts, the QMC is initiated.
7. The application layer sends the AT command `+CAPPLEVMR` including a recording session indication that indicates that a session is started to the access stratum.
8. The UE sends the message `MeasReportAppLayer` including the recording session indication to the eNB.
9. The eNB sends a notification including the recording session indication to the NM.
10. When the QMC is completed, the recorded information is collected in a QMC report [6], [7], including `qoEReference` and `recordingSessionId`. The `qoEReference`, Client Id [6] and [7] in the reporting container (that represent the UE request session), and `recordingSessionId` are needed in the QMC collection entity for post processing purposes.
11. The application layer sends the AT command `+CAPPLEVMR` including `qoEReference` and the QMC report to the access stratum.
12. The UE sends the message `MeasReportAppLayer` including `qoEReference` and the QMC report to the eNB.
13. The eNB sends the QMC report to the MCE associated to the `qoEReference`.

4.2.2 Handling of measurement collection at handover in LTE

4.2.2.1 Handover between cells within an eNB

When handover is made and no `Recording session id` is provided, the measurement area is checked.

- If the mobile is inside the measurement area after the handover, the eNB sends in an indication that the UE is inside the measurement area in the `RRCCONNECTIONRECONFIGURATION` message [8] to the UE. The UE send the `+CAPPLEVMC` AT command [5] to the application to inform that recording shall start if the application becomes active (when the UE moves into the measurement area).
- If the mobile has moved outside the measurement area, there is no indication that the UE is inside the measurement area in the `RRCCONNECTIONRECONFIGURATION` message [8] from the eNB to the UE. The UE sends the `+CAPPLEVMC` AT command [5] to the application to inform that recording shall not be started even if the application becomes active.

4.2.2.2 Handover between eNBs

The figure 4.2.2.2-1 and the text below describes the handling at handover between eNBs.

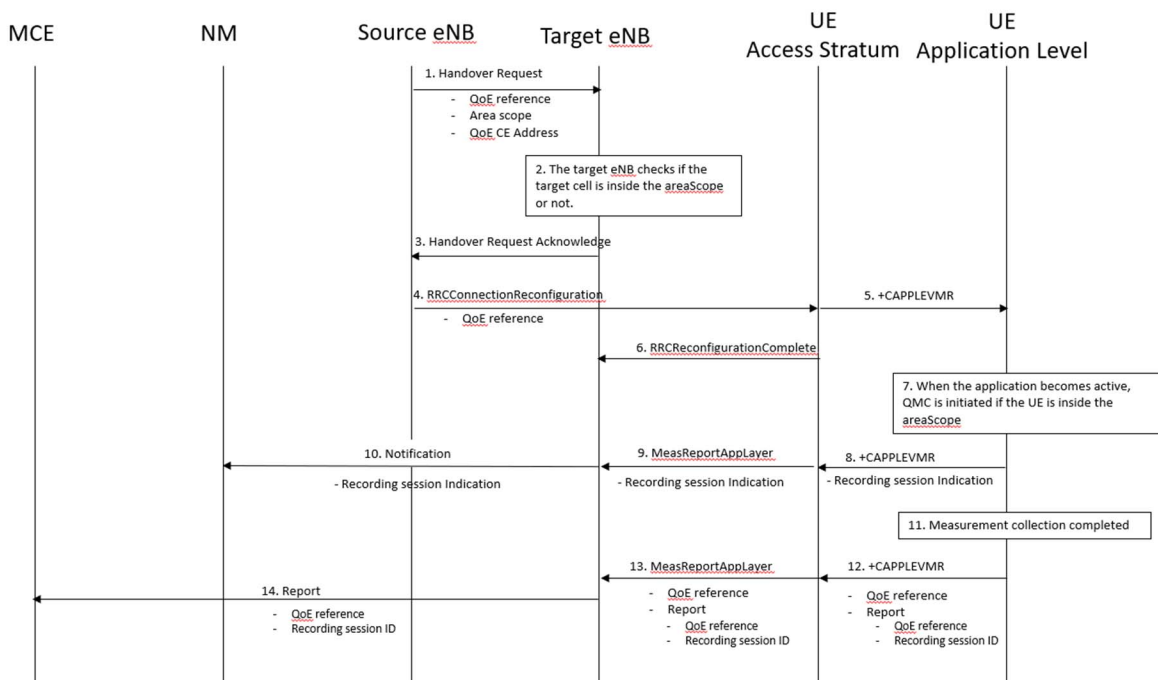


Figure 4.2.2.2-1: Handling of QMC activation in case of handover in LTE

1. Source eNB sends the message `HandoverRequest` to Target eNB and includes `areaScope` and `qoECollectionEntityAddress`.
2. The target eNB checks if the target cell is inside the `areaScope` or not.
3. The target eNB sends the message `HandoverRequestAcknowledge` to the source eNB.
4. The source eNB sends the message `RRCCONNECTIONRECONFIGURATION` to the UE.
5. The access stratum in the UE sends the AT command `+CAPPLEVMC` to application level.
6. The UE sends the message `RRCCONNECTIONRECONFIGURATIONCOMPLETE` to the eNB.
7. When the application becomes active, QMC is initiated if the UE is inside the `areaScope`.

8. The application layer sends the AT command +CAPPLEVMR including a recording session indication indicating that a session has started to the access stratum.
9. The UE sends the message `MeasReportAppLayer` including the recording session indication to the eNB.
10. The eNB sends a notification including the recording session indication to the NM.
11. When the QMC is completed, the recorded information is collected in a QMC report [6] and [7] including `qoEReference` and `recordingSessionId`. The `qoEReference`, Client Id [6] and [7] in the reporting container (that represent the UE request session) and `recordingSessionId` are needed in the QoE collection entity for post processing purposes.
12. The application layer sends the AT command +CAPPLEVMR including `qoEReference` and the QMC report to the access stratum.
13. The UE sends the message `MeasReportAppLayer` including `qoEReference` and the QMC report to the eNB.
14. The eNB sends the QMC report to the MCE associated to the `qoEReference`.

4.2.3 Deactivation of measurement collection job in LTE

4.2.3.1 Forced deactivation

When the operator technician or the management application wants to deactivate a measurement collection job, the management system sends the `deactivateQMCJob` operation [3] to the eNB. The eNB sets the network request session to ended, but does not delete the `UE request session id` and the `Collection Entity Address` parameters [3], as the UE still may send reports which shall be send to the collection centre. For UE request sessions which have reported that a recording session is started, the eNB sends the `RRConnectionReconfiguration` message [8] to relevant UEs. The `RRConnectionReconfiguration` message is including `measConfigAppLayer` set to discard application layer measurement report information in `otherConfig` [8]. The Access stratum sends +CAPPLEVMC AT command [5] to the application with the discard request. The application stops the recording session and stops recording of the requested information. The `UE request session id` and the `Collection Entity Address` parameters [3] in the eNB are deleted when the UE request session is ended.

4.2.3.2 Deactivation of recording session

Regardless of whether the pre-set time has elapsed or not, the recording session continues to be active until the session for the application is ended.

