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Technical Specification

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Subscriber and Equipment Trace
(Release 5)

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Contents

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:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

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.

Introduction

[Editor's note: This document (TS 32.108 v0.0.2) contains the draft TS 32.108 (for Rel5).

The text within the draft is partially from GSM 12.08 and partially from SA5 contributions, as agreed by SA5#23 - SA5#25. Editor's notes are used to clarify the source of each part of text.

The draft will be reviewed and further developed in following SA5 meetings.]

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 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 UTRANend to end UMTS procedure validation.

The capability to log data on any interface at call level for a specific user (IMSI) or mobile type (IMEI) 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, contrary to Performance Measurements that provide values aggregated on an observation period, Subscriber and Equipment Trace give instantaneous values that are more accurate.

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 UMTS 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

[Editor's note: The text is still partly from 12.08. More updating needed.]

This Technical Specification (TS) specifies the Trace facility for 3G mobile networks where it refers to:

- Subscriber tracing (tracing of IMSI or Public ID);
- Equipment tracing (tracing of IMEI).

It does not cover:

- Types of trace which relate more to network elements than to individual subscribers e.g. tracing events within a Base Station System (BSS), and so on;
- Tracing of all possible parties in e.g. a multi-party call, (although multiple calls related to the IMSI specified in the trace type field are traceable).

The control signalings on different interfaces and the characteristics of user data are within the scope of this TS, but not the actual contents of the user data.

This TS does not specify any notification mechanisms or IRPs for trace. Only file transfer mechanism is specified for trace data transfer.

This TS does not specify any data compression mechanisms for trace data transfer.

2 References

[Editor's note: The references are solely from 12.08. Update needed.]

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*.

[<seq>] <doctype> <#>[([up to and including]{yyyy[-mm]|V<a[.b[.c]]>}[onwards])]: "<Title>".

[1] GSM 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[2] GSM 04.08: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 specification".

[3] GSM 08.06: "Digital cellular telecommunications system (Phase 2+); Signalling transport mechanism specification for the Base Station System – Mobile-services Switching Centre (BSS - MSC) interface".

[4] GSM 08.08: "Digital cellular telecommunications system (Phase 2+); Mobile Switching Centre - Base Station System (MSC - BSS) interface Layer 3 specification".

[5] GSM 08.58: "Digital cellular telecommunications system (Phase 2+); Base Station Controller - Base Transceiver Station (BSC - BTS) interface Layer 3 specification".

[6] GSM 09.02: "Digital cellular telecommunications system (Phase 2+); Mobile Application Part (MAP) specification".

[7] GSM 12.00 (ETS 300 612-1): "Digital cellular telecommunications system (Phase 2); Objectives and structure of Network Management (NM)".

[8] GSM 12.01 (ETS 300 612-2): "Digital cellular telecommunications system (Phase 2); Common Aspects of GSM Network Management (NM)".

[9] GSM 12.02: "Digital cellular telecommunications system (Phase 2+); Subscriber, Mobile Equipment (ME) and services data administration".

[10] GSM 12.05: "Digital cellular telecommunications system (Phase 2+); Subscriber related event and call data".

[11] GSM 12.20 (ETS 300 622): "Digital cellular telecommunications system (Phase 2); BSS Management Information".

[12] CCITT Recommendation X.227 - ISO 8650: "Information technology - Open Systems Interconnection - Connection-oriented protocol for the association control service element: Protocol specification".

[13] CCITT Recommendation X.721 (ITU -1): "Information technology - Open Systems Interconnection - Structure of management information: Definition of management information".

[14] CCITT Recommendation X.734 (ITU -5): "Information technology - Open Systems Interconnection - Systems Management: Event report management function".

[15] CCITT Recommendation X.735 (ITU -6): "Information technology - Open Systems Interconnection - Systems Management: Log control function".

[16] CCITT Recommendation X.731 (ITU -2): "Information technology - Open Systems Interconnection - Systems Management: State management function".

[17] GSM 03.79: "Digital cellular telecommunications system (Phase 2+); Support of Optimal Routeing (SOR) - Technical Realisation".

[18] GSM 03.63: "Digital cellular telecommunications system (Phase 2+); Packet Data on Signalling channels service (PDS); Service description, Stage 2".

3 Definitions, symbols and abbreviations

[Editor's note: All terminology shall be checked to ensure consistency with TSs 32.101 and 32.102.]

3.1 Definitions

[Editor's note: The definitions are from 12.08 and need to be checked and updated.]

For the purposes of the present document, the following terms and definitions apply.

activation of a trace: An action taken at the OSF through MMI commands to allow a trace record to be produced for a particular IMSI or IMEI when an Invocation Event occurs. This equates to "activation of a trace" in GSM 09.02 [6].

active pending: The state of an activated trace is called Active Pending in a particular NE when the subscriber or equipment being traced is not registered in that NE.

invocation of a trace: An event relating to a particular IMSI or IMEI that occurs in the network that causes data to be collected in a trace record in circumstances where trace has been activated for that IMSI or IMEI. This equates to "tracing subscriber activity" in GSM 09.02 [6] and "Trace Invocation" in GSM 08.08 [4]. It is possible that an event

relating to the IMSI/IMEI may still be active when another event or events relating to the same IMSI/IMEI occurs which requires additional information to be collected. These additional events are termed parallel events. This additional trace information for parallel events is collected in the same trace record as the first event.

trace record: In the NEF a trace record is a set of traceable data collected as determined by the trace type. The trace record is collected under the trace record criteria specified by the OSF and transferred to the OSF.

3.2 Symbols

[Editor's note: Shall be checked later.]

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

Symbol format

<symbol> <Explanation>

3.3 Abbreviations

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

[Editor's note: Shall be checked later. In 12.08 only a reference to GSM 01.04 existed here.]

Abbreviation format

<ACRONYM> <Explanation>

4 Concepts and Requirements

[Editor's note: Text taken from SA5#22 contribution S5B010509 with corrections agreed in SA5#23, which was previously in this clause, has been moved to annex C. This clause is the current assumption for the place to hold the concepts and the detailed requirements for trace. The contents for this clause will be further developed after SA5#25bis.]

4.1 Requirements for Trace Activation

The high level requirements for trace activation are as follows:

- In case of subscriber trace the trace will be activated for a certain subscriber whose identification (IMSI or Public ID) must be known in the NEs where subscriber trace is needed,

- In case of equipment trace the trace will be activated for a certain mobile equipment whose identification (IMEI) must be known in the NEs where equipment trace is needed,

- Trace activation shall be possible for both home subscribers and visiting subscribers,

- In addition to the subscriber identification for subscriber trace and the equipment identification for equipment trace a unique trace identification (the method is sill FFS) is needed to correctly identify and combine trace data from different sources,

- Trace can be activated either through the management interfaces or through CN signalling.

[Editor's note: Requirements for trace activation in UTRAN in case of simultaneous CS/PS connections is FFS.]

4.2 Requirements for Trace Deactivation

[Editor's note: Requirements for trace deactivation in UTRAN in case of simultaneous CS/PS connections is FFS.]

4.3 Requirements for Trace Data

4.4 Requirements for Trace Reporting

4.5 Trace Concepts

4.6 Use Cases for Trace

The operator can use subscriber and equipment trace for numerous different purposes. However, the use cases for trace can be divided into two basic categories:

- Troubleshooting use cases cover situations where the operator is solving an existing problem in his network,

- Validation testing use cases cover situations where the operator is not solving a known problem but merely analysing, fine-tuning or optimising his network.

A more detailed description for the following use cases for subscriber and equipment trace can be found in Annex ?:

- Interoperability checking between equipment from different vendors,

- QoS profile checking for a subscriber after a subscriber complaint,

- Malfunctioning mobile equipment,

- Checking radio coverage in a certain area,

- Testing new features,

- Fine-tuning and optimisation of algorithms or procedures

5 Trace Activation and Deactivation

5.1 General

[Editor's note: The text in 5.1 is from 12.08 without changes. It will be updated but only when the contents of the rest of the sub-clauses within clause 5 are known.]

This document is only concerned with the activation of a trace from an OSF (OMC), and the OSF shall keep a log of all trace activations and their deactivations. All entries in the log shall be date and time stamped.

In the case of an OSF (OMC) failure, it may be possible to activate and deactivate the trace at a particular network element by means of local MMI, but the procedures for doing this are not covered by this ETS.

Facilities shall exist to allow unsolicited trace data to be received by an OSF. This permits the collection of trace data if the triggering entity (i.e. OSF or network element) is different to the collecting OSF.

5.2 Subscriber Tracing

5.2.1 General

Tracing of both home and foreign subscribers can be handled by this function.

If implemented, then the way the trace facility is used and organized, included restrictions due to national laws and regulations will be a matter for the PLMN Operator.

All trace records created in each Network Element (HSS, MSC Server, MGW, SGSN, GGSN, S-CSCF, P-CSCF, GERAN, UTRAN) are forwarded to the OSF either as notifications and/or with bulk transfer, as defined in the trace parameters.

The following scenarios are identified from the HLPM operation viewpoint:

– HPLMN Operator traces its own IMSI within the HPLMN

– HPLMN Operator traces the HSS activities of its own home subscribers while they are roaming in a VPLMN

– HPLMN Operator wishes to trace foreign roaming subscribers within its own HPLMN.

5.2.2 CS Domain

5.2.2.1 HPLMN Operator Traces Home Subscriber within the HPLMN

The Operator may activate a trace for a home subscriber (IMSI) from any OSF by invoking the management function **Activate Home Subscriber Trace** in the HSS where the IMSI is contained. This request includes the following trace parameters:

- IMSI to be traced;
- Trace reference;
- Trace type;
- HSS Trace type;
- OMC ID of the destination OMC.

For each IMSI, only one HPLMN subscriber trace can be active, any subsequent requests for the same IMSI will be rejected.

If the IMSI is roaming within its HPLMN, then the trace request is forwarded to the VLR where the subscriber is registered via a MAP message (MAP-ACTIVATE-TRACE-MODE).

When the HPLMN subscriber trace is activated, a trace record will be created by MSC Server "A", MSC Server "B", HLR, MGW, GERAN or UTRAN when a certain invoking event occur i.e. MOC, MTC, SS-Action, SMS-MO, SMS-MT, Location update, IMSI attach, and detach. The trace action and record layout is defined by the trace type parameters.

A trace may be invoked in the GERAN when an invoking event, specified in the Invoking Event sub-field in the trace type, occurs and the GERAN RECORD Type is set to other value than "NO GERAN Trace". A trace is invoked by sending a BSSMAP MSC_INVOKE_TRACE message from the MSC Server to the GERAN. When GERAN receives this message it starts tracing the necessary fields as specified in the GERAN Record associated with the specified GERAN Record Type.

A trace may be invoked in the UTRAN when an invoking event, specified in the Invoking Event sub-field in the trace type, occurs and the UTRAN Record Type is set to other value than "NO UTRAN Trace". A trace is invoked by sending a RANAP CN_INVOKE_TRACE message from the MSC Server to the UTRAN. When UTRAN receives this

message it starts tracing the necessary fields as specified in the UTRAN Record associated with the specified UTRAN Record Type.

