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and Evolved Universal Terrestrial Radio Access (E-UTRA);
Radio measurement collection for Minimization of
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Overall description;
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Foreword

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1 Scope

The present document provides an overview and overall description of the minimization of drive tests functionality.

The document describes functions and procedures to support collection of UE-specific measurements for MDT using Control Plane architecture, for both UTRAN, E-UTRAN and NR.

Details of the signalling procedures for single-RAT operation are specified in the appropriate radio interface protocol specification. Network operation and overall control of MDT is described in OAM specifications.

NOTE: The focus is on conventional macro cellular network deployments. In the current release no specific support is provided for H(e)NB deployments.

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 25.133: "Requirements for support of radio resource management (FDD)".
- [3] 3GPP TS 36.133: "Requirements for support of radio resource management (FDD)".
- [4] 3GPP TS 25.331: "Radio Resource Control (RRC); Protocol specification".
- [5] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".
- [6] 3GPP TS 32.422: "Subscriber and equipment trace; Trace control and configuration management".
- [7] 3GPP TS 25.215: "Physical Layer; Measurements (FDD)".
- [8] 3GPP TS 25.225: "Physical Layer; Measurements (TDD)".
- [9] 3GPP TS 36.214: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Layer; Measurements".
- [10] 3GPP TS 36.321: "Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC); Protocol Specification".
- [11] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".
- [12] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access (E-UTRAN); Overall description; Stage 2".
- [13] 3GPP TS 36.314: "Evolved Universal Terrestrial Radio Access (E-UTRA); Layer 2 – Measurements".
- [14] 3GPP TS 25.321: "Medium Access Control (MAC) Protocol Specification".
- [15] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".
- [16] 3GPP TS 38.133: "NR; Requirements for support of radio resource management".

- [17] 3GPP TS 28.552: "Technical Specification Group Services and System Aspects; Management and orchestration; 5G performance measurements".
- [18] 3GPP TS 38.314: "NR; Layer 2 Measurements".
- [19] 3GPP TS 38.215: " NR; Physical layer measurements".
- [20] 3GPP TS 38.213: " NR; Physical layer procedures for control".
- [21] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Immediate MDT: MDT functionality involving measurements performed by the UE in CONNECTED state and reporting of the measurements to RAN available at the time of reporting condition as well as measurements by the network for MDT purposes.

Logged MDT: MDT functionality involving measurement logging by UE in IDLE mode, INACTIVE state, CELL_PCH, URA_PCH states and CELL_FACH state when second DRX cycle is used (when UE is in UTRA) for reporting to eNB/RNC/gNB at a later point in time, and logging of MBSFN measurements by E-UTRA UE in IDLE and CONNECTED modes.

Management Based MDT PLMN List: MDT PLMN List applicable to management based MDT.

MDT measurements: Measurements determined for MDT.

MDT PLMN List: A list of PLMNs where MDT is allowed for a user. It is a subset of the EPLMN list and RPLMN at the time when MDT is initiated.

Signalling Based MDT PLMN List: MDT PLMN List applicable to signalling based MDT.

3.2 Symbols

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

<symbol> <Explanation>

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].

ACK	Acknowledgement
AICH	Acquisition Indicator Channel
BLER	Block Error Rate
BSSID	Basic Service Set Identifier
CA	Carrier Aggregation
CDMA	Code Division Multiple Access
CN	Core Network
CPICH	Common Pilot Channel
DCH	Dedicated CHannel
DL	Downlink
DRX	Discontinuous Reception
ECGI	E-UTRAN Cell Global Identifier

E-CID	Enhanced Cell-ID (positioning method)
E-DCH	Enhanced Uplink DCH
EDGE	Enhanced Data rates for GSM Evolution
E-RUCCH	E-DCH Random Access Uplink Control CHannel
eNB	Evolved NodeB
EPLMN	Equivalent PLMN
E-UTRA	Evolved UTRA
E-UTRAN	Evolved UTRAN
FACH	Forward Access CHannel
FDD	Frequency Division Duplex
FIFO	First Input First Output
FPACH	Fast Physical Access CHannel
GERAN	GSM EDGE Radio Access Network
gNB	Next Generation Node B
GNSS	Global Navigation Satellite System
HESSID	Homogenous Extended Service Set Identifier
HOF	Handover Failure
IMEI-SV	International Mobile Equipment Identity Software Version
IMSI	International Mobile Subscriber Identity
IP	Internet Protocol
ISCP	Interference on Signal Code Power
LA	Location Area
LTE	Long Term Evolution
MAC	Medium Access Control
MBMS	Multimedia Broadcast Multicast Service
MBSFN	MBMS Single Frequency Network
MDT	Minimization of Drive-Tests
NG-RAN	Next Generation RAN
NR	New Radio
OAM	Operation and Maintenance
P-CCPCH	Primary Physical Common Control CHannel
PCH	Paging Channel
PCI	Physical Cell Id
PDCP	Packet Data Convergence Protocol
PH	Power Headroom
PLMN	Public Land Mobile Network
PS	Packet Switched
QCI	QoS Class Identifier
QoS	Quality of Service
RA	Routing Area
RAB	Radio Access Bearer
RAT	Radio Access Technology
RB	Radio Bearer
RF	Radio Frequency
RLC	Radio Link Control
RLF	Radio Link Failure
RNC	Radio Network Controller
RPLMN	Registered PLMN
RRC	Radio Resource Control
RRM	Radio Resource Management
RSCP	Received Signal Code Power
RSRP	Reference Signal Received Power
RSRQ	Reference Signal Received Quality
RSSI	Received Signal Strength Indicator
RTT	Round Trip Time
RTWP	Received Total Wideband Power
SCell	Secondary Cell
SIR	Signal to Interference Ratio
SINR	Signal to Noise plus Interference Ratio
SNR	Signal to Noise Ratio
SON	Self Organizing/Optimizing Network
SRB	Signalling Radio Bearer