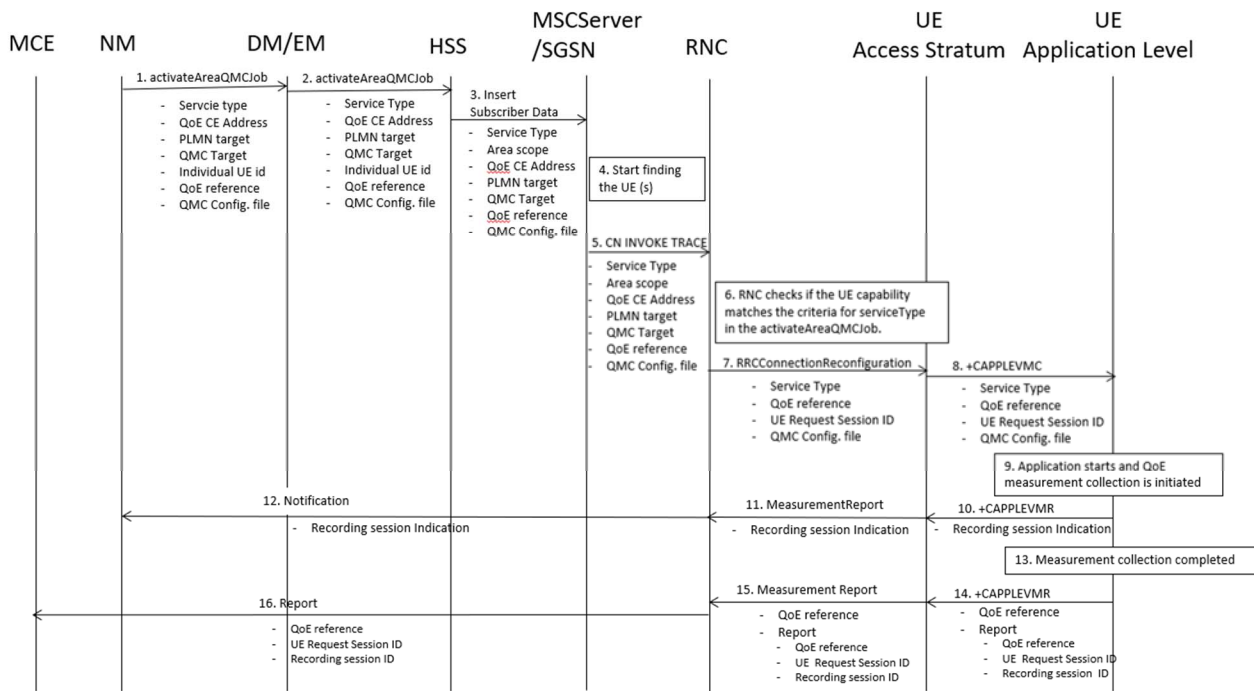
4.2.4 Void

4.3 Signalling based activation in UTRAN

4.3.1 Activation of measurement collection job in UTRAN

In Signalling based activation, the QoE measurement collection is sent to the UE from the OAM via CN. The messages from EMS propagated to HSS, MSE Server/SGSN and RNC. QoE measurement collection activation request is propagated to UE.

When HSS activates the QoE measurement collection for a job, the MSC Server/SGSN can send the QoE measurement collection to the UE through RNC, the following configuration parameters shall be included in the message: `serviceType`, `areaScope`, `qoECollectionEntityAddress`, `PLMNTarget`, `qoETarget`, `qoEReference` and QMC configuration file.



- 1) The NM sends `activateAreaQMCJob` to DM/EM that controls the impacted RNC(s), and includes the parameters: `serviceType`, `areaScope`, `qoECollectionEntityAddress`, `plMNNTarget`, `qMCTarget`, `Individual UE Id`, `qoEReference` and QMC configuration file.
- 2) The DM/EM sends `activateAreaQMCJob` to HSS that controls the impacted RNC(s), and includes the parameters: `serviceType`, `areaScope`, `qoECollectionEntityAddress`, `plMNNTarget`, `qoETarget`, `Individual UE Id`, `qoEReference` and QMC configuration file.
- 3) The HSS sends an `Insert Subscriber Data` to the MSC Server/SGSN that is registered in the HSS in a previous `Update Location Request` message.
- 4) The MSC Server/SGSN starts finding the UE and check if that the UE capability matches the criteria for `ServiceType` in `activateAreaQMCJob`
- 5) The MSC Server/SGSN sends message `CN INVOKE TRACE` to the RNC and includes the parameters: `serviceType`, `areaScope`, `qoECollectionEntityAddress`, `plMNNTarget`, `qoETarget`, `qoEReference` and QMC configuration file.
- 6) The RNC checks for connections where the UE has the `UE Application Layer Measurement Capability` that match the criteria for `serviceType` in the `activateAreaQMCJob`.
- 7) The RNC start a UE request session and stores the associated `QoECollectionEntityAddress`, sends the message `RRCConnectionReconfiguration` to the UE, and includes the following: `serviceType`, `qoEReference` and QMC configuration file.
- 8) The access stratum in the UE sends the AT command `+CAPPLEVMC` to application level and includes the following: `serviceType`, `qoEReference` and QMC configuration file.
- 9) When the application in the `serviceType` starts, the QMC is initiated.
- 10)The application layer sends the AT command `+CAPPLEVMR` including a recording session indication that a session has started to the access stratum.
- 11)The UE sends the message `MeasurementReport` including the recording session indication to the RNC.
- 12)The RNC sends a notification including the recording session indication to the NM.

- 13) When the QMC is completed, the recorded information is collected in a QMC report, including `qoEReference` and `recordingSessionId`. The `qoEReference`, `Client Id`, in the reporting container (that represent the UE request session), and `recordingSessionId` are needed in the QMC collection entity for post processing purposes.
- 14) The application layer sends the AT command `+CAPPLEVMR` including `qoEReference` and the QMC report to the access stratum.
- 15) The UE sends the message `MeasurementReport` including `qoEReference` and the QMC report to the RNC.
- 16) The RNC sends the QMC report to the MCE associated to the `qoEReference`.

4.3.2 Handling of measurement collection at handover in UTRAN

See clause 4.1.2.

4.3.3 Deactivation of measurement collection job in UTRAN

4.3.3.1 Pre-set time has elapsed in UTRAN

When the pre-set time is elapsed, the HSS or SGSN and the RNC sets the network request session to ended, but do not delete the `UE request session id` and the `Collection Entity Address` parameters [3], due to that reports still can come from the UE that has to be transferred to the collection centre. The `UE request session id` and the `Collection Entity Address` parameters [3] are deleted when the session is ended.

4.3.3.2 Forced deactivation in UTRAN

If the operator technician or the management application wants to deactivate a measurement collection job, the management system sends the `deactivateQoEJob` operation [3] to the HSS or SGSN, that propagate it to the RNC. The RNC sets the network request session to ended, but does not delete the `UE request session id` and the `Collection Entity Address` parameters [3], as the UE still may send reports which shall be send to the collection centre. For UE request sessions which have reported that a recording session is started, the RNC sends the `MeasurementControl` message [4] with the `DeactivateJob` request to relevant UEs. The Access stratum sends `+CAPPLEVMC` AT command [5] to the application with the `DeactivateJob` request. The application stops the recording session and stops recording of the requested information. The `UE request session id` and the `Collection Entity Address` parameters [3] in the RNC are deleted when the UE request session is ended.

4.3.3.3 Deactivation of recording session in UTRAN

See clause 4.1.3.3.