A trace may be invoked in the MGW when an invoking event, specified in the Invoking Event sub-field in the trace type, occurs. A trace is invoked by sending a trace package in the ADD command via the MEGACO protocol from the MSC Server to the MGW. When MGW receives this message it starts tracing.

[Editor's note: The mechanisms for trace activation in the MGW do not exist as yet and belong to the responsibility of CN4. The RG decided to send an LS to CN4 to ask for their agreement on adding the needed mechanisms to the Mc interface between the MSC Server and the MGW and to define the exact mechanism later.]

If the subscriber is roaming in a foreign PLMN then the HPLMN subscriber trace request is stored in the HLR, but the trace is not active in the HPLMN VLRs.

The trace is deactivated by using the management function **Deactivate Home Subscriber Trace** in the HLR. This request includes the following trace parameters:

– IMSI;

– Trace reference.

If the IMSI is roaming within its HPLMN then the trace deactivation request is forwarded to the VLR where the subscriber is registered via a MAP message (MAP-DEACTIVATE-TRACE-MODE).

The trace shall be deactivated in the GERAN by the MSC Server sending a BSSMAP MSC_INVOKE_TRACE message from the MSC Server to the GERAN with the GERAN Record Type set to "No GERAN Trace". When GERAN receives this message it shall stop tracing related to that IMSI. Furthermore the trace can be deactivated in the GERAN when all signalling connection related to the IMSI is released.

The trace shall be deactivated in the UTRAN by the MSC Server sending a RANAP CN_DEACTIVATE_TRACE message from the MSC Server to the UTRAN. When UTRAN receives this message it shall stop tracing related to that IMSI. Furthermore the trace can be deactivated in the UTRAN when all Iu signalling connection related to the IMSI is released.

The trace is deactivated in the MGW when the termination, where the trace is activated, is released.

The following TMN Management functions are required for trace activation (in HLR):

- Activate Home Subscriber Trace;

- Deactivate Home Subscriber Trace.

5.2.2.2 HPLMN Operator traces the HLR activities of own IMSI roaming in a VPLMN

This scenario is identical to the previous scenario with the exception that records are only generated from the HSS and trace is not activated in the VPLMN.

5.2.2.3 PLMN Operator wishes to trace foreign subscribers (IMSI) in own PLMN

In order to trace the IMSIs of roaming subscribers in own PLMN, a list of those IMSIs plus the associated subscriber trace parameters must be stored in the VLR. No HLR trace records are produced for foreign subscriber traces.

The operator may activate a trace for any foreign roaming IMSI from an OSF by invoking the management function **Activate Foreign Subscriber Trace** in one or more VLRs within their own PLMN. If the location of the subscriber is not known it is necessary to activate the trace in all VLRs where the subscriber may be located.

The following trace parameters are sent with this request:

– IMSI to be traced;

– Trace Reference;

– OMC-ID of the destination OMC;

[Editor's note: OMC-ID may not be needed. This is still FFS.]

– Trace Type.

The trace request is stored in the VLR. If the subscriber subsequently roams into the VLR area the VPLMN subscriber trace will be activated.

For each IMSI only one foreign subscriber trace can be active in a particular VLR, any subsequent requests for the same IMSI will be rejected.

A trace may be invoked in the GERAN when an invoking event, specified in the Invoking Event sub-field in the trace type, occurs and the GERAN RECORD Type is set to other value than "NO GERAN Trace". A trace is invoked by sending a BSSMAP MSC_INVOKE_TRACE message from the MSC Server to the GERAN. When GERAN receives this message it starts tracing the necessary fields as specified in the GERAN Record associated with the specified GERAN Record Type.

A trace may be invoked in the UTRAN when an invoking event, specified in the Invoking Event sub-field in the trace type, occurs and the UTRAN Record Type is set to other value than "NO UTRAN Trace". A trace is invoked by sending a RANAP CN_INVOKE_TRACE message from the MSC Server to the UTRAN. When UTRAN receives this message it starts tracing the necessary fields as specified in the UTRAN Record associated with the specified UTRAN Record Type.

A trace may be invoked in the MGW when an invoking event, specified in the Invoking Event sub-field in the trace type. A trace is invoked by sending a trace package in the ADD command via the MEGACO protocol from the MSC Server to the MGW. When MGW receives this message it starts tracing.

[Editor's note: The mechanisms for trace activation in the MGW do not exist as yet and belong to the responsibility of CN4. The RG decided to send an LS to CN4 to ask for their agreement on adding the needed mechanisms to the Mc interface between the MSC Server and the MGW and to define the exact mechanism later.]

The VPLMN subscriber trace is deactivated by invoking **Deactivate Foreign Subscriber Trace** in the VLR. This request includes the following trace parameters:

– IMSI;

– Trace Reference.

The trace shall be deactivated in the GERAN by the MSC Server sending a BSSMAP MSC_INVOKE_TRACE message from the MSC Server to the GERAN with the GERAN Record Type set to "No GERAN Trace". When GERAN receives this message it shall stop tracing related to that IMSI. Furthermore the trace can be deactivated in the GERAN when all signalling connection related to the IMSI is released.

The trace shall be deactivated in the UTRAN by the MSC Server sending a RANAP CN_DEACTIVATE_TRACE message from the MSC Server to the UTRAN. When UTRAN receives this message it shall stop tracing related to that IMSI. Furthermore the trace can be deactivated in the UTRAN when all Iu signalling connection related to the IMSI is released.

The trace is deactivated in the MGW when the termination, where the trace is activated, is released.

The following TMN Management functions are required for trace activation (in VLR):

- Activate Foreign Subscriber Trace;

- Deactivate Foreign Subscriber Trace.

5.2.3 PS Domain

5.2.3.1 HPLM Operator Traces Home Subscriber within the HPLMN

Activation of trace in HSS is described in clause 5.2.2 (CS Domain).

If the IMSI is roaming within its HPLMN, the trace request is forwarded to SGSN where the subscriber is registered via a MAP message (MAP-ACTIVATE-TRACE-MODE).

When the HPLMN subscriber trace is activated, a trace record will be created by SGSN "A", SGSN "B", HSS, GERAN or RAN when a certain invoking event occur i.e. PDP context activation, SS-Action, SMS-MO, SMS-MT, Location update, GPRS attach, and detach. The trace action and record layout is defined by the trace type parameters.

Activation of GERAN trace (GSM only):

A trace may be invoked in the GERAN when an invoking Event sub-field in Trace Type and the GERAN Record Type is set to a value other than "No GERAN Trace". A trace is invoked by sending a BSSGP SGSN-INVOKE-TRACE message from SGSN to the GERAN. When GERAN receives this message it starts tracing the necessary fields as specified in the GERAN Record associated with the specified GERAN record type.

Activation of UTRAN trace (UMTS only):

A trace may be invoked in the UTRAN when an invoking Event sub-field in Trace Type and the RAN Record Type is set to a value other than "No RAN Trace". A trace is invoked by sending a RANAP CN INVOKE TRACE message from SGSN to the UTRAN. When UTRAN receives this message it starts tracing the necessary fields as specified in the RAN Record associated with the specified RAN record type.

A trace is invoked in the GGSN by sending a GTP Create PDP Context Request or an Update PDP Context Request message. When GGSN receives this message it starts tracing.

If the subscriber is roaming in a foreign PLMN then the HPLMN subscriber trace request is stored in the HSS, but the trace is not active in the HPLMN SGSNs

The trace is deactivated by using the management function Deactivate Home Subscriber Trace in the HSS. This request includes the following trace parameters:

– IMSI;

– Trace reference.

If the IMSI is roaming within its HPLMN the trace deactivation is forwarded to the SGSN where the subscriber is registered via a MAP message (MAP-DEACTIVATE-TRACE-MODE).

Deactivation of GERAN trace (GSM only):

The trace shall be deactivated in the GERAN by the SGSN sending a BSSGP SGSN-INVOKE-TRACE message from the SGSN to the GERAN with the GERAN Record Type set to "No GERAN Trace". When the GERAN receives this message it shall stop tracing activity related to that IMSI.

Deactivation of UTRAN trace (UMTS only):

The trace shall be deactivated in the UTRAN by the SGSN sending a RANAP CN DEACTIVATE TRACE message from the SGSN to the UTRAN with the RAN Record Type set to "No RAN Trace". When the UTRAN receives this message it shall stop tracing activity related to that trace reference.

The trace shall be deactivated in GGSN by the SGSN sending a GTP Update PDP Context Request message from the SGSN to the GGSN without the following trace parameters: Trace Type, Trace Reference, Trigger Id and OMC Identity. When the GGSN receives this message it shall stop tracing activity related to that PDP context.

5.2.3.2 HPLMN Operator traces the HSS activities of own IMSI roaming in a VPLMN

This scenario is identical to the previous scenario with the exception that the records are only generated from the HSS and trace is not activated in the VPLMN.

5.2.3.3 PLMN Operator wishes to trace foreign subscribers (IMSI) in own PLMN

In order to trace the IMSIs of roaming subscribers in own PLMN, a list of those IMSIs plus the associated subscriber trace parameters must be stored in the SGSN. No HSS trace records are produced for foreign subscriber traces.

The operator may activate a trace for any foreign roaming IMSI from an OSF by invoking the management function Activate Foreign Subscriber Trace in one or more SGSNs within their own PLMN. If the location of the subscriber is not known it is necessary to activate the trace in all SGNSs where the subscriber may be located.

The following trace parameters are sent with this request:

- IMSI to be traced;
- Trace Reference;
- OMC-Id of the destination OMC;

[Editor's note: OMC-ID may not be needed. This is still FFS.]

- Trace Type.

The trace request is stored in the SGSN. If the subscriber subsequently roams into the SGSN area the VPLMN subscriber trace will be activated.

For each IMSI only one foreign subscriber trace can be active in a particular SGSN, subsequent requests being rejected.

A trace may be invoked in the GERAN when an Invoking Event, specified in the Invoking Event sub-field in the Trace Type, occurs and the GERAN Record Type is set to a value other than "No GERAN Trace". A Trace is invoked by sending a BSSGP SGSN_INVOKE_TRACE message from the SGSN to the GERAN. When the GERAN receives this message it starts tracing the necessary fields as specified in the GERAN Record associated with the specified GERAN Record Type.

A trace may be invoked in the UTRAN when an invoking Event sub-field in Trace Type and the RAN Record Type is set to a value other than "No RAN Trace". A trace is invoked by sending a RANAP CN INVOKE TRACE message from SGSN to the UTRAN. When UTRAN receives this message it starts tracing the necessary fields as specified in the RAN Record associated with the specified RAN record type.

A trace in invoked in GGSN by sending a GTP Create PDP Context Request or an Update PDP Context Request message. When GGSN receives this message it starts tracing.

