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**Digital cellular telecommunications system (Phase 2+) (GSM);  
Universal Mobile Telecommunications System (UMTS);**

**LTE;  
5G;**

**Telecommunication management;  
Subscriber and equipment trace;**

**Trace data definition and management  
(3GPP TS 32.423 version 15.4.0 Release 15)**



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**ETSI**650 Route des Lucioles  
F-06921 Sophia Antipolis Cedex - FRANCE

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Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B  
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## Foreword

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

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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.

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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";**

Subscriber and MS 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 purpose

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 and TRAN end to end 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) 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 MS Trace is the easy way to go deeper into investigation and network optimisation.

In order to produce this data, Subscriber and MS 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).

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# 1 Scope

The present document describes Trace data definition and management. It covers the trace records content, their format and transfer across UMTS networks, EPS networks or 5GS networks. GSM Trace is outside of the scope of this specification..

The present document also describes the data definition for Minimization of Drive Tests (MDT) across UMTS networks or EPS networks.

The objectives of the present document are:

- To provide the descriptions for a standard set of Trace and MDT data;
- To define the common format of trace and MDT records; and
- To define a method for the reporting of Trace and MDT results across the management interfaces.

Clause 4 details the various Trace records content, Annex A provides Trace and MDT report file format, Annex B provides the trace report file conventions and transfer procedure, Annex C provides the trace reporting functional architecture and Annex D provides some trace and MDT files examples. Trace and MDT concepts and requirements are covered in TS 32.421 [2] while Trace control and configuration management are described in 3GPP TS 32.422 [3].

The definition of Trace and MDT data is intended to result in comparability of Trace and MDT data produced in a multi-vendor wireless UMTS and/or EPS network.

The following is beyond the scope of the present document, and therefore the present document does not describe:

- Any notification mechanisms or IRPs for trace. Only file transfer mechanism is specified for trace data transfer;
- Any data compression mechanisms for trace data transfer;
- Any Trace capability limitations (e.g. maximum number of simultaneous traced mobiles for a given NE).

---

# 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 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 32.422: "Telecommunication management; Subscriber and equipment trace: Trace control and configuration management".
- [4] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [5] W3C Recommendation "Extensible Markup Language (XML) 1.0" (Second Edition, 6 October 2000) <http://www.w3.org/TR/2000/REC-xml-20001006>
- [6] W3C Recommendation "Namespaces in XML" (14 January 1999) <http://www.w3.org/TR/1999/REC-xml-names-19990114>

- [7] W3C Recommendation "XML Schema Part 0: Primer" (2 May 2001)  
<http://www.w3.org/TR/2001/REC-xmlschema-0-20010502>
- [8] W3C Recommendation "XML Schema Part 1: Structures" (2 May 2001)  
<http://www.w3.org/TR/2001/REC-xmlschema-1-20010502>
- [9] W3C Recommendation "XML Schema Part 2: Datatypes" (2 May 2001)  
<http://www.w3.org/TR/2001/REC-xmlschema-2-20010502>
- [10] International Standard ISO 8601: 1988 (E) "Representations of dates and times" (1988-06-15)  
<http://www.iso.ch/markete/8601.pdf>
- [11] 3GPP TS 32.300: "Telecommunication management; Configuration Management (CM); Name convention for Managed Objects".
- [12] 3GPP TS 32.622: "Telecommunication management; Configuration Management (CM); Generic network resources Integration Reference Point (IRP): Network Resource Model (NRM)".
- [13] 3GPP TS 29.274: "3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3".
- [14] 3GPP TS 29.212: "Policy and Charging Control (PCC);Reference points".
- [15] 3GPP TS 29.273: "Evolved Packet System (EPS); 3GPP EPS AAA interfaces".
- [16] 3GPP TS 36.413: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP)".
- [17] 3GPP TS 36.423 "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 Application Protocol (X2AP)".
- [18] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".
- [19] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2"
- [20] 3GPP TS 38.300: "NR and NG-RAN Overall Description; Stage 2".
- [21] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".
- [22] 3GPP TS 38.401: "NG-RAN; Architecture Description".
- [23] 3GPP TS 38.413: "NG-RAN; NG Application Protocol (NGAP)".
- [24] 3GPP TS 38.423: "NG-RAN; Xn Application Protocol (XnAP)".
- [25] 3GPP TS 38.463: "NG-RAN; E1 Application Protocol (E1AP)".
- [26] 3GPP TS 38.473: "NG-RAN; F1 Application Protocol (F1AP)".
- [27] 3GPP TS 24.501: "Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3".
- [28] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".
- [29] 3GPP TS 23.107: "Quality of Service (QoS) concept and architecture".
- [30] 3GPP TS 25.331: "Radio Resource Control (RRC); Protocol specification".
- [31] 3GPP TS 36.314: "Evolved Universal Terrestrial Radio Access (E-UTRA); Layer 2 - Measurements".
- [32] 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".
- [33] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".