4.4 Signalling based activation in LTE

4.4.2 Activation of measurement collection for a UE in LTE

4.4.2.0 General

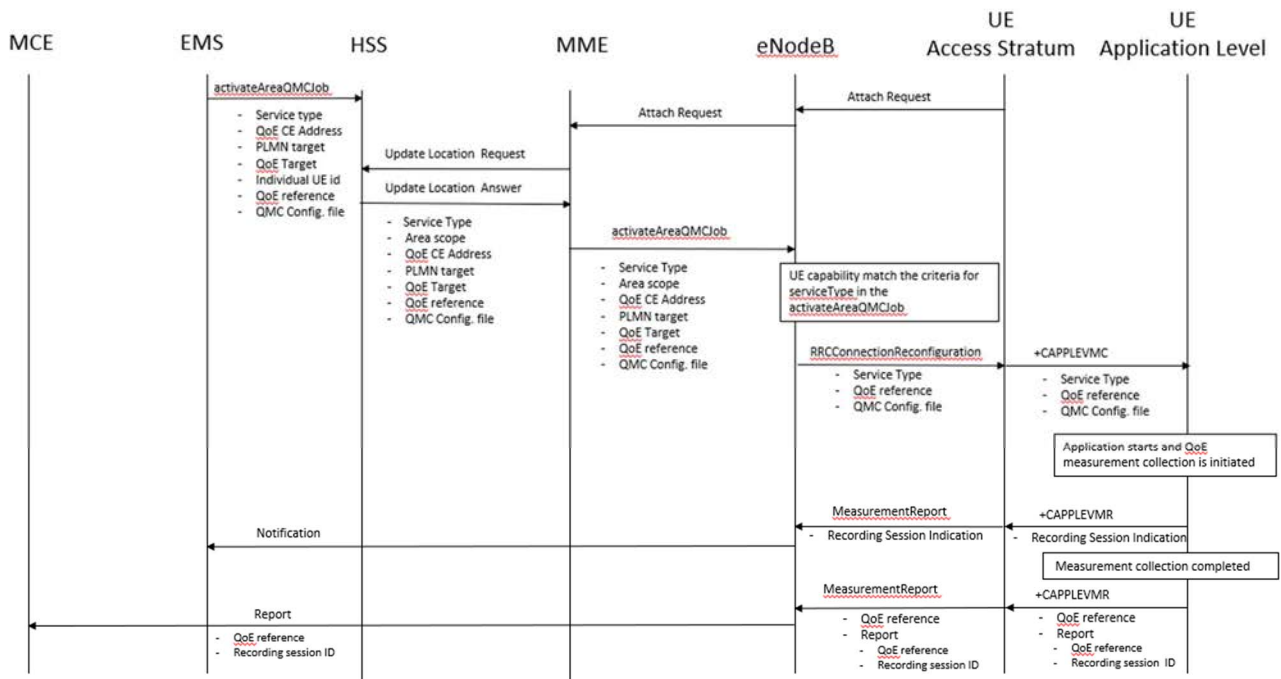
Activation of measurement collection for a UE can be done before UE attachment or after UE is attached.

4.4.2.1 Activation of QoE measurement task before UE attaches to the network

When HSS activates the QoE measurement collection for a job, to the MME the following configuration parameters shall be included in the message: `serviceType`, `areaScope`, `qoECollectionEntityAddress`, `pLMNTarget`, `qoETarget`, `qoEReference` and QMC configuration file.

At UE attachment the configuration parameters for the QoE measurement collection for a job is propagated to the UE.

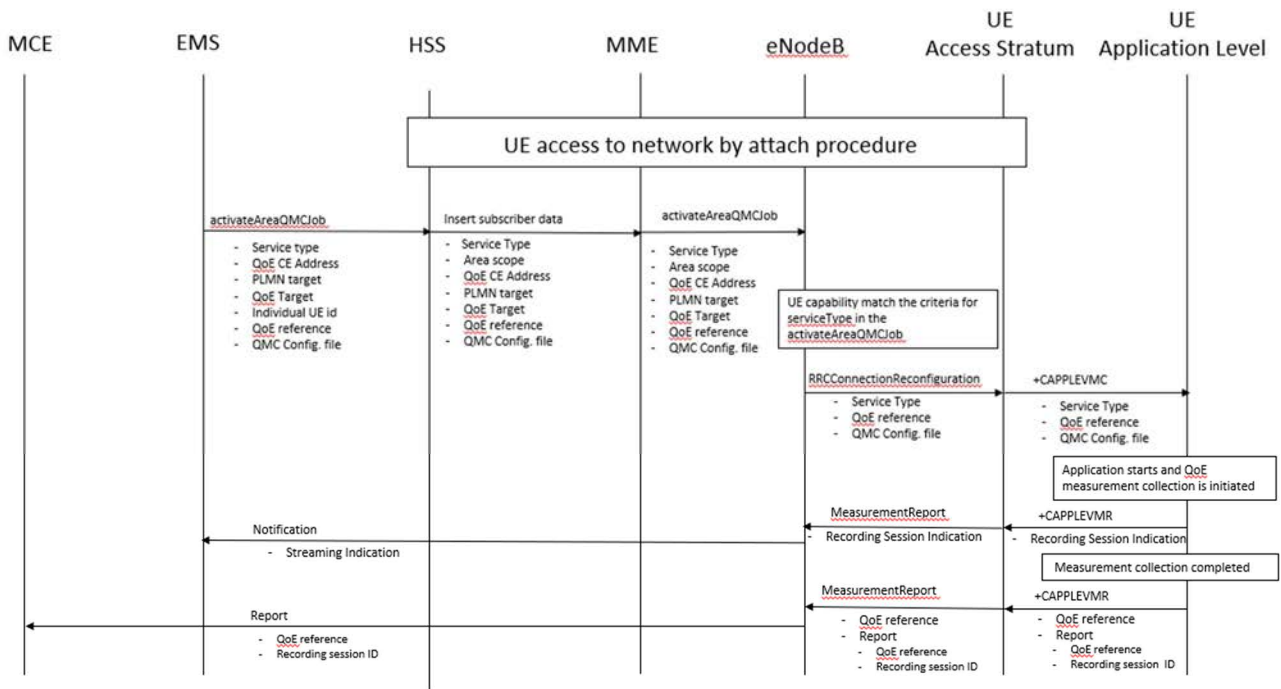
The MME receives and stores QoE measurement collection job as part of Update Location Answer (or Insert Subscriber Information). Then the same procedure for activation of measurement collection job is applied as after UE is attached, described in see 4.4.2.2.



4.4.2.2 Activation of QoE measurement task after UE attachment to the network

The QoE measurement collection is sent to the UE from the OAM via CN. The messages from EMS propagated to HSS, MME and eNodeB are the same as previous section. QoE measurement collection activation request is propagated to UE finally.

When MME can send the QoE measurement collection to the UE through eNodeB, the following configuration parameters shall be included in the message: `serviceType`, `areaScope`, `qoECollectionEntityAddress`, `plmNTarget`, `qoETarget`, `qoEReference` and QMC configuration file. QoE measurement collection activation request is propagated to UE.