The VPLMN subscriber trace is deactivated by invoking **Deactivate Foreign Subscriber Trace** in the SGSN. This request includes the following trace parameters:

- IMSI;
- Trace Reference.

The trace shall be deactivated in the GERAN by the SGSN sending a BSSGP SGSN-INVOKE-TRACE message from the SGSN to the GERAN with the GERAN Record Type set to "No GERAN Trace". When the GERAN receives this message it shall stop tracing activity related to that IMSI.

The trace shall be deactivated in the UTRAN by the SGSN sending a RANAP CN DEACTIVATE TRACE message from the SGSN to the UTRAN with the RAN Record Type set to "No RAN Trace". When the UTRAN receives this message it shall stop tracing activity related to that trace reference.

The trace shall be deactivated in GGSN by the SGSN sending a GTP Update PDP Context Request message from the SGSN to the GGSN without the following trace parameters: Trace Type, Trace Reference, Trigger Id and OMC Identity. When the GGSN receives this message it shall stop tracing activity related to that PDP context.

The following TMN Management Functions are required for trace activation (in SGSN):

- Activate Foreign Subscriber Trace;
- Deactivate Foreign Subscriber Trace.

5.2.4 IMS Domain

5.2.4.1 HPLM Operator trace Home Subscriber with the HPLMN

The operator may activate a trace for a home subscriber (Subscriber ID) from any OSF by invoking the management function Activate Home Subscriber Trace in the HSS where the subscriber ID is contained. This request includes the following trace parameters:

- Subscriber ID to be traced (FFS);
- Trace reference;
- Trace type (will be defined later): HSS trace type;
- IP address of the destination OMC.

For each Subscriber ID, only one HPLMN subscriber trace can be active, subsequent request being rejected.

The trace is always activated to the S-CSCF if the subscriber is registered to it, because of the home model. The HSS activates the trace to the S-CSCF via the Cx interface (HSS initiated update of User Profile (Cx-Update_Subscr-Data)).

[Editor's note: The mechanisms for trace activation over the Cx interface do not exist as yet and belong to the responsibility of CN4. The RG decided to send an LS to CN4 to ask for their agreement on adding the needed mechanisms to the Cx interface between the CSCF and the HSS and to define the exact mechanism later. This is to be combined with the other LS to CN4 (see editor's note in 5.2.2.1)]

Subscriber may register itself to different S-CSCFs for his/her different profiles. In this case, trace shall be activated in all the relevant S-CSCFs. In the following chapters, only the case of a single S-CSCF is described, but this shall be interpreted for each S-CSCF serving the subscriber under trace.

When the trace is activated in the S-CSCF it can forward the trace activation to the P-CSCF. This activation mechanism is done using the SIP SUBSCRIBE-NOTIFY method. The S-CSCF sends a SIP SUBSCRIBE message to the P-CSCF containing the following trace parameters:

[Editor's note: The mechanisms for trace activation over the SIP interface between S-CSCF and P-CSCF do not exist as yet and belong to the responsibility of CN1. The RG decided to send an LS to CN1 to ask for their agreement on adding the needed mechanisms to the interface between the S-CSCF and the P-CSCF and to define the exact mechanism later.]

- Subscriber ID to be traced;
- Trace reference;
- Trace type (to be defined later);
- IP address of the destination OMC.

When P-CSCF receives the SIP SUBSCRIBE message with the trace parameters it starts tracing and acknowledges the trace activation by sending back SIP 202_ACCEPTED response. In compliance with the SUBSCRIBE-NOTIFY method, it will send a SIP NOTIFY request immediately, containing the actual status information "Trace activated". (To be defined later, how this status information shall be coded in SIP). The S-CSCF shall acknowledge the NOTIFY with 200 OK response.

The trace is deactivated in the HSS by using the management function **Deactivate Home Subscriber Trace** in the HSS. This request includes the following parameters:

- Subscriber ID;
- Trace reference.

When the Deactivate Home subscriber Trace management function is invoked in the HSS, HSS deactivates the trace in the S-CSCF via the Cx interface (HSS initiated update of User Profile (Cx-Update_Subscr-Data)).

When S-CSCF receives the trace deactivation it deactivates the trace in the P-CSCF by the same procedure as in the activation: sending SIP SUBSCRIBE message to P-CSCF with the following trace parameters:

– Subscriber ID;

– Trace reference.

P-CSCF acknowledges back the trace deactivation by sending SIP 202 Accepted response. Also SIP NOTIFY request is sent, containing the actual trace status "Trace deactivated". (To be defined later, how this status information shall be coded in SIP). The receipt of NOTIFY shall be acknowledged by S-CSCF, by sending 200 OK response.

The following TMN Management functions are required for trace activation (in HSS):

- Activate Home Subscriber Trace;

- Deactivate Home Subscriber Trace.

5.2.4.2 HPLMN Operator traces HSS of own subscriber roaming in a VPLMN

This scenario is identical to the previous scenario with the exception that records are only generated from the HSS and S-CSCF and trace is not activated in the VPLMN.

5.2.4.3 PLMN Operator wishes to activate trace directly in P-CSCF

In order to trace the roaming subscribers in own PLMN, a list of those Subscriber Ids and the associated trace parameters must be stored in the P-CSCF. No HSS trace records are produced for foreign subscribers.

The need for activating trace directly in P-CSCF of home network exists as well, in order to trace unsuccessful registrations to IMS. (This is due to the CSCF function split: although the real target of REGISTER is the S-CSCF, the contact point is the P-CSCF. In case of e.g. protocol implementation mismatch between UE and the P-CSCF, the REGISTER request is dropped already in proxy.)

The operator may activate a trace for any subscriber (including roaming subscribers) from an OSF by invoking the management function **Activate Foreign Subscriber Trace** in one or more P-CSCF within their own PLMN. If the location of the subscriber is not known it is necessary to activate the trace in all P-CSCF where the subscriber may be registered to/may initiate registration later. The following trace parameters are sent with this request:

– Subscriber Id to be traced;

– Trace reference;

– IP address of the destination OMC;

– Trace type.

The trace request is stored in the P-CSCF. If the subscriber registers into the P-CSCF, the subscriber trace will be activated.

For each Subscriber ID only one subscriber trace can be active in a particular P-CSCF, subsequent requests being rejected.

The foreign subscriber trace is deactivated by invoking **Deactivate ForeignSubscriber Trace** in the VLR. This request includes the following trace parameters:

– Subscriber ID;

– Trace reference.

The following TMN Management functions are required for trace activation (in HSS):

- Activate Foreign Subscriber Trace;

- Deactivate Foreign Subscriber Trace.

5.3 Equipment Tracing

5.3.1 General

[Editor's note: New sub-clause for general issues.]

Equipment trace is only applicable to the CS Domain and to the PS Domain.

If the tracing of IMEIs is implemented then the way the trace facility is used and organized, including restrictions due to national laws and regulations, will be a matter for the PLMN Operator.

An IMEI may be traced in order to find out the current IMSI, or the location of stolen equipment or behaviour of faulty equipment reported via the EIR.

5.3.2 CS Domain

[Editor's note: The behaviour in cases of possibly conflicting requirements in the same NE (concerning simultaneous tracing of IMSI/IMEI) has not been properly defined below. Needs further checking.]

This specification describes the following method of handling IMEI tracing i.e. tracing of IMEI via the VLR.

- Tracing of IMEI Via VLR.

The operator may activate an equipment trace for any subscriber's equipment (identified by IMEI) from an OSF by invoking the management function **Activate Equipment Trace** in one or more VLR in the HPLMN. The trace must be activated in all VLRs controlling areas where it is required to trace the target IMEI. The trace parameters are transmitted with the activation request.

The following trace parameters are sent with this request:

– IMEI to be traced;

– Trace reference;

– OMC-Id of the destination OMC;

[Editor's note: OMC-ID may not be needed. This is still FFS.]

– Trace Type.

To ensure proper functioning of the equipment trace the MSC Server should be configured to indicate the MS that the IMEI is required.

When a subscriber roams to a VLR area using equipment with an IMEI for which trace has been activated but is in Active Pending state at that VLR then the IMEI trace will become active.

For each IMEI only one equipment trace can be active in a particular VLR at any one time, subsequent requests being rejected, although both the subscriber trace (home subscriber tracing and foreign subscriber tracing) and the equipment trace can be active at the same time.

This equipment trace is deactivated by invoking the management function **Deactivate Equipment Trace** in the VLR. This request includes the following trace parameters:

– IMEI;

– Trace Reference.

The following TMN Management Functions are required for trace activation (in VLR):

- Activate Equipment Trace;
- Deactivate Equipment Trace.

5.3.3 PS Domain

[Editor's note: The behaviour in cases of possibly conflicting requirements in the same NE (concerning simultaneous tracing of IMSI/IMEI) has not been properly defined below. Needs further checking.]

The operator may activate an equipment trace for any subscriber's equipment (IMEI) from an OSF by invoking the management function **Activate Equipment Trace** in one or more SGSN in the HPLMN. The trace must be activated in all SGSNs controlling areas where it is required to trace the target IMEI. The trace parameters are transmitted with the activation request.

The following trace parameters are sent with this request:

- IMEI to be traced;
- Trace reference;
- OMC-Id of the destination OMC;

[Editor's note: OMC-ID may not be needed. This is still FFS.]

- Trace Type.

To ensure proper functioning of the equipment trace the SGSN should be configured to indicate the MS that the IMEI is required.

When a subscriber roams to an SGSN area using equipment with an IMEI for which trace has been activated but is in Active Pending state at that SGSN then the IMEI trace will become active.

For each IMEI only one equipment trace can be active in a particular SGSN at any one time, subsequent requests being rejected, although both the subscriber trace (home subscriber tracing and foreign subscriber tracing) and the equipment trace can be active at the same time.

This equipment trace is deactivated by invoking the management function **Deactivate Equipment Trace** in the SGSN. This request includes the following trace parameters:

- IMEI;
- Trace Reference.

The following TMN Management Functions are required for trace activation (in SGSN):

- Activate Equipment Trace;
- Deactivate Equipment Trace.

5.4 UTRAN Trace

5.4.1 Trace Activation in UTRAN

[Editor's note: The need and possibility of direct trace activation to UTRAN is still FFS.]

The trace is activated in UTRAN by using the RANAP: CN_INVOKE_TRACE message sent by the core network (3G-SGSN or MSC Server). The Core Network element can send the trace activation message to UTRAN when the trace is set on in core network and an invoking event occurs in CN for the traced UE. Invoking events are defined when the

trace is activated by the operator in HSS for complete HPLMN or for local activation in 3G-SGSN or in MSC Server. Refer also to clauses 5.2.2.1 and 5.2.3.1.

The basic requirement for the trace activation in UTRAN is that the RRC connection and Iu signalling is established for the traced UE. Therefore, the activation message is sent to serving RNC (SRNC) by using connection oriented signalling, which is possible after UTRAN has received RANAP: COMMON ID message, as specified in 3GPP TS 25.413. By this way, the trace can be active in UTRAN in all UTRAN RRC connected mode states, CELL_DCH, CELL_FACH, CELL_PCH, and URA_PCH.

