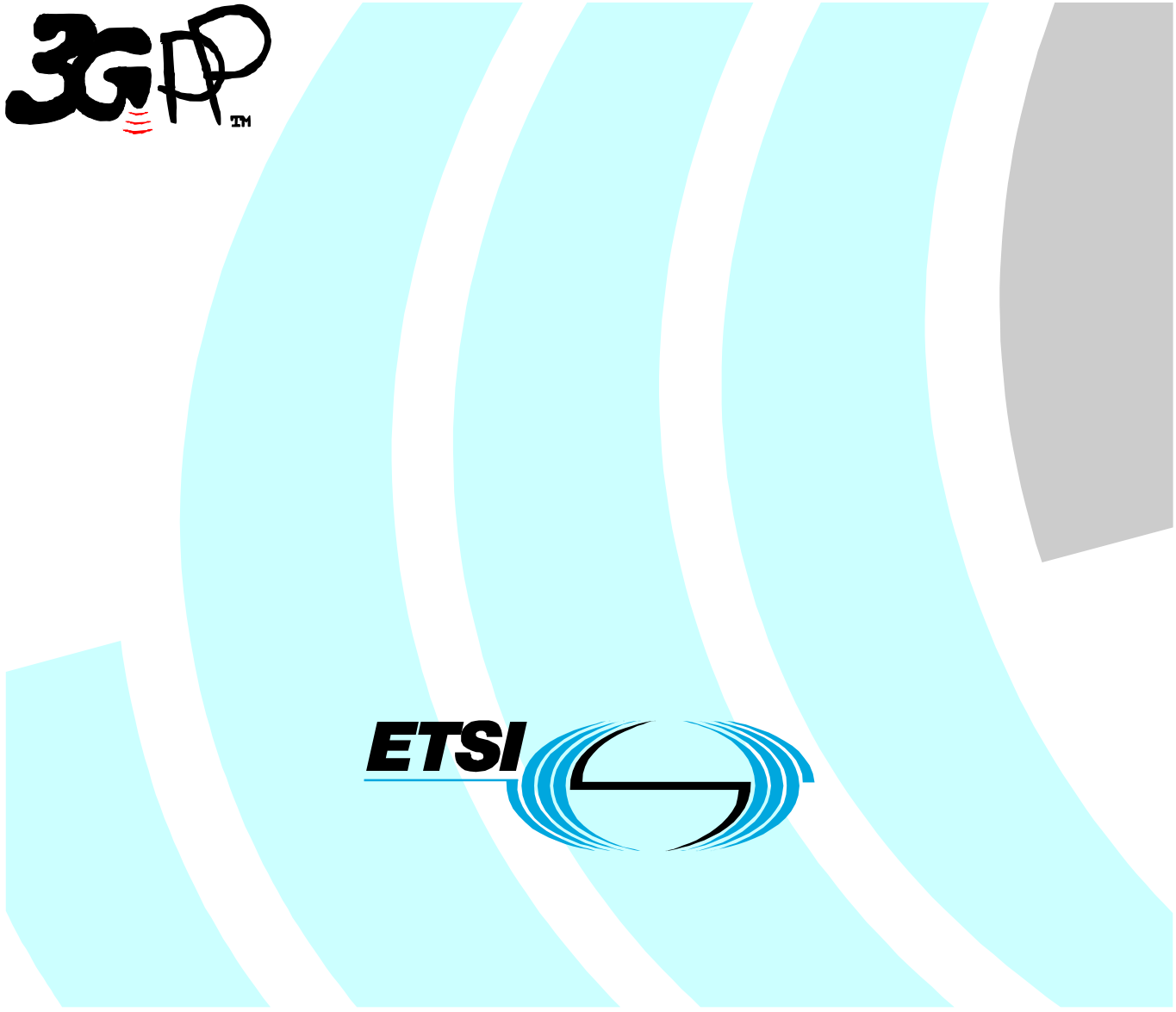
ETSI TS 132 422 V6.1.0 (2004-12)