- 1) The EMS sends `activateAreaQMCJob` to HSS that controls the impacted eNB(s), and includes the parameters: `serviceType`, `areaScope`, `qoECollectionEntityAddress`, `plMNTarget`, `qoETarget`, `qoEReference` and QMC configuration file.
- 2) The HSS inserts subscriber related data and forwards it to the MME.
- 3) The MME forwards `activateAreaQMCJob` to impacted eNB(s), and includes the parameters: `serviceType`, `areaScope`, `qoECollectionEntityAddress`, `plMNTarget`, `qoETarget`, `qoEReference` and QMC configuration file.
- 4) The eNB checks if the UE capability that matches the criteria for `serviceType` in the `activateAreaQMCJob`.
- 5) If the UE has the wanted UE capability, the eNB starts a UE request session and stores the associated `QoECollectionEntityAddress`, sends the message `RRCConnectionReconfiguration` to the UE, and includes the following: `serviceType`, `qoEReference` and QMC configuration file.
- 6) The access stratum in the UE sends the AT command `+CAPPLEVMC` to application level and includes the following: `serviceType`, `qoEReference` and QMC configuration file.
- 7) When the application in the `serviceType` starts, the QMC is initiated.
- 8) The application layer sends the AT command `+CAPPLEVMR` including a recording session indication that indicates that a session is started to the access stratum.
- 9) The UE sends the message `MeasReportAppLayer` including the recording session indication to the eNB.
- 10) The eNB sends a notification including the recording session indication to the NM.
- 11) When the QMC is completed, the recorded information is collected in a QMC report [6], [7], including `qoEReference` and `recordingSessionId`. The `qoEReference`, Client Id [6] and [7] in the reporting container (that represent the UE request session), and `recordingSessionId` are needed in the QMC collection entity for post processing purposes.
- 12) The application layer sends the AT command `+CAPPLEVMR` including `qoEReference` and the QMC report to the access stratum.

- 13) The UE sends the message `MeasReportAppLayer` including `qoEReference` and the QMC report to the eNB.
- 14) The eNB sends the QMC report to the MCE associated to the `qoEReference`.

4.4.3 Handling of measurement collection at handover in LTE

See clause 4.2.2.

4.4.4 Deactivation of measurement collection for a UE in LTE

4.4.4.1 Pre-set time has elapsed in LTE

When the pre-set time is elapsed, the MME and the eNB sets the network request session to ended, but do not delete the `UE request session id` and the `Collection Entity Address` parameters [3], due to that reports still can come from the UE that has to be transferred to the collection centre. The `UE request session id` and the `Collection Entity Address` parameters [3] are deleted when the session is ended.

4.4.4.2 Forced deactivation in LTE

When the operator technician or the management application wants to deactivate a measurement collection job, the management system sends the `deactivateQMCJob` operation [3] to the MME that propagates to the eNB. The eNB sets the network request session to ended, but does not delete the `UE request session id` and the `Collection Entity Address` parameters [3], as the UE still may send reports which shall be send to the collection centre. For UE request sessions which have reported that a recording session is started, the eNB sends the `RRCCONNECTIONRECONFIGURATION` message [8] to relevant UEs. The `RRCCONNECTIONRECONFIGURATION` message is including `measConfigAppLayer` set to discard application layer measurement report information in `otherConfig` [8]. The Access stratum sends `+CAPPLEVMC` AT command [5] to the application with the discard request. The application stops the recording session and stops recording of the requested information. The `UE request session id` and the `Collection Entity Address` parameters [3] in the eNB are deleted when the UE request session is ended.

4.4.4.3 Deactivation of recording session in LTE

See clause 4.2.3.2.

4.5 Management based activation in NR

4.5.1 Activation of measurement collection job and reporting of collected information in NR

Management Based Activation enables collection of application layer measurements from the UEs in the specified area for specified end user service type.

The parameters for the network request session are sent from the MnS Consumer via the management system to the gNBs that host the cells that are included in the QoE Measurement Collection job request in the Create MOI QMC operation [15]. A QMC Job is activated by creating a QMCJob object instance in the MnS producer.

Figure 4.5.1-1 and the text below describe the activation of QoE measurement collection.

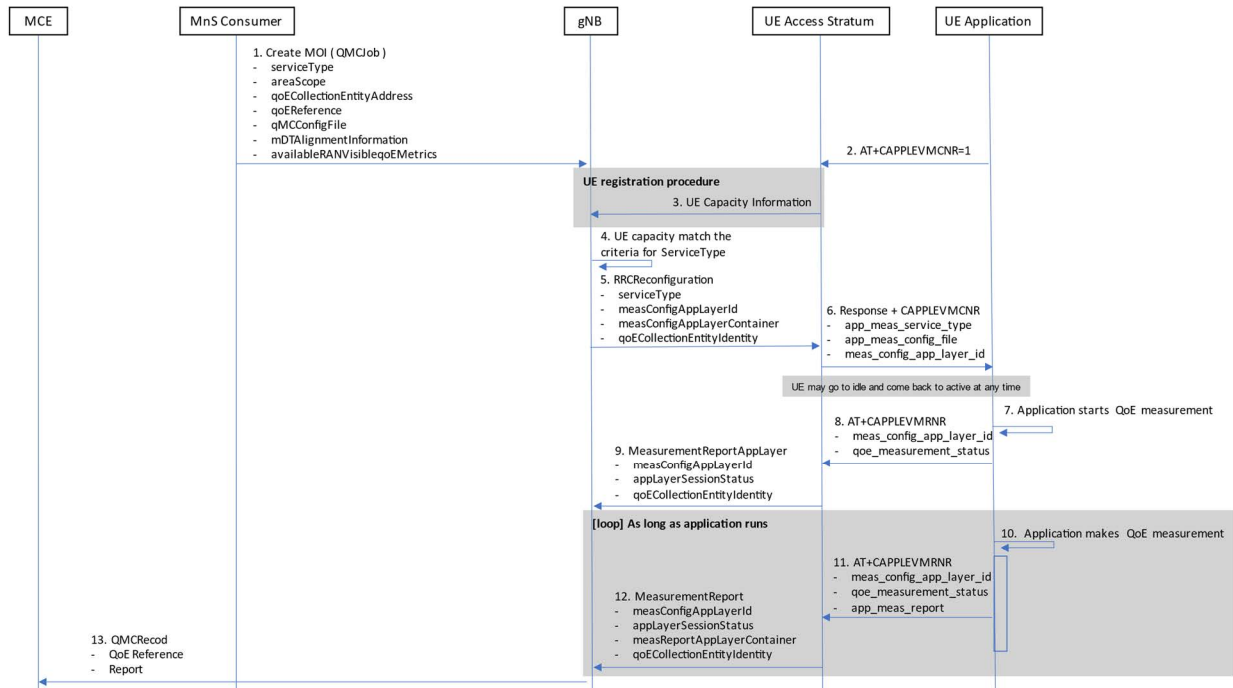


Figure 4.5.1-1: QMC activation example for Management Based Activation and Reporting in NR

- 1) A QoE Measurement Collection Job begins when the MnS Consumer sends createMOI request for QMCJob to the MnS Producer serving the impacted gNB(s), and includes the parameters: `serviceType`, `areaScope`, `qoECollectionEntityAddress`, `qoEReference`, `mDTAlignmentInformation`, `availableRANqoEMetrics` and `qMCConfigFile`. Step 2 and step 3 are asynchronous in time with respect to Step 1; they may occur before or after step 1.

NOTE: The RAN visible QoE measurements are supported for the DASH streaming and VR services.

