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Foreword

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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 32.421: "Subscriber and equipment trace: Trace concepts and requirements";

TS 32.422: "Subscriber and equipment trace: Trace control and configuration management";

TS 32.423: "Subscriber and equipment trace: Trace data definition and management";

Additionally, there is a GSM only Subscriber and Equipment Trace specification: 3GPP TS 52.008 [5].

Subscriber and Equipment Trace provide very detailed information at call level on one or more specific mobile(s). This data is an additional source of information to Performance Measurements and allows going further in monitoring and optimisation operations.

Contrary to Performance Measurements, which are a permanent source of information, Trace is activated on user demand for a limited period of time for specific analysis purposes.

Trace plays a major role in activities such as determination of the root cause of a malfunctioning mobile, advanced troubleshooting, optimisation of resource usage and quality, RF coverage control and capacity improvement, dropped call analysis, Core Network, UTRAN, EPC, 5GC, E-UTRAN and NG-RAN procedure validation.

The capability to log data on any interface at call level for a specific user (e.g. IMSI or SUPI) or mobile type (e.g. IMEI or IMEISV), or service initiated from a UE allows getting information which cannot be deduced from Performance Measurements such as perception of end-user QoS during his call (e.g. requested QoS vs. provided QoS), correlation between protocol messages and RF measurements, or interoperability with specific mobile vendors.

Moreover, Performance Measurements provide values aggregated on an observation period, Subscriber and Equipment Trace give instantaneous values for a specific event (e.g., call, location update, etc.).

If Performance Measurements are mandatory for daily operations, future network planning and primary trouble shooting, Subscriber and Equipment Trace is the easy way to go deeper into investigation and network optimisation.

In order to produce this data, Subscriber and Equipment Trace are carried out in the NEs, which comprise the network. The data can then be transferred to an external system (e.g. an Operations System (OS) in TMN terminology, for further evaluation).

1 Scope

The present document describes the mechanisms used for the control and configuration of the Trace, Minimization of Drive Test (MDT) and Radio Link Failure (RLF) reporting functionality at the management system (at the Element Manager (EM) and or Network Manager (NMs) in UMTS and EPS), Network Elements (NEs) and User Equipment (UEs). For Trace functionality, it covers the triggering events for starting/stopping of subscriber/UE activity traced over 3GPP standardized signalling interfaces, the types of trace mechanisms, configuration of a trace, level of detail available in the trace data, the generation of Trace results in the NEs and UE and the transfer of these results to management system. For MDT, it also covers logged MDT and immediate MDT mechanisms in both area based and signalling based scenarios. GSM is excluded from the RAT systems which the present document can be applied to.

The mechanisms for Trace, MDT and RLF reporting activation/deactivation are detailed in clause 4; clause 5 details the various Trace, MDT and RLF reporting control and configuration parameters and the triggering events that can be set in a network. Trace, MDT and RLF reporting concepts and requirements are covered in 3GPP TS 32.421 [2] while Trace and MDT data definition and management is covered in 3GPP TS 32.423 [3].

The conditions for supporting Network Sharing are stated in 3GPP TS 32.421 [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*.

NOTE: Overall management principles are defined in 3GPP TS 32.101 [1].

- [1] 3GPP TS 32.101: "Telecommunication management; Principles and high level requirements".
- [2] 3GPP TS 32.421: "Telecommunication management; Subscriber and equipment trace: Trace concepts and requirements".
- [3] 3GPP TS 32.423: "Telecommunication management; Subscriber and equipment trace: Trace data definition and management".
- [4] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [5] 3GPP TS 52.008: "Telecommunication management; GSM subscriber and equipment trace".
- [6] 3GPP TS 23.060: "General Packet Radio Service (GPRS) Service description; Stage 2".
- [7] 3GPP TS 23.205: "Bearer-independent circuit-switched core network; Stage 2".
- [8] 3GPP TS 23.108: "Mobile radio interface layer 3 specification, core network protocols; Stage 2 (structured procedures)".
- [9] 3GPP TS 23.246: "Multimedia Broadcast/Multicast Service (MBMS); Architecture and functional description".
- [10] 3GPP TS 29.232: "Media Gateway Controller (MGC) - Media Gateway (MGW); interface; Stage 3".
- [11] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".