Technical Specification

Universal Mobile Telecommunications System (UMTS);
Telecommunication management;
Subscriber and equipment trace;
Trace control and configuration management
(3GPP TS 32.422 version 6.1.0 Release 6)



Reference
DTS/TSGS-0532422v610

Keywords
UMTS

ETSI

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Foreword

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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:

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Introduction

The present document is part of the 32.42x-series covering the 3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Telecommunication management; Subscriber and equipment trace; as identified below:

TS 32.421: "Trace concepts and requirements";

TS 32.422: "Trace control and configuration management";

TS 32.423: "Trace data definition and management".

Additionally, there is a GSM only subscriber and equipment trace specification: 3GPP TS 52.008 [5].

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

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

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

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

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

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

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

1 Scope

The present document describes the mechanisms used for the control and configuration of the Trace functionality at the EMs and NEs. It covers the triggering events for starting/stopping of subscriber/MS activity traced over 3GPP standardized signalling interfaces, the types of trace mechanisms, configuration of a trace, level of detail available in the trace data, the generation of Trace results in the Network Elements (NEs) and the transfer of these results to one or more EM(s) and/or Network Manager(s) (NM(s)).

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

2 References

The following documents contain provisions, which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TS 32.101: "Telecommunication management; Principles and high level requirements".

[2] 3GPP TS 32.421: "Telecommunication management; Subscriber and equipment trace: Trace concepts and requirements".

[3] 3GPP TS 32.423: "Telecommunication management; Subscriber and equipment trace: Trace data definition and management".

[4] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[5] 3GPP TS 52.008: "Telecommunication management; GSM subscriber and equipment trace".

[6] 3GPP TS 23.060: "General Packet Radio Service (GPRS) Service description; Stage 2".

[7] 3GPP TS 23.205: "Bearer-independent circuit-switched core network; Stage 2".

[8] 3GPP TS 23.108: "Mobile radio interface layer 3 specification core network protocols; Stage 2 (structured procedures)".

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

3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [4], 3GPP TS 32.101 [1] and the following apply:

P-CSCF Proxy - Call Session Control Function

4 Trace activation and deactivation

4.1 Trace session activation / deactivation

4.1.2 Management activation

4.1.2.1 General

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

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

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

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

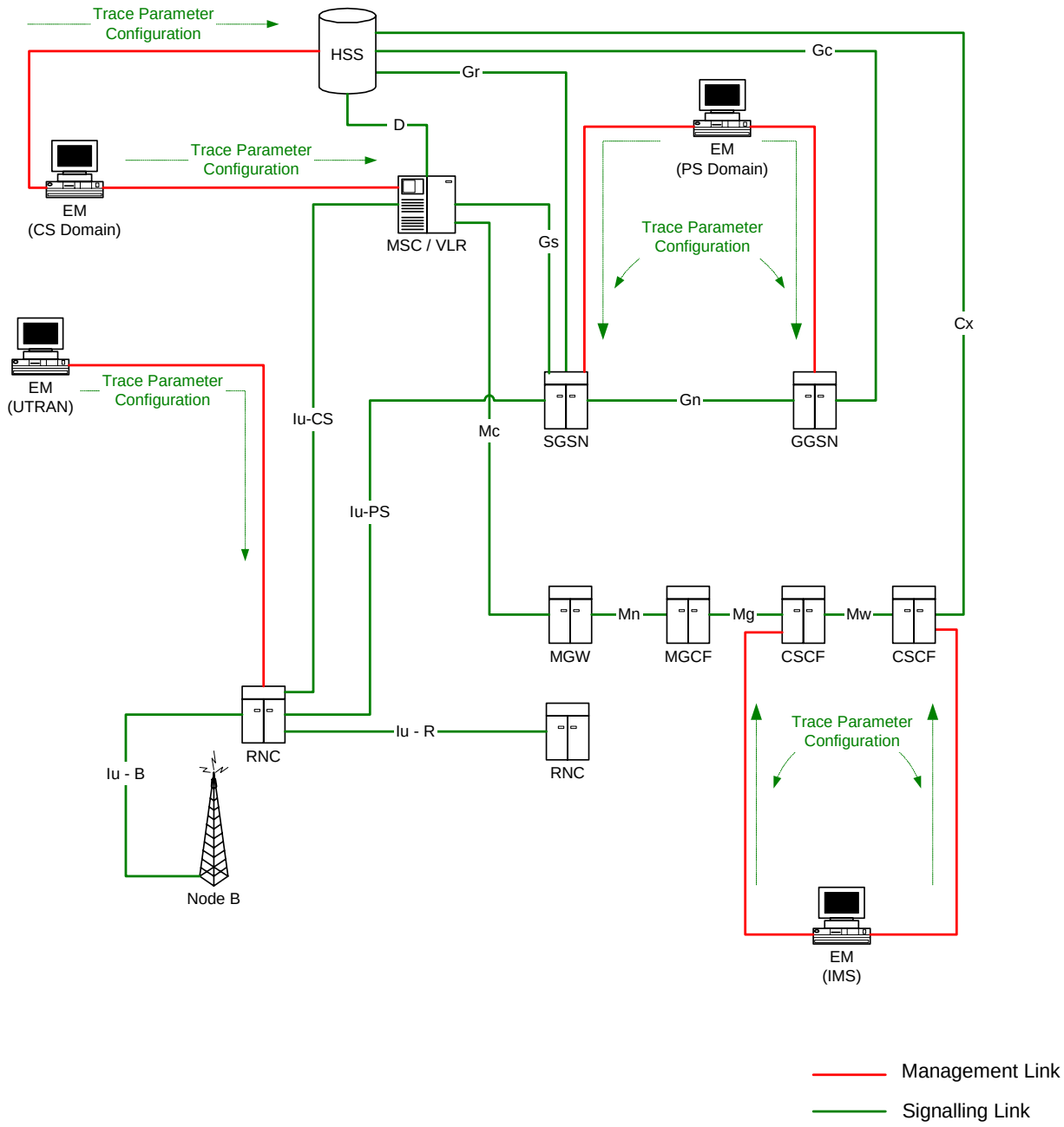


Figure 4.1.1: Overview of management activation

4.1.2.2 UTRAN activation mechanisms

When an RNC receives Trace Session activation from the EM it shall start a Trace Session. The trace control and configuration parameters of the Trace Session are received in Trace Session activation from the EM. The RNC shall not forward these trace control and configuration parameters to other nodes. The received trace control and configuration parameters shall be saved and used to determine when and how to start a Trace Recording Session. (Starting a Trace Recording Session is described in subclause 4.2.2.1). A Trace Session may be requested for a limited geographical area.

When the Trace session is requested for an IMEI(SV) or a list of IMEI(SV), the RNC shall send the requested IMEI(SV)/list of IMEI(SV)s in Uplink Information Transfer Indication to the interacting MSC Server(s) and SGSN(s). The MSC Servers and SGSNs shall store the requested IMEI(SV)s per RNC. For each subscriber/MS activity the MSC Servers and SGSNs shall request IMEI(SV), if it is not already provided. For each subscriber/MS activity the MSC server/SGSN shall check whether a trace request is active in an RNC for the IMEI(SV). If a match is found, the MSC Server/SGSN shall inform the RNC about the IMEI(SV) in CN Invoke Trace, so that the RNC can trace the control signalling according to the trace control and configuration parameters that are received from its EM.

If an Inter-MSC SRNS Relocation or an Inter-SGSN SRNS relocation occurs, the anchor MSC Server or source SGSN shall transfer the IMSI and IMEI(SV) for the subscriber/MS activity to the non anchor MSC Server or target SGSN. The non anchor MSC Server/target SGSN shall check whether it has received a trace request from the target RNC for the transferred IMEI(SV). If a match is found on the IMEI(SV) in the non anchor MSC Server/target SGSN, the MSC Server/SGSN shall inform the RNC about the IMEI(SV) in the CN Invoke Trace. The IMSI shall be transferred from the non anchor MSC Server/target SGSN to the target RNC in Relocation Request. The RNC can then trace the subscriber/MS activity according to the trace control and configuration parameters that are received from its EM.