- 2) Application level measurement configuration. The Application in the UE shall send AT command +CAPPLEVMCNR [5] containing the parameter <n> set to 1 to the Access Stratum. This enables the the Access Stratum to present an unsolicited result code to the Application at a later time. Step 2 and step 3 are asynchronous in time with respect to Step 1; they may occur before or after step 1.
- 3) UE registration procedure. The UE shall register QMC capability with the gNB by setting qoe-Streaming-MeasReport to “supported” in UE-NR-Capability [11]. Step 2 and step 3 are asynchronous in time with respect to Step 1; they may occur before or after step 1.
- 4) The gNB starts a network request session, with the QoE Reference [3] given in createMOI for QMCJob [3]. For the duration of the network request session, the gNB(s) checks for connections where the UE has qoe-Streaming-MeasReport set to “supported” [11] in step 2.
- 5) If a UE has the wanted capability, the gNB stores the associated `qoECollectionEntityAddress` and starts a UE request session by sending RRCReconfiguration to the UE including `serviceType`, `measConfigAppLayerId` (corresponding to the value of `qoEReference` from step 4) and `measConfigAppLayerContainer`.

If QoE measurement configuration pertains to MBS communication service, the gNB translates the `qoECollectionEntityAddress` into `qoECollectionEntityIdentity` and includes `qoECollectionEntityIdentity` in the RRCReconfiguration.

NOTE: The IE `measConfigAppLayerId` indicates the identity of the application layer measurement configuration, see [11].

- 6) The access stratum in the UE sends an unsolicited response to the Application including `app-meas_service_type`, `meas_config_app_layer_id` and `app-meas_config_file`. These

IEs map directly to the IEs in step 5. The unsolicited response is for the AT command +CAPPLEVMCNR [5] which is sent from Application in step 2.

- 7) The QMC Job remains inactive until the Application for the specified `serviceType` initiates service.
- 8) When the Application begins service, it sends the AT command +CAPPLEVMRNR [5], including `meas_config_app_layer_id` and `qoe_measurement_status` to indicate a recording session has started, to the access stratum.
- 9) The UE sends the message `MeasurementReportAppLayer` including `measConfigAppLayerId`, `appLayerSessionStatus`, and `qoeCollectionEntityIdentity` to the gNB to indicate a recording session has started.
- 10) While active, the Application collects measurement reports. When the QMC is completed or at the end of period for periodic report, the recorded information is formatted in a QMC report, see [6] for DASH, [7] for MTSI or [13] for VR.
- 11) When a formatted measurement report is available, the Application sends the AT command +CAPPLEVMRNR [5] including `meas_config_app_layer_id`, `qoe_measurement_status` and `app-meas_report` to the Access Stratum. If the QMC Job has ended, `qoe_measurement_status` is set to indicate the Job has ended.
- 12) When the AT command +CAPPLEVMRNR is received from the Application, the Access Stratum sends the message `MeasurementReportAppLayer` including `measConfigAppLayerId`, `appLayerSessionStatus`, `measReportAppLayerContainer`, and `qoeCollectionEntityIdentity` to the gNB.
- 13) The gNB translates the `qoeCollectionEntityIdentity` into `qoeCollectionEntityAddress` if it is needed, and sends the `QMCRecord` to the MCE associated to the `qoeCollectionEntityAddress`. The report contains the `QoE Reference` from step 4 and `measReportAppLayerContainer` from step 12.

4.5.3 Deactivation of measurement collection job in NR

4.5.3.1 Forced deactivation

When the operator technician or the management application wants to deactivate a measurement collection job, the management system sends the `deactivateQMCJob` operation [3] to the gNB. The gNB sets the network request session to ended, but does not delete the `UE request session id` and the `Collection Entity Address` parameters [3], as the UE still may send reports which shall be sent to the collection centre. For UE request sessions which have reported that a recording session is started, the gNB sends the `RRCReconfiguration` message [11] to relevant UEs. The `RRCReconfiguration` message is including `measConfigAppLayerId` set to discard application layer measurement report information in `otherConfig` [11]. The Access Stratum sends +CAPPLEVMC AT command [5] to the application with the discard request. The application stops the recording session and stops recording of the requested information. The `QoE Reference Id` and the `QoE Collection Entity Address` parameters [3] in the gNB are deleted when the UE request session is ended.

4.5.3.2 Deactivation of recording session

The recording session continues to be active until the session for the Application is ended.

4.5.4 Temporary stop and restart of QoE information reporting during RAN overload in NR

In case of overload in RAN, the gNB may temporarily stop the reporting from the UE by sending the `RRCReconfiguration` message [11] to relevant UEs. The `RRCReconfiguration` message [11] includes

pauseReporting set to TRUE in *appLayerMeasConfig* to temporarily stop application layer measurement reporting. The access stratum continues recording further information until the data storage capacity for the reporting is fully used or the UE request session ends. Then the recorded data is kept until it is reported to the gNB or when the UE request session is ended.

When the overload situation in RAN is ended the gNB restart the reporting from the UE by sending the *RRCReconfiguration* message [11] to relevant UEs. The *RRCReconfiguration* message is including *pauseReporting* set to FALSE in *appLayerMeasConfig* to restart application layer measurement reporting.

The UE application level is not directly affected by the RAN overload.

4.6 Signalling based activation in NR

4.6.1 Activation of measurement collection for a UE in NR

4.6.1.0 General

Activation of measurement collection for a UE can be done after UE is registered or before UE Registration procedure.

4.6.1.1 Activation of QoE measurement task after completion of UE registration procedure

Figure 4.6.1.1-1 and the text below describe the activation of QoE measurement collection after completion of UE registration procedure.

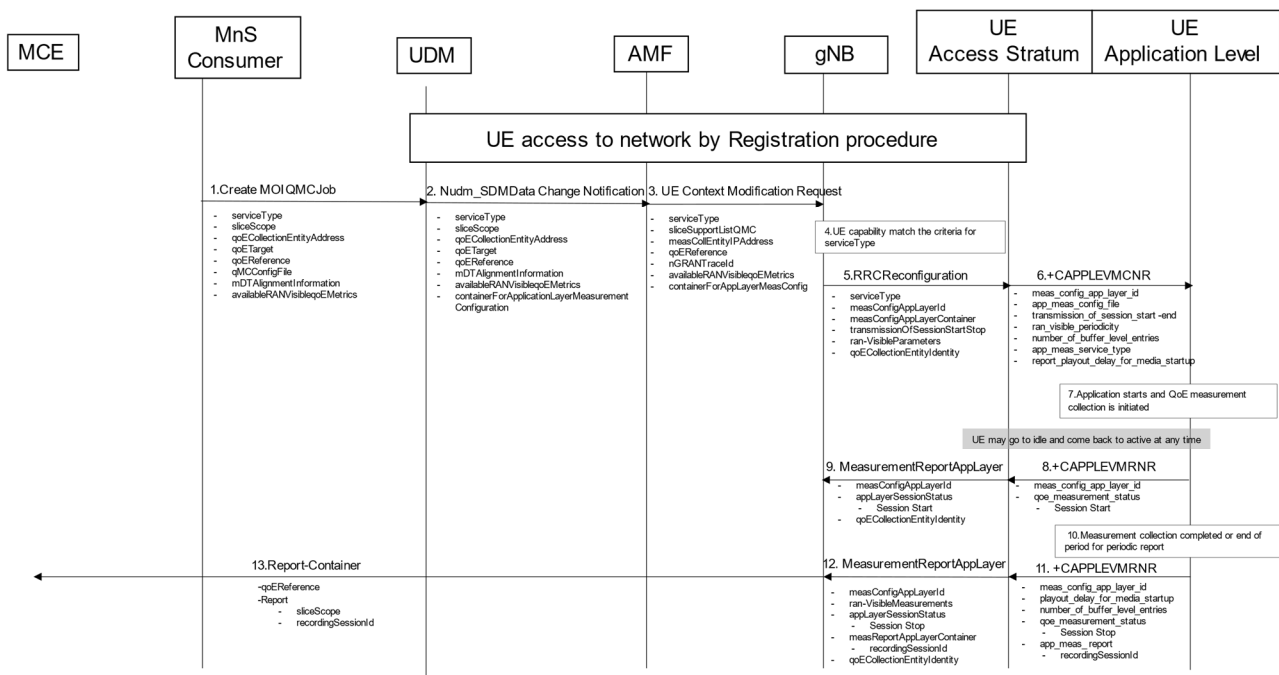


Figure 4.6.1.1-1: QMC activation and reporting example in NR after UE is registered