SRNC	Serving RNC
SSB	Synchronization Signal Block
SSID	Service Set Identifier
TA	Tracking Area
TCE	Trace Collection Entity
TDD	Time Division Duplex
UE	User Equipment
UL	Uplink
UMTS	Universal Mobile Telecommunication System
UPH	Uplink PH
URA	UTRAN Registration Area
UTRA	Universal Terrestrial Radio Access
UTRAN	Universal Terrestrial Radio Access Network

4 Main concept and requirements

4.1 General

The general principles and requirements guiding the definition of functions for Minimization of drive tests are the following:

1. MDT mode

There are two modes for the MDT measurements: Logged MDT and Immediate MDT. There are also cases of measurement collection not specified as either immediate or logged MDT, such as Accessibility measurements.

2. UE measurement configuration

It is possible to configure MDT measurements for the UE logging purpose independently from the network configurations for normal RRM purposes. However, in most cases, the availability of measurement results is conditionally dependent on the UE RRM configuration.

3. UE measurement collection and reporting

UE MDT measurement logs consist of multiple events and measurements taken over time. The time interval for measurement collection and reporting is decoupled in order to limit the impact on the UE battery consumption and network signalling load.

4. Geographical scope of measurement logging

It is possible to configure the geographical area where the defined set of measurements shall be collected.

5. Location information

The measurements shall be linked to available location information and/or other information or measurements that can be used to derive location information.

6. Time information

The measurements in measurement logs shall be linked to a time stamp.

7. Sensor information

The measurements can be linked to available sensor information that can be used to derive UE orientation in a global coordinate system, the uncompensated barometric pressure and the UE speed.

8. UE capability information

The network may use UE capabilities to select terminals for MDT measurements.

9. Dependency on SON

The solutions for MDT are able to work independently from SON support in the network. Relation between measurements/solution for MDT and UE side SON functions shall be established in a way that re-use of functions is achieved where possible.

10. Dependency on TRACE

The subscriber/cell trace functionality is reused and extended to support MDT. If the MDT is initiated toward to a specific UE (e.g. based on IMSI, IMEI-SV, etc.), the signalling based trace procedure is used, otherwise the

management based trace procedure (or cell traffic trace procedure) is used. Network signalling and overall control of MDT is described in TS 32.422 [6].

The solutions for MDT shall take into account the following constraints:

1. UE measurements

The UE measurement logging mechanism is an optional feature. In order to limit the impact on UE power consumption and processing, the UE measurement logging should as much as possible rely on the measurements that are available in the UE according to radio resource management enforced by the access network.

2. Location information

The availability of location information is subject to UE capability and/or UE implementation. Solutions requiring location information shall take into account power consumption of the UE due to the need to run its positioning components.

5 Functions and procedures

5.1 General procedures

5.1.1 Logged MDT procedures

Support of Logged MDT complies with the principles for IDLE and INACTIVE state measurements in the UE specified in TS 25.133[2], TS 36.133 [3] and TS 38.133 [16] and principles for IDLE and CONNECTED mode MBSFN measurements in the UE specified in TS 36.133 [3].

NOTE: It should be noted the established principles may result in different logged information in different UEs.

Furthermore, measurement logging is differentiated based on UE states in idle mode i.e. camped normally, any cell selection or camped on any cell. The UE shall perform measurement logging in "camped normally" state and "any cell selection" state. In "camped on any cell" state the UE is not required to perform MDT measurement logging (including time and location information).

For Logged MDT, the configuration will always be done in cells of the same RAT type. However, measurements included in the logged MDT report comprises of measurements from the same RAT type (serving cell measurements, intra-frequency and inter-frequency neighbor cell measurements) and different RAT types (inter-RAT neighbor cell measurements).

Logging of MBSFN measurements is only applicable to E-UTRA.

5.1.1.1 Measurement configuration

Logged MDT measurements are configured with a MDT Measurement Configuration procedure, as shown in Figure 5.1.1.1-1.