5.4.2 UE with two Core Capability

If the traced UE consists of a ME, which has capability to have simultaneous active Iu connections to 3G-SGSN and MSC Server, the RANAP: CN_INVOKE_TRACE message can be received twice in UTRAN for one UE. This is because both core network elements can send the activation message independently, when the invoking event occurs. Refer also to clauses 5.2.2.1 and 5.2.3.1.

However, only one trace should be active in UTRAN providing trace records to OMC. The rationale is that the traced UE has only one RRC connection and common radio link(s) to serve requested RAB(s) from both CN.

5.4.3 Trace deactivation in UTRAN

Trace is deactivated in UTRAN by using the RANAP: CN DEACTIVATE TRACE message sent by core network (3G-SGSN or MSC Server) as specified in 3GPP TS 25.413. In this case, the trace is always deactivated even if the UE's Iu connection remains, from where the deactivation message was received. Refer also to clauses 5.2.2.1 and 5.2.3.1.

However, if the trace reference number differs in the RANAP: CN DEACTIVATE TRACE message, from trace reference number received in the RANAP: CN_INVOKE_TRACE message the UTRAN shall ignore the deactivation message, i.e. trace is not deactivated.

5.4.4 Interactions with Iu Release

When the Iu signalling is released, the core network (3G-SGSN MSC Server) can send only the RANAP: IU RELEASED COMMAND message. When the traced UE has only one Iu connection the RRC connection is also released and the UE is moved to IDLE state. Therefore the trace is deactivated in UTRAN.

When traced UE has two Iu connections, and the other one is released by the RANAP: IU RELEASED COMMAND message the Iu release is seen as the RAB release procedure and the trace shall be deactivated in SRNC only if the RANAP: CN INVOKE TRACE message was received only from the released Iu connection. Therefore, if the activation message was received from both Iu interface connections the trace shall remain active in UTRAN until both Iu are released.

5.4.5 Interactions with Handovers

When the intra RNC handover occurs to the traced UE, the SRNC shall perform all required actions. This is applicable for all intra-frequency handovers (soft, softer, intra-frequency hard), and for inter-frequency hard handovers.

[Editor's note: The phrase "all required actions" above needs to be clarified. Trace support in Iur interface is still FFS.]

When a new cell, which is controlled by another RNC, is inserted to the active set, this RNC is in Drift RNC mode (DRNC). However, because the Iur interface does not support any trace-related messages, all trace records are provided from SRNC.

This solution is also applicable for SRNC anchoring, which is required if the SRNC relocation is not supported by one of RNCs.

5.4.6 Interactions with Relocation

When a UE is moving in the network and requests that last cell, controlled by SRNC, is to be removed from active set (other cells in AS are controlled by other RNC), the SRNC relocation procedure can be performed. In this situation, the

Iu signalling connection between SRNC and CN is changed to DRNC and CN and the mode of the DRNC is changed to SRNC.

If the SRNC relocation is performed for traced UE the trace is deactivated in source RNC (old SRNC), when the Iu connection is released, and the trace is activated by CN in target RNC (new SRNC).

The requirement for this procedure is that if the core network element is also changed the trace is also activated in there.

This procedure is also applicable for inter RNC hard handovers.

5.5 TMN Management Functions for Activation/Deactivation

5.5.1 General

[Editor's note: This clause will be used for general introductory text to the rest of clause 5.5.]

[Editor's note: NOTE that the all the rest of clause 5, i.e. sub-clauses 5.5.2 – 5.5.7, and sub-clauses 5.6 – 5.9 need to be re-thought and re-written according to the redefined objectives of the TS with respect to the management interfaces as defined by TS 32.101. This means that for the interface between the Network Element and the Network Element Manager only the requirements and a high level description of needed procedures will be specified in this TS. This means considerable changes to clauses (at least clauses 5.5.2 to the end of clause 5, clause 8, and clause 9) that are using terminology and approach inherited from GSM 12.08.]

5.5.2 Activate Home Subscriber Trace

[Editor's note: The following contains the original text from 12.08.]

This function is equivalent to the OM_Subscriber_Tracing_Activation_req in GSM 09.02 [6].

The subscriber tracing procedures are used for the management of the trace status and the type of trace.

The subscriber tracing activation procedure operates as follows:

a) The OSF creates a *tracedHomeSubscriberInHlr* object instance in the HLR of the subscriber to be traced.

b) If the subscriber is roaming outside of the HPLMN or not currently registered, then the trace is in active pending state. The home subscriber trace for the subscriber is activated in the HLR on a subsequent location update. This activation is shown as an attribute value change in the attribute traceActivatedInVlr.

c) If the subscriber is already registered then the home subscriber trace becomes immediately active in the HLR (after positive confirmation from the VLR).

When the trace is first activated then the status of the trace indicator attribute traceActivatedInVlr in the *tracedHomeSubscriberInHlr* object instance is set to **False**.

If the subscriber is **registered and is roaming in the home PLMN area** then the HLR will initiate the MAP-ACTIVATE-TRACE-MODE request primitive and the trace indicator status will be set to **True** only in the case of a positive confirmation of the MAP-ACTIVATE-TRACE-MODE. In case of an error, the trace indicator status remains **False**.

If the MAP-ACTIVATE-TRACE-MODE confirm primitive is received indicating an error situation then this is recorded in an error attribute in the *tracedHomeSubscriberInHlr* object instance.

If the subscriber roams to an area outside that where tracing is possible then the status in the *tracedHomeSubscriberInHlr* object instance is updated to **False**.

The trace records are sent from the recording NEF to the OSF by the deployed event reporting mechanism (see chapter Trace Record Transfer). The Trace Type attribute indicates the type of trace records to be produced and the way in which they will be reported i.e. each event record being either directly sent to the OSF in real in a file for later transfer.

All attribute value changes will be reported with a notification to the OSF.

System management functions:

Create tracedHomeSubscriberInHlr

Get Attribute

Notifications:

objectCreation

attributeValueChange

5.5.3 Deactivate Home Subscriber Trace

[Editor's note: The following contains the original text from 12.08.]

This function is equivalent to the OM_Subscriber_Tracing_Deactivation_req in GSM 09.02 [6].

The subscriber trace is deactivated by the OSF deleting the *tracedHomeSubscriberInHlr* object instance in the HLR.

If the trace status is **True** then the HLR will send the MAP-DEACTIVATE-TRACE-MODE message to VLR.

If the MAP-DEACTIVATE-TRACE-MODE confirm primitive is received indicating an error situation then this is indicated to the OSF via an error attribute in the *tracedHomeSubscriberInHlr* object instance and the object is not deleted.

The home subscriber trace deactivation can be indicated with a notification to the initiating OSF.

System management functions:

Delete tracedHomeSubscriberInHlr

Get Attribute

Notifications:

objectDeletion

attributeValueChange

5.5.4 Activate Foreign Subscriber Trace

[Editor's note: The following contains the original text from 12.08.]

This function is analogous to the OM_Subscriber_Tracing_Activation_req in GSM 09.02 [6], but the trace activation is performed directly in the VLR.

The foreign subscriber trace is activated by the OSF executing the system management function Create *tracedForeignSubscriberInVlr* in the VLR.

THE OSF creates a *tracedForeignSubscriberInVlr* object instance in the VLR(s) in which the network operator wishes to trace the subscriber.

The tracing continues as follows:

- If the subscriber is not currently registered, then the foreign subscriber trace for the subscriber is active pending. It is activated (i.e. status attribute value is set to **True**) in the VLR on a subsequent location update. The activation is notified to the OSF as an attribute value change in the attribute foreignSubscriberRegisteredInVlr.

- If the subscriber is already registered then the foreign subscriber trace becomes immediately active in the VLR.

When the trace is first activated then the status of the attribute foreignSubscriberRegisteredInVlr is set to **False**. When the traced subscriber registers in the VLR the attribute status of foreignSubscriberRegisteredInVlr is set to **True**.

All attribute value changes will be reported with a notification to the OSF.

The trace records are sent from the corresponding MSC to the OSF by the deployed event reporting mechanism (see chapter Trace Record Transfer). The Trace Type attribute indicates the type of trace records to be produced and the method by which they will be reported.

System management functions:

- Create tracedForeignSubscriberInVlr;

- Get Attribute.

Notifications:

- objectCreation;

- attributeValueChange.

5.5.5 Deactivate Foreign Subscriber Trace

[Editor's note: The following contains the original text from 12.08.]

This function is analogous to the OM_Subscriber_Tracing_Deactivation_req in GSM 09.02 [6], but the trace deactivation is performed.

The OSF deactivates subscriber trace by deleting the *tracedForeignSubscriberInVlr* object instance in the VLR(s) in which the object instance had previously been created.

The foreign subscriber trace is deactivated by the OSF executing the system management function Delete *tracedForeignSubscriberInVlr* in the VLR.

System management functions required:

- Delete tracedForeignSubscriberInVlr.

Notifications required:

- objectDeletion;

- attributeValueChange.

5.5.6 Activate Equipment Trace

[Editor's note: The following contains the original text from 12.08.]

This function is analogous to the OM_Subscriber_Tracing_Activation_req in GSM 09.02 [6], but the trace activation is performed directly in the VLR.

The equipment trace is activated by the OSF executing the system management function Create *tracedEquipmentInVlr*.

The OSF creates a *traceEquipmentInVlr* object instance in the VLR(s) for the areas to be monitored.

The tracing continues as follows:

- If the equipment is not currently registered, then the equipment trace for the equipment is active pending. It is activated (i.e. status attribute value is set to **True**) in the VLR on a subsequent location update or IMSI attach. The activation is notified to the OSF as an attribute value change in the attribute equipmentRegisteredInVlr.

- If the equipment is already registered then the equipment trace becomes immediately active in the VLR.

When the trace is first activated then the status of the attribute equipmentRegisteredInVlr is set to **False**. When the equipment registers in the VLR the attribute status of equipmentRegisteredInVlr is set to **True**.

All attribute value changes will be reported with a notification to the OSF.

The trace records are sent from the corresponding MSC to the OSF by the deployed event reporting mechanism (see chapter Trace Record Transfer). The Trace Type attribute indicates the type of trace records to be produced and the method by which they will be reported.

System management functions:

- Create tracedForeignSubscriberInVlr;
- Get Attribute.

Notifications:

- objectCreation;
- attributeValueChange.

5.5.7 Deactivate Equipment Trace

[Editor's note: The following contains the original text from 12.08.]

This function is analogous to the OM_Subscriber_Tracing_Deactivation_req in GSM 09.02 [6], but the trace deactivation is performed in the VLR.

The equipment trace is deactivated by the OSF executing the system management function Delete *tracedEquipmentInVlr*.

The OSF deactivates equipment trace by deleting the *tracedEquipmentInVlr* object instance in the VLR(s) in which the object instance had previously been created.