1. The MnS Consumer sends createMOI request for QMCJob to UDM that controls the impacted gNB(s), and includes the parameters: *serviceType*, *sliceScope*, *qoECollectionEntityAddress*, *qoETarget*, *qoEReference*, *mDTAlignmentInformation*, *availableRANqoEMetrics* and *qMCConfigFile*.
2. The UDM inserts subscriber related data and forwards it to the AMF.

3. The AMF forwards the configuration parameters `serviceType`, `sliceSupportListQMC`, `measCollEntityIPAddress`, `qoEReference`, `nGRANTraceId`, `availableRANqoEMetrics` and `containerForAppLayerMeasConfig` in message UE Context Modification Request to the impacted gNB.
4. The gNB checks if the UE capability matches the criteria for `serviceType` in the QoE measurement configuration information.
5. If the UE has the wanted UE capability, the gNB starts a UE request session and stores the associated `qoECollectionEntityAddress`, sends the message `RRCReconfiguration` to the UE including `serviceType`, `measConfigAppLayerId`, `transmissionOfSessionStartStop`, `ran-VisibleParameters` and `measConfigAppLayerContainer`.

If QoE measurement configuration pertains to MBS communication service, the gNB translates the `qoECollectionEntityAddress` into `qoECollectionEntityIdentity` and includes `qoECollectionEntityIdentity` in the `RRCReconfiguration`.

NOTE: The IE `measConfigAppLayerId` indicates the identity of the application layer measurement configuration, see [11].

6. The access stratum in the UE sends an unsolicited response to the application level including `app-meas_service_type`, `meas_config_app_layer_id`, `transmission_of_session_start_end`, `ran_visible_periodicity`, `number_of_buffer_level_entries`, `report_playout_delay_for_media_startup`, and `app-meas_config_file`. The unsolicited response is for the AT command `+CAPPLEVMCNR` which is sent from UE Application Level to UE Access Stratum during Registration procedure.
7. When the application for the specified `serviceType` starts, the QMC is initiated. To specify the session which is started, the application generates a `recordingSessionId`.
8. The application layer sends the AT command `+CAPPLEVMRNR` [7] including `meas_config_app_layer_id` and `qoe_measurement_status` that indicates that a session is started to the access stratum.
9. The UE sends the message `MeasurementReportAppLayer` including `measConfigAppLayerId`, `appLayerSessionStatus` and `qoECollectionEntityIdentity` to the gNB.
10. When the QMC is completed or at the end of period for periodic report, the recorded information is collected in a QMC report, see [6], [7] or [13].
11. The application layer sends the AT command `+CAPPLEVMRNR` [7] including `meas_config_app_layer_id`, `playout_delay_for_media_startup`, `number_of_buffer_level_entries`, `qoe_measurement_status` indicating that session has ended and `app-meas_report` including `recordingSessionId` to the access stratum.
12. The UE sends the message `MeasurementReportAppLayer` including `measConfigAppLayerId`, `appLayerSessionStatus`, `ran-VisibleMeasurements` and `measReportAppLayerContainer` including `recordingSessionId` and `qoECollectionEntityIdentity` to the gNB.
13. The gNB translates the `qoECollectionEntityIdentity` to the `qoECollectionEntityAddress`, if it is needed, and sends the QMC report to the MCE associated to the `qoEReference`. The report contains the `qoEReference` and the RAN transparent container including the `recordingSessionId` and `sliceScope`, which contains only the S-NSSAI used. Note that the `qoEReference` is mapped to the `measConfigAppLayerId` at gNB on the previous step and is included in QMC report.

4.6.1.2 Activation of QoE measurement task before UE Registration procedure to the network

Figure 4.6.1.2-1 and the text below describe the activation of QoE measurement collection before UE registration procedure to the network.

The AMF receives and stores QoE measurement collection job as part of API: Nudm_SDM. Then the same procedure for activation of measurement collection job is applied as after completion of UE registration procedure, except that instead of UE Context Modification Request the message Initial Context Setup Request is sent, see 4.6.1.1.

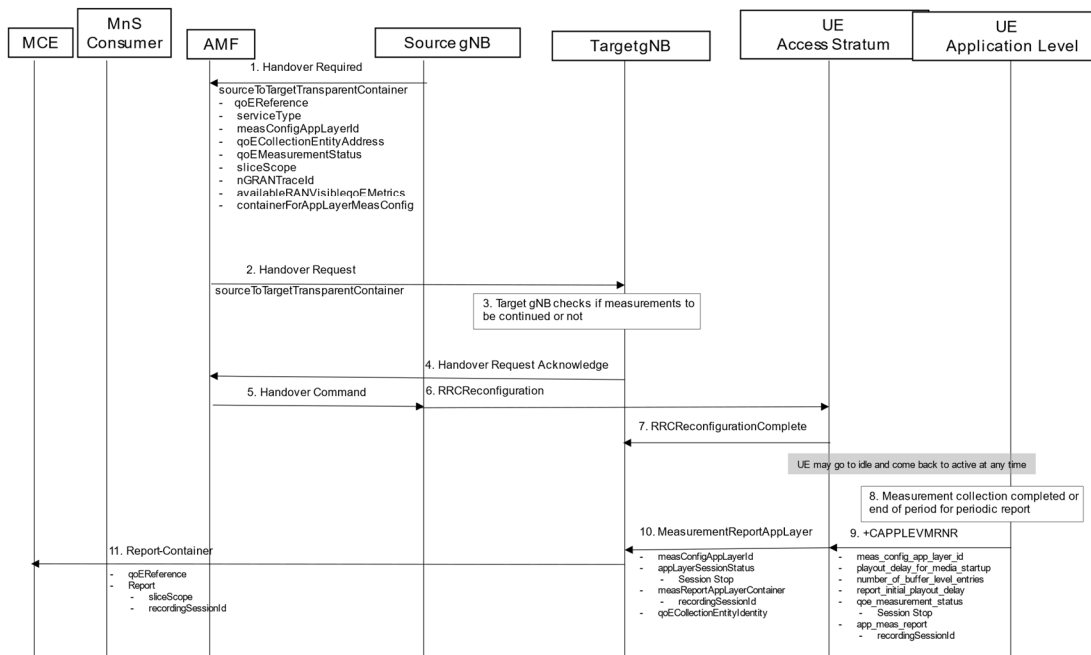


Figure 4.6.1.2-1: QMC activation and reporting example in NR before UE Registration procedure to the network

4.6.2 Handling of measurement collection at handover in NR

4.6.2.1 NG Based Handover for Signalling Based Activation

The figure 4.6.2.1-1 and the text below describe the handling at NG Based handover between gNBs for Signalling Based Activation case.