- [34] 3GPP TS 36.133: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management".
- [35] – [47] Void
- [48] 3GPP TS 33.401: "System Architecture Evolution (SAE); Security architecture".
- [49] 3GPP TS 33.501: "Security architecture and procedures for 5G system".

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## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TS 32.421 [2], 3GPP TS 32.422 [3], TS 23.501 [18], TS 38.300 [20], TS 38.401 [22], TS 37.320 [32] and the following apply.

**Minimum Level of detail:** Allows for retrieval of a decoded subset of the IEs contained in the signalling interface messages.

**Medium Level of detail:** Allows for retrieval of the decoded subset of the IEs contained in the signalling interface messages in the Minimum Level plus a selected set of decoded radio measurement IEs.

**Maximum Level of detail:** Allows for retrieval of signalling interface messages within the Trace Scope in encoded format.


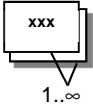






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## 3.2 Symbols

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

	: Element named xxx The maximum number of occurrence is 1
	: Element named xxx The maximum number of occurrence is unbounded
	: Global element
	The XML element has a value part
	: Required element
	: Optional element
	: Sequence
	: Choice

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [4], TS 32.101 [1], TS 23.501 [18], TS 38.300 [20] and TS 38.401 [22] and TS 37.320 [32] apply.

NSA                      Non Stand Alone

## 4 Trace record contents

### 4.1 General

The trace reference, trace type and operation system identification are all provided on trace activation.

Each record may contain an MSC Server, MGW, SGSN, GGSN, S-CSCF, P-CSCF, UTRAN, HSS, MME, Serving GW, E-UTRAN, AUSF, AMF, NEF, NRF, NSSF, PCF, SMF, SMSF, UDM, UPF, AF and , ng-eNB, gNB-CU-CP, gNB-CU-UP and gNB-DU event record. A key is included in the table indicating whether or not the field is mandatory.

The following table shows the template for trace record description for minimum and medium trace depth:

Interface name	Protocol name	IE name	Message name(s)	Trace depth		Notes
				Min	Med	

**Interface name:** Contains the name of the interface, where the IE is available.

**Protocol name:** Contains the protocol name on the interface, where the IE is available.

**IE name:** The name of the Information Element, which should be decoded.

**Message name(s):** The name of the message(s), where the IE is included.

**Trace depth:** Shows in which trace depth the IE should be recorded. It also classifies whether the IE is mandatory in the trace record or not (M, O or X: meaning described in the previous table)

<b>M</b>	Mandatory	This field must be in the trace record if it is available, i.e. if the message appears during the trace recording session and the IE is present in the message.
<b>O</b>	Optional	This field is optional and its support is a matter for agreement between equipment manufacturer and network operator.
<b>X</b>	Not applicable	This field is not required in this instance.
<b>CM</b>	Conditional Mandatory	This field must be in the trace record if it is available and the condition is met.

NOTE: Any kind of comments related to the IE can be made here. Also this is the placeholder for referencing the relevant 3GPP specifications, which define the IE.

Receiving entities may be outside an operator's secure domain. For any IEs or parts of IEs containing security keys as specified in subclause 6.2 of 3GPP TS 33.401 [48] and subclause 6.2.2.1 of TS 33.501 [49] (e.g. **K<sub>eNB</sub>**) the value 0 shall be written in the trace file.

## 4.2 MSC Server Trace Record Content

The following table shows the trace record content for MSC Server.  
The trace record is the same for management based activation and for signalling based activation.  
For MSC Server, the Minimum level of detail shall be supported.