System management functions:

- Delete tracedEquipmentInVlr.

Notifications:

- objectDeletion;
- attributeValueChange.

5.6 HSS Functional Entities

[Editor's note: The following contains the original text from 12.08. Update and re-formatting needed.]

Figure 2 shows that part of the Subscriber Administration Containment Tree for the HLR relevant to Trace activation and deactivation.

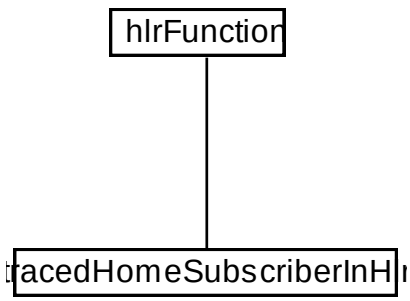

Figure 2: Subscriber Trace Containment Tree for the HLR

5.6.1 Managed Object Classes in HLR

5.6.1.1 tracedHomeSubscriberInHlr

This object class controls the home subscriber trace facility. Each instance of this object represents an IMSI of a home subscriber to be traced i.e. if an instance for an IMSI exists then that means that the trace has been activated for that IMSI.

Name	M/O	Value-Set
IMSI	RDN	Single
traceActivatedInVlr	M	Single
traceReference	M	Single
traceType	M	Single
hlrTraceType	M	Single
operationSystemId	O	Single
mapErrorOnTrace	M	Single

5.6.1.2 Attributes

5.6.1.2.1 tracedHomeSubscriberInHlr

IMSI

This attribute is the RDN of the object *tracedHomeSubscriberInHlr* and defines an IMSI to be traced. It will be an IMSI of a home subscriber for whom tracing is required.

The syntax is defined in MAP-CommonDataTypes IMSI.

traceActivatedInVlr

This attribute is single valued and gives an indication of the status of the Trace. Possible values of this attribute are **True** and **False**.

On creation this attribute is set to **False**.

If the subscriber is registered and roaming within the HPLMN (see GSM 09.02 [6]) then the attribute is set to **TRUE** (in case of positive confirmation from VLR).

If the subscriber roams to an area which is outside that where tracing is possible the attribute is set to **FALSE**.

Each status change triggers an attributeValueChange notification.

traceReference

This attribute is a unique reference for a particular trace associated with a particular IMSI and is allocated by the OSF.

traceType

This attribute describes the invoking events for which the operator wishes to collect a trace record for a particular IMSI in an MSC or GERAN. It also describes the type of record to be collected and indicates whether or not this is a priority trace.

hlrTraceType

This attribute describes the type of trace record (if any) the operator wishes to be collected in the HLR for a particular IMSI. It is assumed for all invoking events.

operationSystemId

This attribute contains the address of the OSF to which the operator wishes the trace records associated with this particular IMSI to be sent.

If EFDs are used then trace records are sent to OSFs defined in EFD.

mapErrorOnTrace

This attribute is single valued and read only. The syntax is defined in GSM-12-02-SyntaxMapErrorOnTrace.

It is set by MAP and contains the MAP-Errors that may be returned in the confirm primitives of the ActivateTraceMode and DeactivateTraceMode Operations.

If there are MAP-Errors in case of activation of trace, the traceActivatedInVlr parameter is set to **False**.

If there are Map-Errors in case of deactivation of trace (deleting tracedHomeSubscriberInHlr), the deleting is not completed successfully.

Possible error values are defined in MAP-OperationAndMaintenance Operations and in MAP-Errors.

5.6.1.3 Notifications

For each object:

- objectCreation;
- objectDeletion;
- AttributeValueChange.

5.7 VLR Functional Entities

[Editor's note: The text is from 12.08 without changes.]

Figure 3 shows that part of the Subscriber Administration Containment Tree for the VLR relevant to Trace.

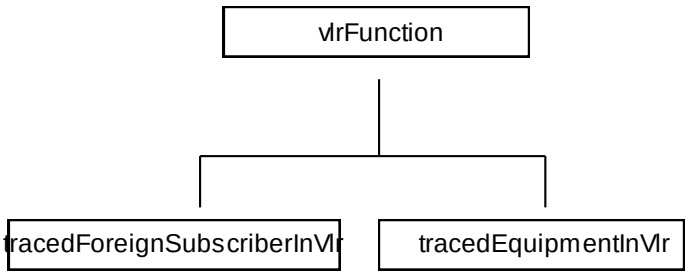

Figure 3: Subscriber Trace Containment Tree for the VLR

5.7.1 Managed Object Classes in VLR

5.7.1.1 tracedForeignSubscriberInVlr

This object class controls the foreign subscriber trace facility. Each instance of this object represents an IMSI of a foreign subscriber to be traced i.e. if an instance for an IMSI exists then that means that the trace has been activated for that IMSI.

Name	M/O	Value-Set
IMSI	RDN	Single
foreignSubscriberRegisteredInVlr	M	Single
traceReference	M	Single
traceType	M	Single
operationSystemId	O	Single

5.7.1.2 tracedEquipmentInVlr

This object class controls the equipment trace facility. Each instance of this object represents an IMEI to be traced i.e. if an instance for an IMEI exists then that means that the trace has been activated for that IMEI.

Name	M/O	Value-Set
IMEI	RDN	Single
equipmentRegisteredInVlr	M	Single
traceReference	M	Single
traceType	M	Single
operationSystemId	O	Single

5.7.1.3 Attributes

5.7.1.3.1 tracedForeignSubscriberInVlr

IMSI

This attribute is the RDN of the object *tracedForeignSubscriberInVlr* and defines an IMSI to be traced. It will be an IMSI of a foreign subscriber for whom tracing is required.

The syntax is defined in MAP-CommonDataTypes IMSI.

foreignSubscriberRegisteredInVlr

This attribute is single valued and gives an indication of the status of the Trace. Possible values of this attribute are **True** and **False**.

On creation this attribute is set to **False**.

If the foreign subscriber is currently registered in the VLR then the attribute is set to **TRUE**.

If the foreign subscriber is not registered in the VLR then the attribute is set to **FALSE**.

Each status change triggers an attributeValueChange notification.

traceReference

This attribute is a unique reference for a particular trace associated with a particular IMSI and is allocated by the OSF.

traceType

This attribute describes the invoking events that the operator wishes to collect a trace record for a particular IMSI in an MSC or GERAN. It also describes the type of record to be collected and indicates whether or not this is a priority trace.

operationSystemId

This attribute contains the address of the OSF to which the operator wishes the trace records associated with this particular IMSI to be sent.

If EFDs are used, then trace records are sent to OSFs defined in EFD.

5.7.1.3.2 tracedEquipmentInVlr

IMEI

This attribute is the RDN of the object *tracedEquipmentInVlr* and defines an IMEI to be traced. It will be an IMEI for the equipment for which tracing is required.

The syntax is defined in MAP-CommonDataTypes IMEI.

equipmentRegisteredInVlr

This attribute is single valued and gives an indication of the status of the Trace. Possible values of this attribute are **True** and **False**.

On creation this attribute is set to **False**.

If the equipment is registered in the VLR then the attribute is set to **TRUE**.

If the equipment is not registered in the VLR then the attribute is set to **FALSE**.

Each status change triggers an attributeValueChange notification.

traceReference

This attribute is a unique reference for a particular trace associated with a particular IMSI and is allocated by the OSF.

traceType

This attribute describes the invoking events for which the operator wishes to collect a trace record for a particular IMSI in an MSC or GERAN. It also describes the type of record to be collected and indicates whether or not this is a priority trace.

operationSystemId

This attribute contains the address of the OSF to which the operator wishes the trace records associated with this particular IMSI to be sent.

If EFDs are used, then trace records are sent to OSFs defined in EFD.

5.7.1.4 Notifications

- objectCreation;
- objectDeletion;
- attributeValueChange.

5.8 SGSN Functional Entities

[Editor's note: A new chapter. Only the editing instructions from S5B010508 included. Contents are FFS.]

New chapter for defining the functional entities in the SGSN. It is similar to the VLR chapter.

Managed Object Classes in the SGSN:

– tracedForeignSubscriberInSgsn;

– tracedEquipmentInSgsn.

5.9 P-CSCF Functional Entities

[Editor's note: A new chapter. Only the editing instructions from S5B010508 included. Contents are FFS.]

New chapter for defining the functional entities in the P-CSCF. Similar to the VLR chapter, but instead of the IMSI the Private ID will be used.

Only one managed object class is defined in the P-CSCF:

– tracedForeignSubscriberInPcscf.

6 Trace Types

[Editor's note: There are still open issues, so the contents of clause 6 need more review. Also, the following contents of the clause have not been fully reviewed. So, the contents of clause 6 represent the current working assumptions for trace activation through CN signalling interfaces, pending further review. The trace types for trace activation through the management interfaces are FFS.]

In the following sub-clauses (6.1 – 6.4) the "trace type" field contains the type of trace activated in the Network Element. These sub-clauses define the contents of the "trace type" field in each Network Element.

6.1 MSC Server/GERAN/UTRAN trace type

8	7	6	5	4	3	2	1
Priority Indication	Spare	GERAN/UTRAN Record Type		MSS/MGW Record Type		Invoking Event	

Table 1: Invoking events

Bits		Invoking Events
2	1	
0	0	MOC, MTC, SMS MO, SMS MT, PDS MO, PDS MT, SS, Location Updates, IMSI attach, IMSI detach
0	1	MOC, MTC, SMS_MO, SMS_MT, PDS MO, PDS MT, SS only
1	0	Location updates, IMSI attach IMSI detach only
1	1	Operator definable

If the "operator definable" option is selected, all subsequent Trace Record Types are deemed to be "operator definable". In this case the significance of bits 3 - 6 are operator defined, however the significance of bit 8 remains "Priority Indication".

Table 2: MSC Server/MGW record type

Bits		Record Type
4	3	
0	0	Basic
0	1	Detailed (Optional)
1	0	Spare
1	1	No MSC Server/MGW Trace

Table 3: GERAN/UTRAN record type

Bits		Record Type
6	5	
0	0	Basic
0	1	Handover
1	0	Radio
1	1	No GERAN/UTRAN Trace

Table 4: Priority Indication

Bit	Priority
8	
0	No priority
1	Priority

This bitmap of the Trace Type is required to map onto the Trace Type as defined in 3GPP 29.002 as an Integer with 256 possible values. This is achieved by a binary to decimal conversion of the bitmap, where bit 8 has weight 128 and bit 1 has weight 1.

6.2 SGSN/GGSN Trace Type

8	7	6	5	4	3	2	1
Priority Indication	Spare	GERAN/UTRAN Record Type		SGSN/GGSN Record Type		Invoking Event	

Table 5: Invoking events

Bits		Invoking Events
2	1	
0	0	PDP Context Activation/Modification/Deactivation, MO_SMS, MT_SMS, Routing Area Update, IMSI attach, IMSI detach
0	1	PDP Context Activation/Modification/Deactivation, MO_SMS, MT_SMS only
1	0	Routing Area Updates, IMSI attach IMSI detach only
1	1	Operator definable

If the "operator definable" option is selected, all subsequent Trace Record Types are deemed to be "operator definable". In this case the significance of bits 3 - 6 are operator defined, however the significance of bit 8 remains "Priority Indication".