4.1.2.3 PS Domain activation mechanisms

When a SGSN or GGSN receives Trace Session activation from the EM it shall start a Trace Session. The trace control and configuration parameters of the Trace Session are received in the Trace Session activation from the EM. The SGSN/GGSN shall not forward these trace control and configuration parameters to other nodes. The received trace control and configuration parameters shall be saved and used to determine when and how to start a Trace Recording Session. (Starting a Trace Recording Session is described in subclause 4.2.2.2)

4.1.2.4 CS Domain activation mechanisms

When a MSC Server receives Trace Session activation from the EM it shall start a Trace Session. The trace control and configuration parameters of the Trace Session are received in the Trace Session activation from the EM. The MSC Server shall not forward these trace control and configuration parameters to other nodes. The received trace control and configuration parameters shall be saved and used to determine when and how to start a Trace Recording Session. (Starting a Trace Recording Session is described in subclause 4.2.2.3)

4.1.2.5 IP Multimedia Subsystem activation mechanisms

When a S-CSCF/P-CSCF receives Trace Session activation from EM, the S-CSCF/P-CSCF shall start a Trace Session. The Trace control and configuration parameters of the Trace Session, received from EM in the Trace Session activation, shall be saved. The Trace control and configuration parameters define when the S-CSCF and P-CSCF shall start and stop a Trace Recording Session. For detailed information on starting and stopping Trace Recording Session in IMS see sub clauses 4.2.2.4 and 4.2.4.4.

Figure 4.1.2 illustrates the Trace Session activation in S-CSCF and in P-CSCF in case of Management based activation.

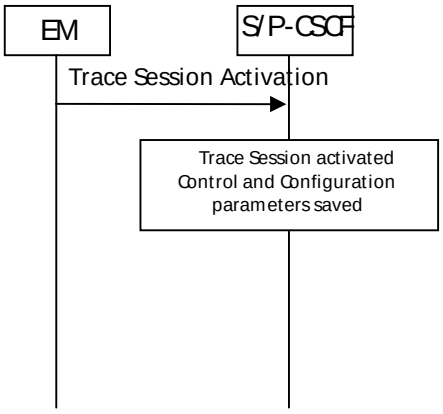


Figure 4.1.2: Trace Session activation in IMS

4.1.3 Signalling activation

4.1.3.1 General

In Signalling activation, the Trace Activation shall be carried out from the Core Network EM only [EM (PS), EM (CS), and EM (HSS) are generally considered to be in the Core Network. A Core Network EM can be any of these or their combinations].

In case of home subscriber trace (i.e. in the HPLMN) the Trace Session activation shall go to the HSS / MSC Server / SGSN. Instances where the home subscriber is roaming in a VPLMN, the HSS may initiate a trace in that VPLMN. The VPLMN may reject such requests.

In case of foreign subscriber trace (i.e. the HPLMN operator wishes to trace foreign subscribers roaming in his PLMN) the Trace Session activation shall go the MSC Server/VLR or SGSN. Depending on the Trace Control and Configuration parameters received, the Core Network shall propagate the activation to selected NE's in the entire network – UTRAN and CN.

4.1.3.2 Intra PLMN signalling activation

Figure 4.1.3 presents the signalling based trace functionality within a PLMN. The figure represents a typical PLMN network. A dotted arrow with "Trace Parameter Configuration" represents the availability of the trace functionality at the EM for that domain. E.g. you cannot invoke a Signalling Trace at the EM (UTRAN) because there is no such arrow shown in the figure. You can however do it from the EM (CS Domain). Similarly "Trace Parameter Propagation" is allowed only for the interfaces indicated in the figure. E.g. there is no parameter propagation over Iu-B.