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Interface name	Prot. name	IE name	Message name(s)	Trace depth		Notes
				Min	Med	
lu, A	CC	Facility	ALERTING CALL PROCEEDING CONNECT DISCONNECT FACILITY RELEASE RELEASE COMPLETE SETUP	M	M	TS 24.008 TS 24.080
		Bearer capability	CALL CONFIRMED CALL PROCEEDING EMERGENCY SETUP MODIFY MODIFY COMPLETE MODIFY REJECT SETUP	M	M	TS 24.008
		Cause	CALL CONFIRMED CONGESTION CONTROL DISCONNECT HOLD REJECT MODIFY REJECT RELEASE RELEASE COMPLETE RETRIEVE REJECT START DTMF REJECT STATUS	M	M	TS 24.008
		Connected number	CONNECT	M	M	TS 24.008
		Calling party BCD number	SETUP	M	M	TS 24.008
		Called party BCD number	SETUP	M	M	TS 24.008
		Redirecting party BCD number	SETUP	M	M	TS 24.008
lu, A	MM	Reject cause	AUTHENTICATION FAILURE CM SERVICE REJECT ABORT LOCATION UPDATING REJECT MM STATUS	M	M	TS 24.008
		Location area identification	CM RE-ESTABLISHMENT REQUEST LOCATION UPDATING ACCEPT LOCATION UPDATING REQUEST TMSI REALLOCATION COMMAND	M	M	TS 24.008
		Mobile identity	CM RE-ESTABLISHMENT REQUEST CM SERVICE REQUEST IDENTITY REQUEST IDENTITY RESPONSE IMSI DETACH INDICATION LOCATION UPDATING ACCEPT LOCATION UPDATING REQUEST TMSI REALLOCATION COMMAND	M	M	TS 24.008
		CM service type	CM SERVICE REQUEST	M	M	TS 24.008
		Location updating type	LOCATION UPDATING REQUEST	M	M	TS 24.008
		Facility	FACILITY REGISTER RELEASE COMPLETE	M	M	TS 24.008

		Cause	RELEASE COMPLETE	M	M	TS 24.008
Iu, A	SMS	TP-Originating-Address	SMS-DELIVER	M	M	TS 23.040
		TP-Service-Centre- Time-Stamp	SMS-DELIVER SMS-SUBMIT-REPORT SMS-STATUS-REPORT	M	M	TS 23.040
		TP-Failure-Cause	SMS-DELIVER-REPORT SMS-SUBMIT-REPORT	M	M	TS 23.040
		TP-Destination-Address	SMS-SUBMIT SMS-COMMAND	M	M	TS 23.040
		TP-Recipient-Address	SMS-STATUS-REPORT	M	M	TS 23.040
		A	BSSMAP	Channel Type	ASSIGNMENT REQUEST HANDOVER REQUEST	M
Circuit	ASSIGNMENT REQUEST			M	M	TS 48.008
Cell Identifier (Serving)	ASSIGNMENT COMPLETE HANDOVER REQUEST HANDOVER COMMAND HANDOVER PERFORMED PERFORM LOCATION REQUEST			M	M	TS 48.008
Chosen Channel	ASSIGNMENT COMPLETE HANDOVER REQUEST ACKNOWLEDGE HANDOVER PERFORMED			M	M	TS 48.008
Speech version (chosen)	ASSIGNMENT COMPLETE HANDOVER REQUEST HANDOVER REQUIRED HANDOVER REQUEST ACKNOWLEDGE HANDOVER PERFORMED			M	M	TS 48.008
Cause	ASSIGNMENT FAILURE HANDOVER REQUEST HANDOVER REQUIRED HANDOVER FAILURE CLEAR REQUEST CLEAR COMMAND HANDOVER PERFORMED HANDOVER REQUIRED REJECT			M	M	TS 48.008
RR Cause	ASSIGNMENT FAILURE HANDOVER COMPLETE HANDOVER FAILURE			M	M	TS 48.008
Cell Identifier (target)	HANDOVER REQUEST			M	M	TS 48.008
Current Channel type 1	HANDOVER REQUEST HANDOVER REQUIRED			M	M	TS 48.008
Cell Identifier List (Preferred)	HANDOVER REQUIRED PAGING			M	M	TS 48.008
IMSI	PAGING COMMON ID			M	M	TS 48.008
Location Type	PERFORM LOCATION REQUEST			M	M	TS 48.008
Location Estimate	PERFORM LOCATION RESPONSE			M	M	TS 48.008
LCS Cause	PERFORM LOCATION RESPONSE PERFORM LOCATION ABORT			M	M	TS 48.008