Table 6: SGSN/GGSN report type

Bits		Record Type
4	3	
0	0	Basic
0	1	Detailed (Optional)
1	0	Spare
1	1	No SGSN/GGSN Trace

Table 7: GERAN/UTRAN report type

Bits		Record Type
6	5	
0	0	Basic
0	1	Handover
1	0	Radio
1	1	No GERAN/UTRAN Trace

Table 8: Priority indication

Bit	Priority
8	
0	No priority
1	Priority

This bitmap of the Trace Type is required to map onto the Trace Type as defined in 3GPP 29.002 as an Integer with 256 possible values. This is achieved by a binary to decimal conversion of the bitmap, where bit 8 has weight 128 and bit 1 has weight 1.

6.3 HSS Trace Type

8	7	6	5	4	3	2	1
Priority Indication	UMTS domain/subsystem			HSS Record Type		Invoking Event	

Table 9: Invoking events

Bits		Invoking Events
2	1	
0	0	All HSS Interactions
0	1	Spare
1	0	Spare
1	1	Operator definable

If the "operator definable" option is selected, all subsequent Trace Record Types are deemed to be "operator definable". In this case the significance of bits 3 and 4 are operator defined, however the significance of bit 8 remains "Priority Indication". In all cases, for Network Elements the setting of bits 5 - 7 shall not affect trace record generation.

Table 10: HSS record type

Bits		Record Type
4	3	
0	0	Basic
0	1	Detailed
1	0	Spare
1	1	No HSS Trace

Table 11: UMTS domain/subsystem

Bit	Domain/subsystem
5	CS domain
6	PS domain
7	IM subsystem

The UMST domain/susbsystem subfield of the HSS trace type is a bit structure. Each bit reperesents one domain or subsystem in the UMTS. If the correspodnig bit is set to 1 than trace is required in that domain/subsystem. If tracing is needed only in one domain/subsystem than HSS shall produce reports only from those invoking events, which are related to that domain.

Table 12: Priority indication

Bit	Priority
8	
0	No priority
1	Priority

This bitmap of the Trace Type is only required in the HSS and is not required to be mapped onto any 3GPP 29.002 or other Trace Types.

6.4 CSCF Trace Type

8	7	6	5	4	3	2	1
ext 0/1	Priority Indication	Spare		P-CSCF Record Type		S-CSCF Record Type	
16	**15**	**14**	**13**	**12**	**11**	**10**	**9**
Spare		Invoking Event					

Table 13: Invoking events

Bit	Invoking Events
9	SIP call (setup, modification and release (SIP INVTIE request))
10	Registration (registration, re-registration and deregistration (SIP REGISTER request))
11	Instant Message (SIP MESSAGE request)
12	Presence (SIP SUBSCRIBE and SIP NOTFIY request)
13	Service OPTION (SIP OPTION request)
14	Other SIP methods

The invoking event field is a bit structure. If the corresponding bit is set to 1 it means that a trace record shall be produced for that event.

Table 14: S-CSCF record type

Bits		Record Type
2	**1**	
0	0	Basic
0	1	Detailed (Optional)
1	0	Spare
1	1	No S-CSCF Trace

Table 15: P-CSCF record type

Bits		Record Type
4	**3**	
0	0	Basic
0	1	Detailed (Optional)
1	0	Spare
1	1	No P-CSCF Trace

Table 16: Priority indication

Bit	Priority
7	
0	No priority
1	Priority

7 Trace Record Contents

7.1 General

[Editor's note: The following extract from 12.08, clause 7.1, is included for the convenience of the reader as a key to the tables. It should be noted that the keys and their meanings, as well the values may need to be changed/updated and are FFS.]

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, GERAN or HSS event record. A key is included in the table indicating whether or not the field is mandatory. In this table and throughout this document the key field has the following meaning:

M	This field must appear in at least one trace record associated with the invoking event. Any exceptions to this rule are explicitly described.
C	This field is only available under certain conditions. If available this field must be present in at least one trace record associated with the invoking event. The conditions under which this field is available are individually described.
O	This field is optional and its support is a matter for agreement between equipment manufacturer and network operator. Equipment manufacturers do not have to be capable of providing all these fields to claim conformance with this TS.
X	This field is not required in this instance.

7.2 MSC Server Trace Record Content

[Editor's note: The following is from 12.08 clause 7.2. Updates are FFS.]

The following types of fields are supported in the 2 MSC Server trace types.

Table n: MSC Server Trace Record Content

Field	MSC Server Trace Type		Description
	Basic	Detailed	
Invoking Event	M	M	Event invoking trace (Not available at the non-anchor MSC on Inter-MSC Handover).
Served IMSI	C	C	IMSI of the calling party in the case of MOC or the called party in the event of MTC. Not available in case of emergency call without SIM. This field is only required for IMEI trace.
Served IMEI	C	C	IMEI of the calling ME in the case of MOC or the called party in the event of MTC. This field is only required for IMSI trace.
Served MSISDN	C	C	Primary MSISDN of the party being traced.
Calling/Called Number	C	C	The MSISDN of the calling party in case of MTC. The MSISDN of the called party in case of MOC.
Calling Subaddress	C	C	The subaddress of the calling party (for both MOC and MTC).
Called Subaddress	C	C	The subaddress of the called party (for both MOC and MTC).
Translated Number	C	C	The called number of the party not being traced after digit translation within the MSC Server (if applicable) (i.e. applies to MOC only).
Connected Number	C	C	The number of the party not being traced (applies to MOC only).
Forwarded-to Number	C	C	The number to which the call will be forwarded (applies to MTC only).
Forwarded-to Subaddress	C	C	The subaddress to which the call will be forwarded (applies to MTC only).
Redirecting Number	C	C	The number from which the call was last redirected (applies to MTC only).
Original Called Number	C	C	The number of the original called party (applies to MTC only).
Roaming Number	C	C	The MSRN of the traced subscriber in the case of MTC, or the MSRN of the called subscriber in case of MOC, if available.
Network Trunk Group Point	C	C	In case of a MOC the outgoing trunk on which the call leaves the MSC. In case of an MTC the incoming trunk on which the call originates as seen from the MSC.
Basic Service	C	C	The bearer- or teleservice employed.
Radio Channel types	O	C	A list of radio channel types used during the compilation of the trace record, each timestamped.
BSS Handover Trunk	O	C	A list of the incoming/outgoing trunk group and member used to connect the MSC to BSS (including the original and each intra-MSC BSS handover) each time-stamped.
MSC Handover Trunk	O	C	A list of the trunk group and member used to connect two MSCs (including the original and each inter-MSC handover) each time-stamped.

(continued)

Table n: MSC Trace Record Content (concluded)

Field	MSC Trace Type		Description
	Basic	Detailed	
Location	C	C	A list of Location Area Codes / Cell Ids used during the compilation of the trace record starting with the identity of the cell in which the invoking event originated or terminated, each time stamped.
SS Information	C	C	A list of information related to any SS actions carried out during the period of the trace. The SS Information contains the SS Code for each SS Action, the Basic Services for which each SS action was carried out, the type of each SS action carried out, a list of SS parameters associated with each SS action, the result of each SS action and the Invoke Id allocated for each SS Action.
AOC Parameters	O	C	A list of the charge advice parameters sent to the MS (including on call set-up and on changes as a result of a tariff switch over), each timestamped.
MS Classmark 2	C	C	A list of the mobile station classmark 2 information (starting with on call set-up), each timestamped.
Call Termination Diagnostics	C	C	A detailed reason for the release of the connection. See GSM 12.05 annex B - Diagnostics.
A-Interface Messages	X	C	A sequential list of all DTAP and BSSMAP messages passed on the A-Interface.
C-Interface Messages	X	C	A sequential list of all MAP messages passed between the Tracing MSC and the HLR/AUC.
D-Interface Messages	X	C	A sequential list of all MAP messages passed between the Tracing VLR and the HLR/AUC.
E-Interface Messages	X	C	A sequential list of all MAP messages passed between the Tracing MSC and the subsequent MSC.
F-Interface Messages	X	C	A sequential list of all MAP messages passed between the Tracing MSC and the EIR.
G-Interface Messages	X	C	A sequential list of all MAP messages passed between the Tracing VLR and another VLR.
Network Signalling Messages	X	C	A sequential list of all user part messages e.g. ISUP, TUP messages.
Event Start Time	C	C	The time the event was started. It must always appear in case the trace record is already being compiled and the event belonging to this event record for this same subscriber occurs.
Event Stop Time	C	C	The time the event was finished. It must always appear in case the trace record is still being compiled due to an ongoing event and the event belonging to this event record finishes.
Event Number	M	M	The Event Number is used to identify tracing data belonging to the same event.
Record extensions	O	O	A set of network/ manufacturer specific extensions to the record.
OR information	C	C	Information about the use of optimal routeing shall be present in the MSC Trace Record (applies to MTC only) if optimal routeing was tried otherwise it shall be absent. OR information contains: E.164 address of the GMSC, Call reference number used by the GMSC for Optimal Routeing of this call and reason for failure of optimisation. Error situations which lead to failure of the call, rather than non-optimal routeing, are not described here.
MS Classmark 3	C	C	The MS Classmark 3 indicated during the period of the trace invocation, each timestamped.

7.3 MGW Trace Record Content

[Editor's note: The following is from S5B010613 with minor corrections as agreed in SA5#23.]

Some items in the MSC trace record are no more reachable for the MSC server in the bearer independent architecture. MSC server cannot know e.g. the physical trunk involved in the session (the trunk group was mentioned in the three different fields in the MSC trace record) and some operator/vendor specific record extensions. Moreover the new bearer types (IP and ATM) require comparable information elements to identify physical/logical connection points e.g. ATM virtual paths and channels. Therefore it is essential to determine the trace record for MGW.

In the MGW the context determines the session between subscribers whereas the termination represent a point in the context that is the source or the sink for the media stream. During the lifetime of a session a context includes at least two terminations, but usually because of handovers there might be several terminations. In the MGW trace record it is sensible to show the ID of context and the IDs of terminations. After the field indicating the termination ID there could be fields important to particular kinds of termination (IP, ATM or TDM). The fields including termination specific information could be repeated, as many times as there were terminations in the traced context. The reservation and release times, bearer type and channel coding fields of the terminations are common for all kinds of termination types. The type of media is common for all terminations in the context; therefore it is before termination ID.

In the IP based bearer networks the ensuring and management of QoS (Quality of Service) is essential. When IP termination is in the question, a suitable tool for QoS monitoring is to collect standard outputs of the RTP protocol and it's MIB (RFC 2959 and 1889) into the MGW trace record. The outputs are e.g. sent/received/lost packets and jitter. IP addresses and port numbers are also important information items in the session.