- [12] 3GPP TS 29.060: "General Packet Radio Service (GPRS); GPRS Tunnelling Protocol (GTP) across the Gn and Gp interface".
- [13] 3GPP TS 25.413: "UTRAN Iu interface Radio Access Network Application Part (RANAP) signalling".
- [14] 3GPP TS 23.218: "IP Multimedia (IM) session handling; IM call model; Stage 2".
- [15] 3GPP TS 23.228: "IP Multimedia Subsystem (IMS); Stage 2".
- [16] 3GPP TS 29.228: "IP Multimedia (IM) Subsystem Cx and Dx Interfaces; Signalling flows and message contents".
- [17] 3GPP TS 29.328: "IP Multimedia Subsystem (IMS) Sh interface; Signalling flows and message contents".
- [18] Enabler Release Definition for OMA Device Management Specifications, version 1.2, The Open Mobile Alliance™ ([URL:http://www.openmobilealliance.org/](http://www.openmobilealliance.org/)).
- [19] 3GPP TS 32.240: "Telecommunication management; Charging management; Charging architecture and principles".
- [20] 3GPP TS 32.260: "Telecommunication management; Charging management; IP Multimedia Subsystem (IMS) charging".
- [21] 3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access".
- [22] 3GPP TS 23.402: "Architecture enhancements for non-3GPP accesses".
- [23] 3GPP TS 36.401: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Architecture description".
- [24] 3GPP TS 32.442: "Telecommunication management; Trace management Integration Reference Point (IRP); Information Service (IS)".
- [25] 3GPP TS 29.273: "Evolved Packet System (EPS); 3GPP EPS AAA interfaces".
- [26] 3GPP TS 29.272: "Evolved Packet System (EPS); Mobility Management Entity (MME) and Serving GPRS Support Node (SGSN) related interfaces based on Diameter protocol".
- [27] 3GPP TS 32.615: "Telecommunication management; Configuration Management (CM); Bulk CM Integration Reference Point (IRP); eXtensible Markup Language (XML) definitions".
- [28] 3GPP TS 32.342: "Telecommunication management; File Transfer (FT) Integration Reference Point (IRP); Information Service (IS)".
- [29] 3GPP TS 29.212: " Policy and Charging Control (PCC);Reference points".
- [30] 3GPP TS 37.320: "Universal Terrestrial Radio Access (UTRA) and Evolved Universal Terrestrial Radio Access (E-UTRA); Radio measurement collection for Minimization of Drive Tests (MDT);Overall description; Stage 2".
- [31] 3GPP TS 25.331: "Radio Resource Control (RRC); Protocol specification"
- [32] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".
- [33] 3GPP TS 24.301: "Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3".
- [34] 3GPP TS 29.274: "3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3".
- [35] 3GPP TS 32.622: "Telecommunication management; Configuration Management (CM); Generic network resources Integration Reference Point (IRP); Network Resource Model (NRM)".

- [36] 3GPP TS 36.413: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol".
- [37] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN): Overall description stage 2".
- [38] 3GPP TS 36.214: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer - Measurements".
- [39] 3GPP TS 32.130: "Network sharing; Concepts and requirements".
- [40] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".
- [41] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2"
- [42] 3GPP TS 38.300: "NR and NG-RAN Overall Description; Stage 2".
- [43] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".
- [44] 3GPP TS 38.401: "NG-RAN; Architecture Description".
- [45] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".
- [46] 3GPP TS 28.541: "Network Resource Model (NRM); Stage 2 and stage 3".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [4] , 23.501 [40], 38.300 [42] 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 [4] , 23.501 [40] or 38.300 [42].

Area based MDT: MDT data is collected from UEs in a specified area. The area is defined as a list of cells (UTRAN or E-UTRAN) or as a list of tracking/routing/location areas. The area based MDT is an enhancement of the management based trace functionality. Area based MDT can be either a logged MDT or Immediate MDT.

Immediate MDT: Collection of UE measurements in connected mode.

Logged MDT: Collection of UE measurements in idle mode.

Logged MBSFN MDT: Collection of MBSFN measurements in idle and connected mode. Applicable only for eUTRAN.

Signalling based MDT: MDT data is collected from one specific UE. The UE that is participating in the MDT data collection is specified as IMEI(SV) or as IMSI. The signalling based MDT is an enhancement of the signalling based subscriber and equipment trace. A signalling based MDT can be either a logged MDT or Immediate MDT.

MBSFN Area: See 3GPP TS 36.300 [37]

MBSFN Area Reserved Cell: See 3GPP TS 36.300 [37]

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [4], 3GPP TS 32.101 [1] , 23.501 [40], 38.300 [42] 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 [4].

AS	Application Server
BGCF	Breakout Gateway Control Function

CSCF	Call Session Control Function
I-CSCF	Interrogating-CSCF
IM CN SS	IP Multimedia Core Network Subsystem
IMEI-TAC	IMEI Type Allocation Code
MBMS	Multimedia Broadcast Multicast Services
MBSFN	MBMS over a Single Frequency Network
MDT	Minimization of Drive Tests
P-CSCF	Proxy - CSCF
RCEF	RRC Connection Establishment Failure
RLF	Radio Link Failure
S-CSCF	Serving-CSCF
TAU	Tracking Area Update

4 Trace/UE measurements activation and deactivation

4.1 Trace Session activation / deactivation for Trace and MDT

4.1.1 Management activation

4.1.1.1 General

In Management activation, the Trace Control and Configuration parameters are sent directly to the concerned NE by its management system in UMTS or EPS (by its EM). This NE shall not propagate the received data to any other NE's - whether or not it is involved in the actual recording of the call.

Once the parameters have been provided, the NE looks for the IMSI or IMEI (IMEISV) passing through it. If it does not have them, these shall be provided to the NE (that performs the trace recording) as part of traffic signalling by the CN.

The following figure represents the management based trace functionality within a PLMN. The figure represents a typical PLMN network. A dotted arrow with "Trace Parameter Configuration" represents the availability of the management based trace functionality at the EM for that domain.

NOTE: There is no propagation of trace parameters in management based trace activation.