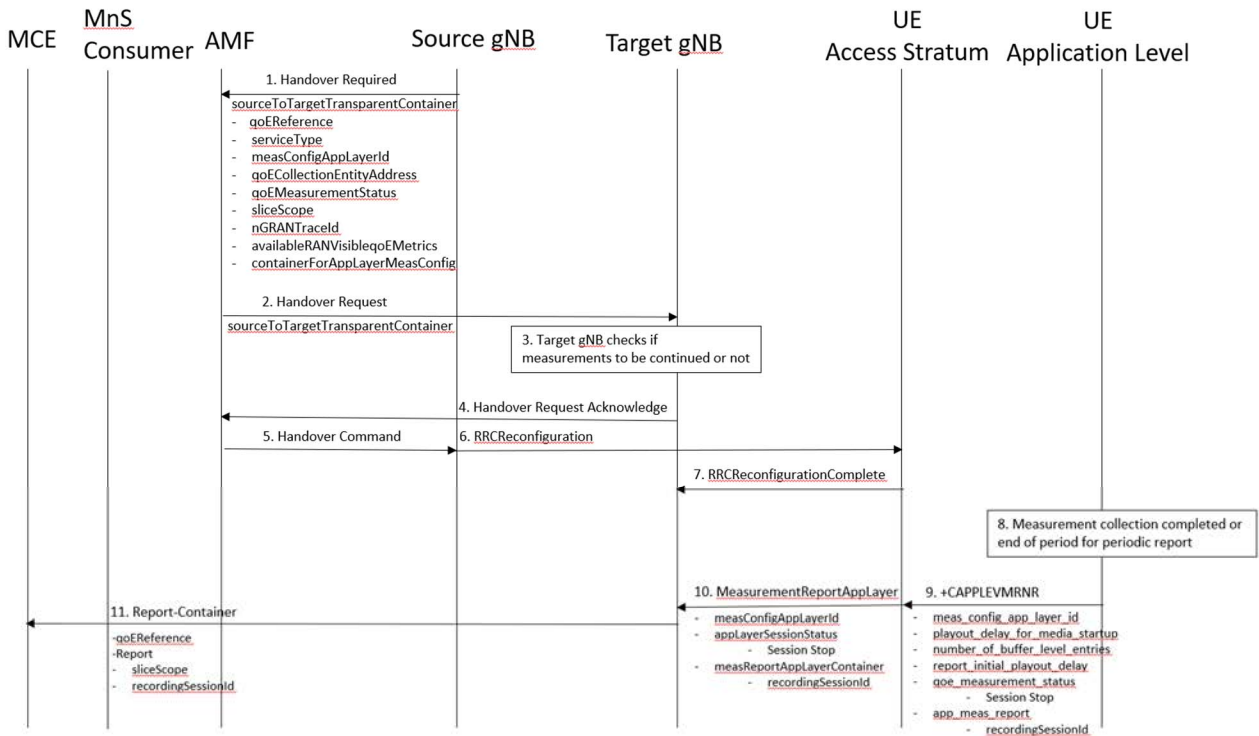


Figure 4.6.2.1-1: Handling of QMC activation example in case of NG Based handover in NR for Signalling Based Activation

1. Source gNB sends the message `HANDOVER REQUIRED` to AMF. The message includes the Source to Target Transparent Container which contains `qoEReference`, `serviceType`, `measConfigAppLayerID`, `measCollEntityIPAddress`, `qoEMeasurementStatus`, `sliceSupportListQMC`, `nGRANTraceId`, `availableRANVisibleqoEMetrics` and `containerForAppLayerMeasConfig`.
2. AMF sends the message `HANDOVER REQUEST` to the Target gNB. The message includes the Source to Target Transparent Container which contains the same parameters as in step 1.
3. The target gNB checks if the measurements will be continued or not.
4. The target gNB sends the message `HANDOVER REQUEST ACKNOWLEDGE` to the AMF.
5. The AMF sends the message `HANDOVER COMMAND` to the source gNB.
6. The source gNB sends the message `RRCReconfiguration` to the UE.
7. The UE sends the message `RRCReconfigurationComplete` to the gNB.
8. When the ongoing QMC is completed or end of periodic reporting is reached, the recorded information is collected in a QMC report, see [6], [7] or [13], at UE Application Level.
9. The application layer sends the AT command `+CAPPLEVMRNR` including `meas_config_app_layer_id`, `qoe_measurement_status`, `playout_delay_for_media_startup`, `number_of_buffer_level_entries`, `report_initial_playout_delay`, and the `app-meas_report` to the access stratum.
10. The UE sends the message `MeasurementReportAppLayer` including `measConfigAppLayerId`, `appLayerSessionStatus`, `measReportAppLayerContainer`, and `qoECollectionEntityIdentity` to the gNB.
11. The gNB translates the `qoECollectionEntityIdentity` into `qoECollectionEntityAddress` and sends the QMC report to the MCE associated to the `qoEReference`. The report contains the `qoEReference` and the RAN transparent container including the `recordingSessionId` and `sliceScope` (which contains

only S-NSSAI that is used). Note that the `qoEReference` is mapped to the `measConfigAppLayerId` at gNB on the previous step and is included in QMC report.

4.6.3 Deactivation of measurement collection for a UE in NR

4.6.3.1 Pre-set time has elapsed in NR

When the pre-set time is elapsed, the gNB sets the network request session to ended, but do not delete the `UE request session id` and the `Collection Entity Address` parameters [3], due to that reports still can come from the UE that has to be transferred to the collection centre. The `UE request session id` and the `Collection Entity Address` parameters [3] are deleted when the session is ended.

4.6.3.2 Forced deactivation in NR

When the operator technician or the management application wants to deactivate a measurement collection job, the management system sends the `deactivateQMCJob` operation [3] to the UDM that propagates to the AMF/gNB . The gNB sets the network request session to ended, but does not delete the `UE request session id` and the `Collection Entity Address` parameters [3], as the UE still may send reports which shall be send to the collection centre. For UE request sessions which have reported that a recording session is started, the gNB sends the `RRCCONNECTIONRECONFIGURATION` message [8] to relevant UEs. The `RRCCONNECTIONRECONFIGURATION` message is including `measConfigAppLayer` set to discard application layer measurement report information in `otherConfig` [8]. The Access stratum sends +CAPPLEVMC AT command [5] to the application with the discard request. The application stops the recording session and stops recording of the requested information. The `UE request session id` and the `Collection Entity Address` parameters [3] in the gNB are deleted when the UE request session is ended.

4.6.3.3 Deactivation of recording session in NR

Regardless of whether the pre-set time has elapsed or not, the recording session continues to be active until the session for the application is ended.

5 Quality of Experience (QoE) measurement management parameters

5.1 QoE collection entity address (M)

This is a parameter which defines the IP address to which the QMC records shall be transferred. Ipv4 or Ipv6 address(es) may be used.