NOTE: For tracing on the basis of IMEI(SV), the signalling based activation can be only initiated from the MSC/VLR or SGSN.

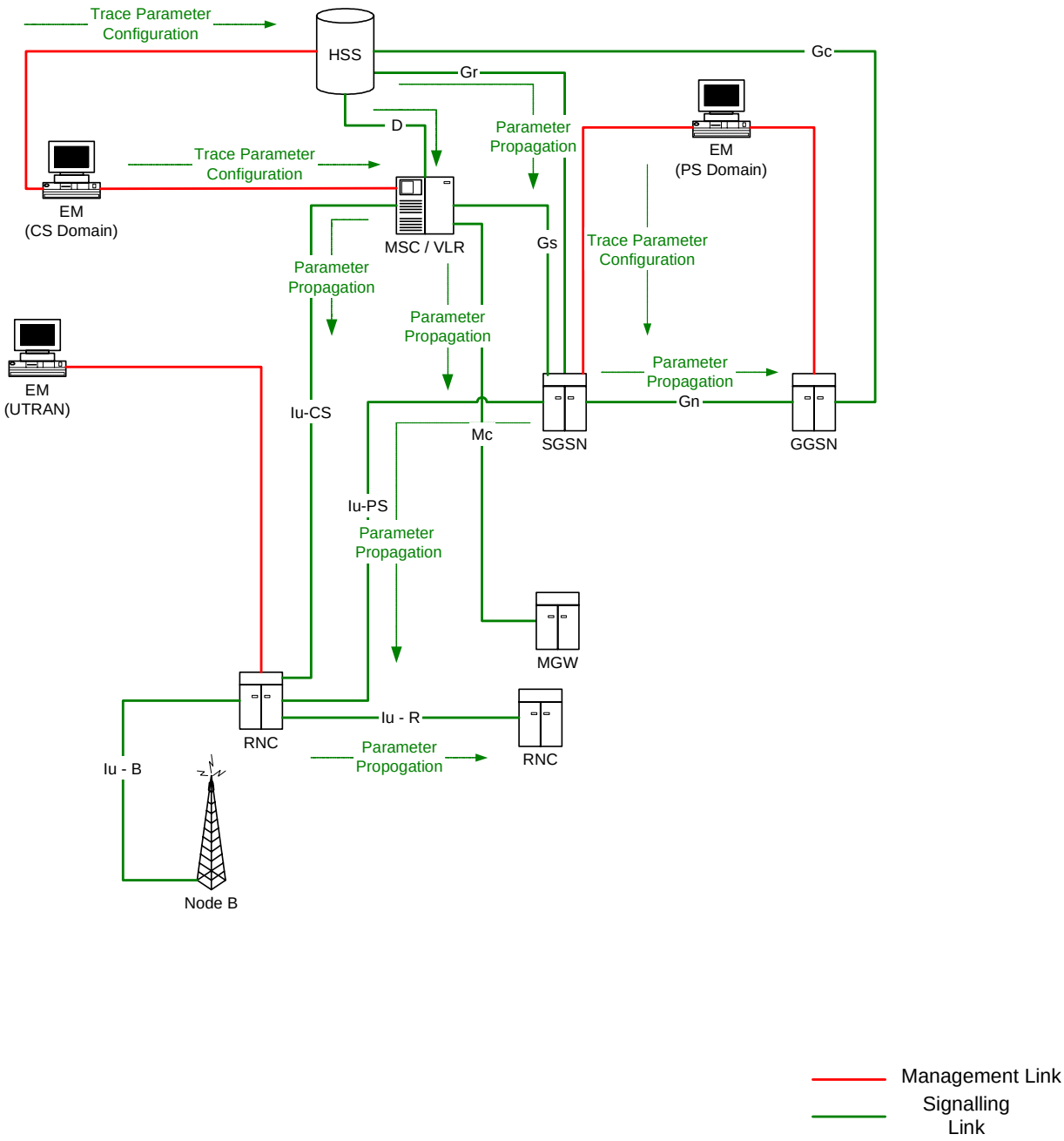


Figure 4.1.3: Overview of Intra-PLMN Signalling Activation

4.1.3.3 Inter PLMN Signalling Activation

Figure 4.1.4 presents the signalling based trace functionality between PLMNs. This is particularly useful when a roaming subscriber needs to be traced in a network. The figure represents a typical PLMN network and its connections with another PLMN"s HSS. A dotted arrow with "Trace Parameter Configuration" represents the availability of the trace functionality at the EM for that domain. E.g. you cannot invoke a Signalling Trace at the EM (UTRAN) because there is no such arrow shown in the figure. You can however do it from the EM (CS Domain). Similarly "Trace Parameter Propagation" is allowed only for the interfaces indicated in the figure. E.g. there is no parameter propagation over Iu-B.

NOTE: There is no intention to allow tracing of a home subscriber roaming in a foreign network i.e. the trace function is limited to a single PLMN.