The MGW trace record includes context ID and media fields for session and certain number of termination specific fields. The terminations may have different kinds of fields indicating physical/logical connection points, bearer types, addresses, and QoS parameters.

The following types of fields are supported in the 2 MGW trace record types:

Field	MGW Trace Type		Description
	Basic	Detailed	
Context ID	M	M	The context ID of the session in the MGW.
Media	M	M	Media type is e.g. audio, video or data.
Termination ID*	M	M	The ID number of termination in the context.
Bearer	C	C	Basic transport mechanism (e.g. TDM, IP or AAL2).
Channel coding	C	C	The coding in the use, e.g. speech version.
Time of reservation	C	C	The time when termination was reserved.
Time of release	C	C	The time when termination was released.
Network Trunk Group Point	C	C	The trunk group point associated to the termination (TDM termination).
Timeslot	C	C	The timeslot in the physical trunk associated to the termination (TDM termination).
Source IP Address	C	C	The IP address from which IP stream is sent. (IP termination)
Source Port	C	C	The Port from which e.g. RTP stream is sent. (IP termination)
Destination IP Address	C	C	The IP address where IP stream is sent. (IP termination)
Destination Port	C	C	The Port where e.g. RTP stream is sent to. (IP termination)
Packets sent	X	O	The number of sent packets during the live time of termination. (IP termination)
Packets received	X	O	The number of received packets during the live time of termination. (IP termination)
Packets lost	X	O	The number of lost packets during the live time of termination. (IP termination)
Jitter	X	O	The delay variation of RTP stream. (IP termination)
ATM interface identifier	C	C	The identifier for ATM interface connection point (ATM termination).
ATM Virtual Path	C	C	The virtual Path of ATM layer (ATM termination).
ATM Virtual Channel	C	C	The virtual Channel of ATM layers (ATM termination).
Remote ATM Address	C	C	The ATM address of remote point (ATM termination)

Record extensions	O	O	A set of network/manufacturer specific extensions to the record.

* From the Termination ID field onwards the fields can exist as many times as there have been terminations in the context. A new termination ID field acts as a separator between fields provided by different terminations.

7.4 SGSN Trace Record Content

FFS

7.5 GGSN Trace Record Content

FFS

7.6 UTRAN Trace Record Content

FFS

7.7 GERAN Trace Record Content

[Editor's note: The following is from 12.08 clause 7.3. Updates are FFS.]

The following types of fields are supported in the 3 GERAN trace record types:

Table x: GERAN Trace Record Content

Field	GERAN Trace Type			Description
	Basic	Hand-over	Radio	
Invocation Message	M	M	M	GSM 08.08 [4] invocation message which started the trace action.
BTS ID	M	M	M	The ids of all BTSs accessed by the traced party during the period of the trace invocation (as per GSM 12.20 [11]), each timestamped.
TRX ID	M	M	M	The ids of all TRXs accessed by the traced party during the period of the trace invocation (as per GSM 12.20 [11]), each timestamped.
TRAU ID	O	O	O	The ids of all TRAUs accessed by the traced party during the period of the trace invocation (as per GSM 12.20 [11]), each timestamped.
Radio Channel Info.	M	M	M	The radio channel types and descriptions used during the period of the trace invocation, each timestamped. If the trace record relates to a HSCSD call then the field Radio Channel Info 96 shall be used instead.
Request type	C	C	C	The reasons for channel seizure (originating, terminating, re-establishment, handover) (see GSM 04.08 [2]), each timestamped.
End Indication	C	C	C	The reasons for channel release (see GSM 04.08 [2]), each timestamped.
MS Power	X	C	C	The last MS power used before a channel is released (see GSM 12.20 [11]), each timestamped.
BS Power	X	C	C	The last BS power used before a channel is released (see GSM 12.20 [11]), each timestamped.
Timing advance	X	C	C	The last timing advance used before a channel is released (see GSM 12.20 [11]), each timestamped.
MS Classmark 1	C	C	C	The MS Classmark 1 indicated during the period of the trace invocation, each timestamped.
MS Classmark 2	C	C	C	The MS Classmark 2 indicated during the period of the trace invocation, each timestamped.
MS Classmark 3	C	C	C	The MS Classmark 3 indicated during the period of the trace invocation, each timestamped.

BSIC	M	M	M	This field is the combination of Network Colour Code and Base station Colour Code (see GSM 12.20 [11]).
CIC	C	C	C	The terrestrial circuit identification codes used for the call on which the trace is being performed, each timestamped (see GSM 08.08 [4]).
Handover result	O	C	C	The results of each handover occurring during the period of the trace invocation each timestamped.
Handover cause	O	C	C	The reasons for starting each handover attempt during the period of the trace invocation (see GSM 08.08 [4]), each timestamped.

(continued)

Table 10: GERAN Trace Record Content (concluded)

Field	GERAN Trace Type			Description
	Basic	Handover	Radio	
Handover duration	O	C	C	The times taken between sending the handover command and receiving the handover complete for each successful handover, each timestamped.
Target Cell list	X	C	C	The target cells at the start of each handover attempt, each timestamped.
Synchronization information	X	C	C	The synchronization values for each handover attempt, each timestamped.
SCCP connection event	X	O	O	Each SCCP connection event used during the period of the trace invocation (Connection Request, Confirm, Refuse, Released, Released Complete), each timestamped.
BSSMAP message	X	C	C	L3 Message contents, during the period of the trace invocation, each timestamped, see GSM 08.08 [4].
DTAP message	X	O	O	L3 Message contents, during the period of the trace invocation each timestamped, see GSM 04.08 [2].
RR message	X	C	C	L3 Message contents, during the period of the trace invocation, each timestamped, see GSM 04.08 [2]. Only applies to those parts of the message between the BSC and the MS.
A-bis Messages	X	X	C	All Abis messages except measurement reports and power control, each timestamped, see GSM 08.58 [5].
Timed A-bis Messages	X	C	X	X Abis messages (except measurement reports and power control) received before and Y Abis messages received after a handover, each timestamped. X & Y are operator configurable parameters via MMI and are local to the GERAN.
Measurement Reports	X	X	C	All uplink and downlink measurement reports, each timestamped, see GSM 08.58 [5]. As a manufacturer option, the list of the ARFCN corresponding to frequency indexes indicated in MEASUREMENT REPORT message (see GSM 04.08 [2]) can be included in order to ease interpretation of the measurements relating to neighbour cells.
Timed Measurement Reports	X	C	X	X uplink and downlink measurement reports received before and Y measurement reports received after a handover, each timestamped. X & Y are operator configurable parameters via MMI and are local to the GERAN. As a manufacturer option, the list of the ARFCN corresponding to frequency indexes indicated in MEASUREMENT REPORT message (see GSM 04.08 [2]) can be included in order to ease interpretation of the measurements relating to neighbour cells.
Power Control Messages	X	X	C	All power control messages, each timestamped, see GSM 08.58 [5].
Timed Power Control Message	X	C	X	X power control messages received before and Y power control messages received after a handover, each timestamped. X & Y are operator configurable parameters via MMI and are local to the GERAN.
Record extensions	O	O	O	A set of network/ manufacturer specific extensions to the record.
Radio Channel Info 96	C	C	C	The radio channel types and descriptions used during multislot calls for the period of the trace invocation, each timestamped. If this field is present, the field Radio Channel Info shall be ignored.

7.8 S-CSCF Trace Record Content

FFS

7.9 P-CSCF Trace Record Content

FFS

7.10 HSS Trace Record Content

FFS

8 Creation of Trace Records

[Editor's note: NOTE that the clause needs to be re-thought and re-written according to the redefined objectives of the TS with respect to the management interfaces as defined by TS 32.101. This means that for the interface between the Network Element and the Network Element Manager only the requirements and a high level description of needed procedures will be specified in this TS. This means considerable changes to clauses (at least clauses 5.5.2 to the end of clause 5, clause 8, and clause 9) that are using terminology and approach inherited from GSM 12.08.]

8.1 General

As has already been stated, the sequence of events for the creation of a trace record is as follows:

a) Trace is activated for a particular IMSI or IMEI.

b) The subscriber undertakes such action as to cause an invoking event to start.

c) The compilation of a trace record commences in the NEF as described in the Trace Type and under the control of the traceRecord attribute recordCriteria. This allows trace records to be produced at times other than when the invoking event ends, e.g. after a specific event has occurred.

d) If a further invoking event occurs trace data related to this event is collected in the same trace record.

e) All invoking events end or the recordCriteria attribute is satisfied, (see 3) above), or for the GERAN only, an MSC INVOKE TRACE message is received with the GERAN record type field set to "No GERAN Trace" and the message relates to an ongoing trace.

f) The record is forwarded to the OSF or local filestore (depending on priority).

In certain circumstances it may be undesirable for the invoking event to have to end before the record is forwarded to the OSF or local filestore. Examples of these circumstances may be:

- The operator requires to know a subscriber's whereabouts at the moment he starts making a call.

- The operator requires to know when a handover occurs, as soon as it occurs.

- The buffer in the NEF may be too full to contain any more trace record data.

This is resolved through the use of the attribute recordCriteria in the traceControl object. When this attribute is set to anything other than noCriteria, records are forwarded to either the filestore or the OSF as soon as the specified criteria is satisfied.

8.2 Trace Record Control

8.2.1 General

The trace record collection and generation processes are controlled by the traceControl managed object class. There shall be one, and only one, instance of this object class for each NEF that supports the trace function. This object carries out the following functions:

- to cause the data to be collected in the NEF as defined by the Trace Type;
- to define the criteria by which records are generated;
- to generate the trace record notifications.

System management functions:

- Create traceControl;
- Delete traceControl;
- Get Attribute;
- Set Attribute.

Notifications:

- stateChange;
- objectCreation;
- objectDeletion;
- attributeValueChange;
- traceReport.

8.2.2 Attributes

There is one instance of this object class in each NEF that supports the trace function. It contains the following attributes:

Name	M/O	Value-Set
traceControlId	RDN	Single
administrativeState	M	Single
operationalState	M	Single
recordCriteria	M	Single
eventTypes	O	Single

traceControlId

This attribute is a unique identifier for the traceControl MOI in the NEF and is used as an RDN.

administrativeState

This attribute defines the administrative state of the traceControl MOI in the NEF (Recommendation X.731 [16]).

operationalState

This attribute defines the operational status of the traceControl MOI in the NEF (Recommendation X.731 [16]).

recordCriteria

This attribute, if set, defines the criteria by which trace records are generated in the NEF. It may have one or more of the following values:

noCriteria	The NEF will not output trace records of the event type.
event	The NEF will output a trace record every time a particular recordable event occurs, the nature of that event being defined in the attribute eventTypes.

In all cases, a trace record will be produced at the end of the invoking event, or if other criteria are set by the manufacturer, when these criteria are met.

eventTypes

This attribute defines a set of recordable events, the appearance of any will trigger a trace record to be output, assuming the "event" value is set in the recordCriteria attribute.