5.2 QoE reference (M)

The QoE reference parameter specify the network request session. The QoE reference shall be globally unique therefore it is composed as follows:

MCC+MNC+QMC ID, where the MCC and MNC are coming with the QMC activation request from the management system to identify one PLMN containing the management system, and QMC ID is a 3 byte Octet String.

The QMC ID is generated by the management system or the operator.

It is used to identify the QoE measurement collection job in the traffic nodes and in the measurement collection centre.

5.3 PLMN target (CM)

This parameter defines the PLMN for which sessions shall be selected in the network request session in case of area based QMC when several PLMNs are supported in the RAN (this means that shared cells and not shared cells are allowed for the specified PLMN. Furthermore, several PLMNs can be used for not shared RAN cases as well as for shared RAN cases.). Only the sessions may be selected where the PLMN that the UE reports as selected PLMN is the same as the PLMN Target.

Note that the PLMN Target might differ from the PLMN specified in the Network Request Session Id, as that specifies the PLMN that is containing the management system requesting the Network Request Session from the NE.

The parameter is mandatory if network sharing is deployed.

5.4 Area scope (CM)

The area scope parameter defines the area in terms of cells or Tracking Area/ Routing Area/ Location Area where the QMC shall take place. If the parameter is not present the QMC shall be done throughout the PLMN specified in PLMN target.

The area scope parameter in UMTS is either:

- List of cells, identified by CGI. Maximum 32 CGI can be defined.
- List of Routing Area, identified by RAI. Maximum of 8 RAIs can be defined.
- List of Location Area, identified by LAI. Maximum of 8 LAIs can be defined.

The area scope parameter in LTE is either:

- list of cells, identified by E-UTRAN-CGI. Maximum 32 CGI can be defined.
- List of Tracking Area, identified by TAC. Maximum of 8 TAC can be defined.

The area scope parameter in NR is either:

- list of cells, identified by N-CGI. Maximum 32 NCGI can be defined.
- List of Tracking Area, identified by TAC. Maximum of 8 TAC can be defined.

The parameter is mandatory if area based QMC is requested.

5.5 QMC configuration file (container) (M)

The QMC configuration file is a container that is specified in Annex L of TS 26.247 [6], clause 16.5 of TS 26.114[7] or clause 9.4 of TS 26.118 [13].

The corresponding parameter name for this container in Radio Resource Control (RRC) Protocol specification is `measConfigAppLayerContainer` in case of NR and LTE, see TS 38.331 [11], TS 25.331 [4] or "Container for application layer measurement configuration" in case of UTRAN, see TS 36.331 [8]

For NR, the QMC configuration file parameter in the management interface defines the location of the container..

5.6 QMC target (M)

The QMC target parameter specifies if the QMC is area based or individual UE based.

- Area based QMC (0)
- Individual UE based QMC (1)

NOTE: Void.

5.7 Recording session id (M)

This parameter shall be a 2 byte octet string. The recording session id shall be the same for the whole session in the application, while for each different session in the application the recording session id shall be changed. The recording session id is generated by the application in the UE.

It is used in the measurement collection centre to identify which session within a UE has collected information in the application.

5.8 Service type (M)

Which kind of service that shall be recorded.

- DASH (0)
- MTSI (1)
- VR (2)

DASH measurements are specified in [6]. MTSI measurements are specific in [7]. VR measurements are specified in TS 26.118 [13].

5.9 Slice scope (CM)

This parameter contains a list of S-NSSAIs (Single Network Slice Selection Assistance Information). A Network Slice end to end is identified by S-NSSAI.

5.10 QoE Target (CM)

This parameter specifies the target object (individual UE) for the QMC in case of signalling based QMC. The `qoeTarget` parameter shall be able to carry "IMSI" or "SUPI".

5.11 Job Id (O)

This parameter presents the job identifier of a QMCJob instance. The `jobId` can be used to associate multiple QMCJob instances.

5.12 Available RAN visible QoE metrics (O)

This parameter indicate available RAN visible QoE metrics to the gNB. The list of available RAN visible metrics are outside the legacy QoE configuration file. This parameter is optional and is valid for NR only.

The gNB 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 the 5GC. Available RAN visible QoE Metrics are: "Application Layer Buffer Level List" and "Playout Delay for Media Startup".

The RAN visible QoE measurements are supported for the DASH streaming and VR services.

5.13 MDT Alignment information (O)

This parameter indicates the MDT measurements with which alignment of QoE measurement is required. This parameter is optional and is valid for NR only.

The gNB may activate the MDT measurements upon/after receiving the MDT activation message from the OAM.

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.

5.14 QoE collection entity identity

This is a parameter which defines the unique identity of the QoE collection entity to which the QMC reports shall be transferred. It is unique per PLMN. This parameter is applicable if QoE measurement configuration pertains to MBS communication service.

Annex A (informative): Change history

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2020-07	SA#88e					Upgrade to version under change control	16.0.0
2021-09	SA#93e	SP-210883	0001	-	F	Aligning with RAN specifications 36.331 and 25.331	16.1.0
2021-12	SA#94e	SP-211454	0004	1	F	Correct the description of QoE reference and PLMN target	16.2.0
2021-12	SA#94e	SP-211453	0003	1	B	Adding Signalling Based Activation for UTRAN and LTE	17.0.0
2022-03	SA#95e	SP-220181	0005	-	B	Adding Management Based Activation and Temporary stop and restart during RAN overload in NR	17.1.0
2022-03	SA#95e	SP-220181	0008		B	Update to include NR and adding VR	17.1.0
2022-06	SA#96	SP-220500	0011	1	F	Adding missing parameters and updating definition	17.2.0
2022-09	SA#97e	SP-220850	0012	-	F	Align Requirements of handling QMC during RAN overload to RAN specifications	17.3.0
2022-09	SA#97e	SP-220855	0014	1	B	Adding Signalling Based Activation for NR	18.0.0
2022-09	SA#97e	SP-220855	0015	1	B	Handling of QoE measurement collection at handover in NR	18.0.0
2022-12	SA#98e	SP-221167	0017	2	F	Clean up	18.1.0
2022-12	SA#98e	SP-221176	0018	1	F	Management based activation in NR correction for SBMA	18.1.0
2022-12	SA#98e	SP-221176	0019	-	B	Add MDT alignment Information and RAN visible QoE Metrics to Handling QMC at Handover	18.1.0
2022-12	SA#98e	SP-221176	0021	-	B	Definition of parameters MDT Alignment Information and Available RAN Visible QoE Metrics	18.1.0
2023-03	SA#99	SP-230204	0022	-	B	Add MDT Alignment Information and RAN visible QoE Metrics to Signalling Based Activation	18.2.0
2023-06	SA#100	SP-230651	0023	-	F	Several editorial Corrections	18.3.0
2023-09	SA#101	SP-230959	0025	-	F	Corrections on Signalling Based Activation for NR	18.4.0
2023-12	SA#102	SP-231494	0026	-	D	Fix API name	18.5.0
2024-03	SA#103	SP-240186	0027	1	F	Rel-18 CR TS28.405 Adding MCE ID	18.6.0
2024-03	SA#103	SP-240167	0028	-	F	Rel-18 CR TS28.405 Missing QoE Deactivation in NR	18.6.0
2024-03	SA#103	SP-240186	0029	-	F	R18 CR 28.405 Rapporteur's clean up	18.6.0

History

Document history		
V18.6.0	May 2024	Publication