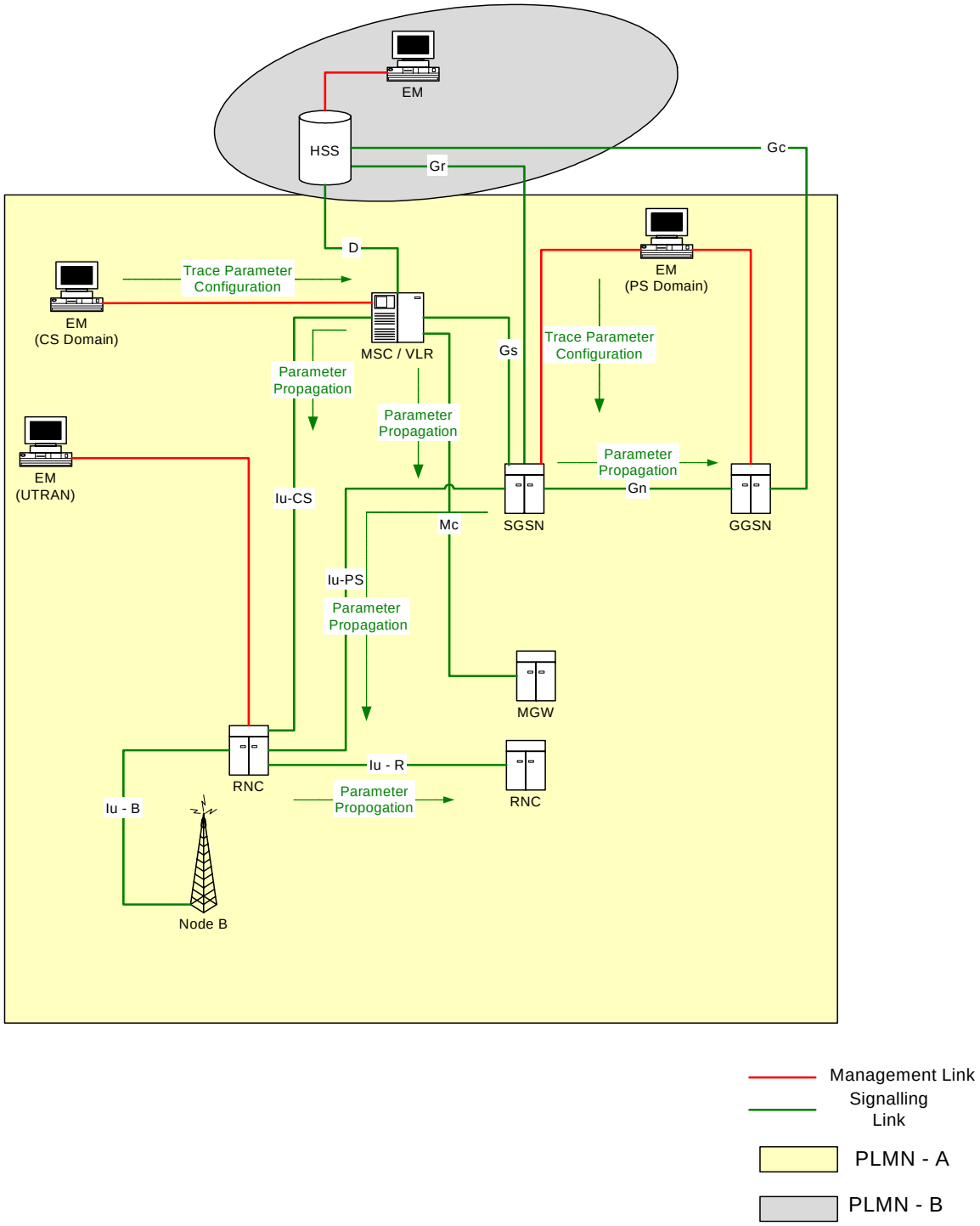


Figure 4.1.4: Overview of Inter-PLMN Signalling Activation

4.1.3.4 UTRAN activation mechanisms

See subclause 4.2.3.1.

4.1.3.5 PS Domain activation mechanisms

Figure 4.1.5 shows the Trace Session activation in the PS domain. The figure is an example of tracing PDP context.

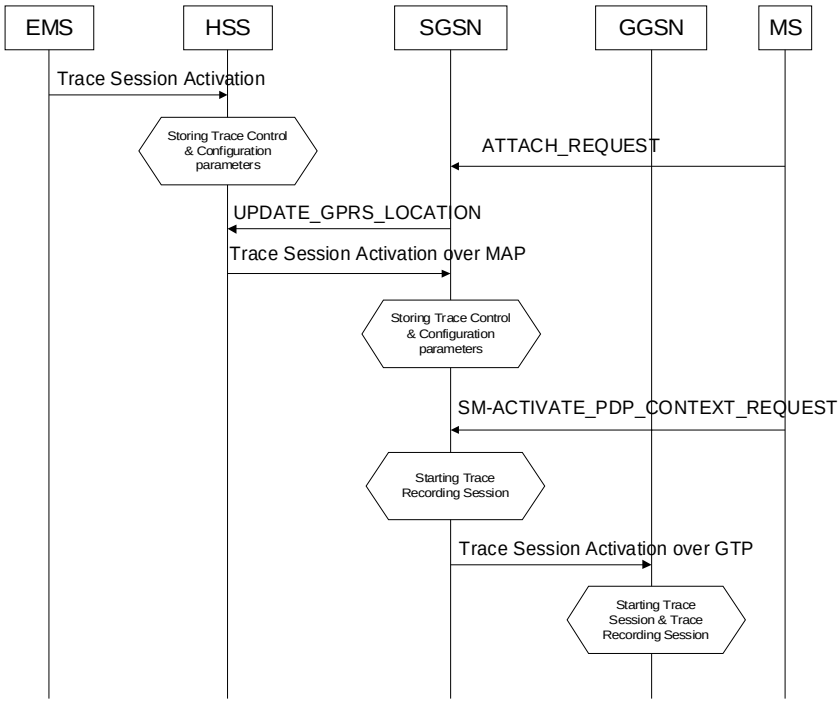


Figure 4.1.5: Trace session activation in PS domain

When HSS receives a Trace Session activation from its EMS, it shall store the received trace control and configuration parameters.. At this point a Trace Session shall be started in the HSS.

When a MS registers with the network by sending an ATTACH_REQUEST message to the SGSN, it updates the location information in the HSS by sending the UPDATE_GPRS_LOCATION message to the HSS. The HSS checks if the MS is being traced. If it is being traced, the HSS shall propagate the trace control and configuration parameters to the SGSN by sending a Trace Session Activation message to the SGSN. When an inter-SGSN routing area update occurs, HSS shall send the Trace Session Activation message to the new SGSN.

When SGSN receives the Trace Session activation message it shall store the trace control and configuration parameters and shall start a Trace Session.