8.2.3 Other Trace Record Criteria

Regardless of the trace record criteria set by the operator, there are circumstances under which a trace record may be generated, with the criteria being set by the manufacturer. These will usually be due to a lack of resources such as "Buffer Full" or "Processor Overload".

9 Trace Record Transfer

[Editor's note: NOTE that the clause needs to be re-thought and re-written according to the redefined objectives of the TS with respect to the management interfaces as defined by TS 32.101. This means that for the interface between the Network Element and the Network Element Manager only the requirements and a high level description of needed procedures will be specified in this TS. This means considerable changes to clauses (at least clauses 5.5.2 to the end of clause 5, clause 8, and clause 9) that are using terminology and approach inherited from GSM 12.08.]

The text will be updated. The protocol for the transfer has to be chosen.

At least two kinds of trace record transfer are needed:

- Bulk record transfer;
- Event reporting.

10 Format of the Trace Records

[Editor's note 1: As agreed in SA5#23 the formats to be defined are ASN.1 and XML. The definitions will be moved to annex A]

[Editor's note 2: As agreed in SA5#23 the GDMO definitions shall be removed and replaced by another notation, which is still FFS.]

[Editor's note 3: In this draft version of this TS clause 10 is empty on purpose. The formats are FFS.]

Annex A (normative): Trace Report File Format

[Editor's note: Structure like in 32.401, contents to be provided later.]

Annex <B> (normative): Trace Report File Conventions and Transfer Procedure

[Editor's note: Structure like in 32.401, contents to be provided later.]

Annex C (informative): Trace Functional Architecture

[Editor's note: The contents of clause 4 in the previous version were moved to this annex.]

Figure 1 gives an outline of the subscriber and equipment tracing in the UMTS network and shows the relationship between the inputs on activation and deactivation and the trace record outputs.

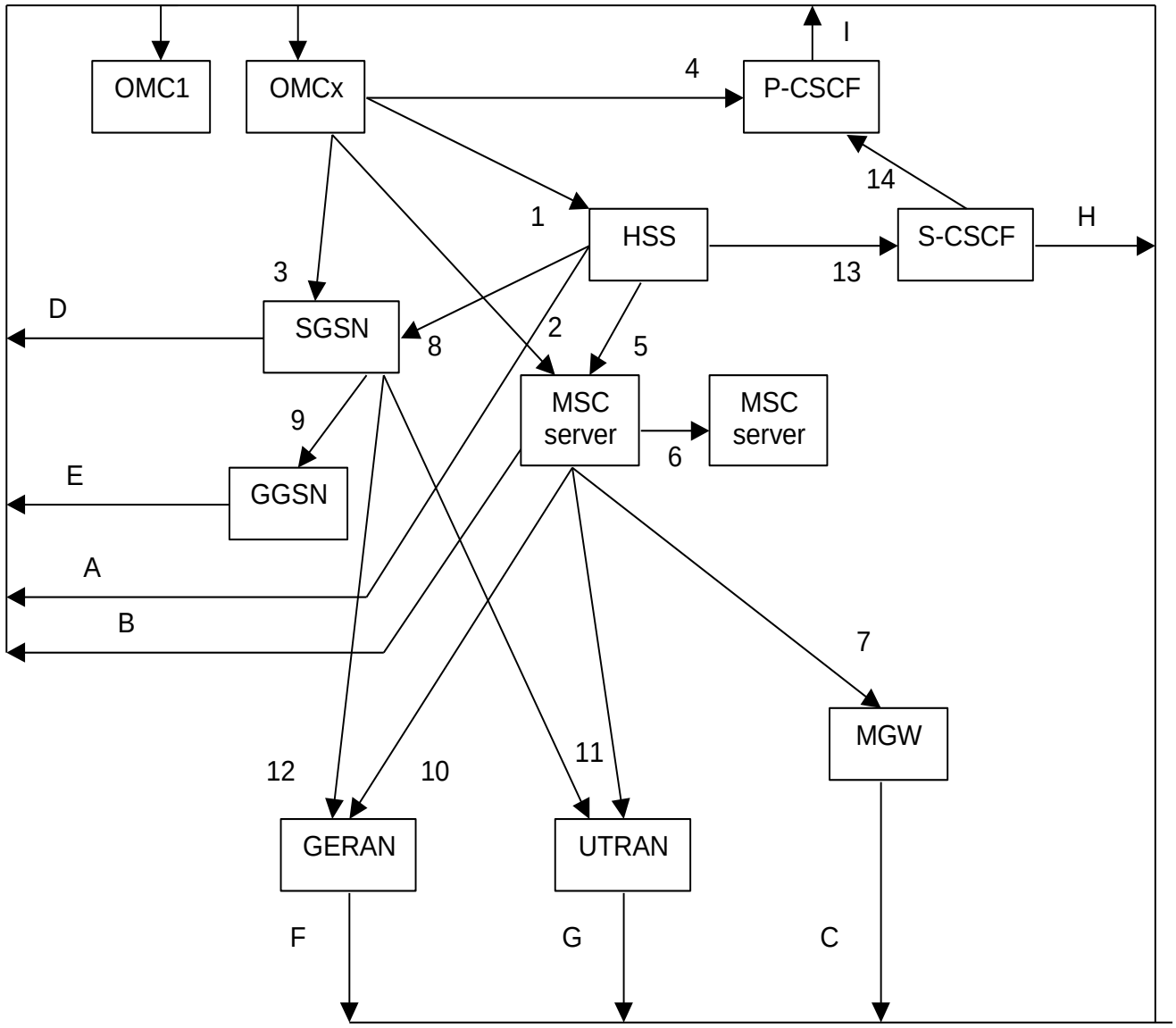

Figure 1: Subscriber and Equipment Trace

Table 1: Trace Activation Transactions for the NEs

Index	Command	Content
1	**Trace Activation (32.108)**	IMSI, Trace Reference, OMC Destination, Trace Type, HSS Trace type
2a	**Trace Activation (32.108)**	IMSI, Trace Reference, OMC Destination, Trace Type
2b	**Trace Activation (32.108)**	IMEI, Trace Reference, OMC Destination, Trace Type
3	**Trace Activation (32.108)**	IMSI, Trace Reference, OMC Destination, Trace Type
3b	**Trace Activation (32.108)**	IMEI, Trace Reference, OMC Destination, Trace Type
4	**Trace Activation (32.108)**	private ID, Trace Reference, OMC Destination, Trace Type
5a	**MAP-ACTIVATE-TRACE-MODE (09.02)**	IMSI, Trace Reference, OMC Destination, Trace Type
5b	**MAP-DEACTIVATE-TRACE-MODE**	IMSI, Trace Reference
6	**MAP-PREPARE-HANDOVER (09.02)**	(Contains MSC_INVOKE_TRACE_MESSAGE)
7a	**H.248-ADD(Trace Package)**	IMSI, Trace Reference, OMC Destination, Trace Type, Trace Activity Control
8a	**MAP-ACTIVATE-TRACE-MODE**	IMSI, Trace Reference, OMC Destination, Trace Type
8b	**MAP-DEACTIVATE-TRACE-MODE**	IMSI, Trace Reference
9	Create-PDP-Context-Request	IMSI, Trace Reference, OMC Destination, Trace Type
10	**MSC-INVOKE-TRACE (08.08)**	Message Type, IMSI or IMEI, Trace Reference,Trigger Id, OMC Id, Trace Type, Transaction Id
11a	**CN_INVOKE_TRACE (25.413)**	Trace Reference,Trigger Id, OMC Id, Trace Type
11b	**CN_DEACTIVATE_TRACE (25.413)**	Trace Reference,Trigger Id
12	SGSN-Invoke-Trace	IMSI, TLLI – Temporary Logic Link Identity, Trace Reference, Trace Type, OMC Id
13a	**Cx-Push (Trace activation package)**	Subscriber Identification, Trace Reference, OMC Destination, Trace Type
13b	**Cx-Pull-Resp (Trace activation package)**	Subscriber Identification, Trace Reference, OMC Destination, Trace Type
14	**SIP Subscribe request (3GPP trace event)**	Subscriber Identification, Trace Reference, OMC Destination, Trace Type
		Note: Subscriber identification is FFS

Table 2: Trace Record Contents

index	Trace Record Generation (spec. number)	index	Trace Record Generation (spec. number)
A	a) Trace Record Header b) HSS Trace Record	F	a) Trace Record Header b) GERAN Trace Record
B	a) Trace Record Header b) MSC server Trace Record	G	a) Trace Record Header b) UTRAN Trace Record
C	a) Trace Record Header b) MGW Trace Record	H	a) Trace Record Header b) S-CSCF Trace Record
D	a) Trace Record Header b) SGSN Trace Record	I	a) Trace Record Header b) P-CSCF Trace Record
E	a) Trace Record Header b) GGSN Trace Record		

Trace Activation and Deactivation are described in clause 5. The Trace Types are defined in clause 6. The Trace Records are defined in clause 7.

The following events may invoke a MSS, GPRS or GERAN/UTRAN trace:

- Call set-up within MSC (MOC, MTC) (incl. attempts);
- SS-Action;
- Location Update (Normal and Periodic);
- SMS-MO;

- SMS-MT;
- IMSI attach and detach;
- PDS-MO;
- PDS-MT.

Additionally, the following event may invoke the GERAN/UTRAN trace:

- Handover.

[Editor's Note: The effect of different handover types shall be clarified later; see also clause 5.4.5.]

Additionally, the following event may invoke the GPRS trace:

- GPRS Attach/Detach;
- PDP Context Activation / Deactivation / Modification;
- Inter / Intra SGSN RA Update.

An IMS Trace may be invoked by one of the following:

- Subscriber registration/re-registration/de-registration;
- SIP call (INVITE session);
- SIP instant messaging (MESSAGE request);
- SIP presence messaging (NOTIFY request).

An HSS Trace may be invoked by one of the following:

- Location updates/cancellations;
- Insert/delete subscriber data;
- Routing enquiry (speech and SM);
- Provide roaming number;
- SS activity;
- SMS: Alert service centre/Ready for SM.

Trace records are generated within the managed elements by the trace control function according to the trace type. Once a trace has been invoked and a trace record is being compiled, subsequent invoking events relating to that IMSI or any other identifier (parallel events) will not cause new records to be compiled simultaneously but will be contained in the same trace record as the first event.

For operator defined trace types the events on which trace records are generated and their contents are defined within the trace record generation control.

[Editor's note: The rest seems to be out of context here.]

These records are then transferred to the OSF (as defined by OMC-Id of the Destination OMC or forwarded by the EFD) either as notifications (CMISE), or with bulk transfer (FTAM).

Annex D (informative): Trace Use Cases

Annex <X> (informative): Change history

It is usual to include an annex (usually the final annex of the document) for specifications under TSG change control which details the change history of the specification using a table as follows:

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
31.10.01					First draft created		0.0.1
					The results of SA5#24 incorporated	0.0.1	0.0.2