When any of the triggering events defined in the trace control and configuration parameters occur, (e.g. PS session is started (i.e. a ACTIVATE PDP CONTEXT REQUEST message is received from the MS)) the SGSN shall propagate the trace control and configuration parameters to the GGSN and to the radio network by sending a Trace Session activation message, if it is defined in the trace control and configuration parameters (NE types to trace). The Trace Session activation to UTRAN is described in sub clauses 4.1.3.4.

When HSS sends the Trace Session activation message to SGSN it shall include the following parameters to the message:

- IMSI or IMEI (SV) (M).
- Trace reference (M).
- Triggering events (M).
- Trace Depth (M).
- List of NE types to trace (M).
- List of interfaces (O).

When the SGSN sends the Trace Session activation message to GGSN it shall include the following parameters to the message:

- IMSI or IMEI (SV) (M).

- Trace reference (M).
- Trace Recording Session Reference (M).
- Triggering events (M).
- Trace Depth (M).
- List of interfaces (O).

4.1.3.6 CS Domain activation mechanisms

Figure 4.1.6 shows the Trace Session activation in the CS domain. The figure is an example of tracing Mobile Originating Call.

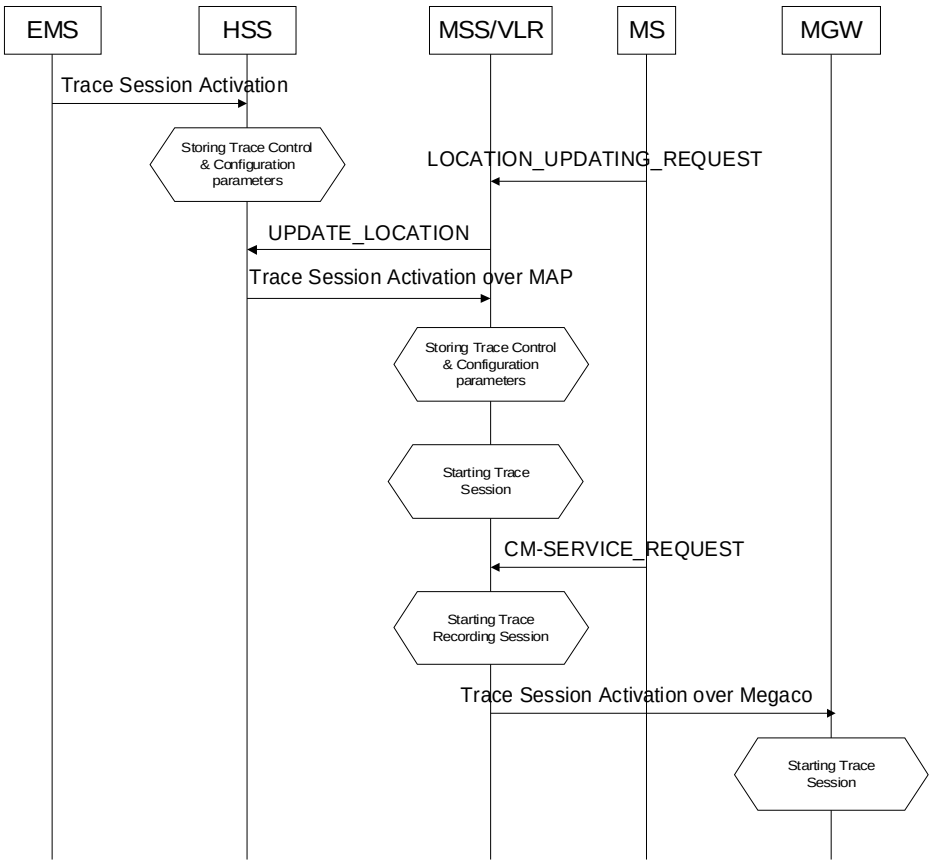


Figure 4.1.6: Trace Session Activation in CS domain

When HSS receives Trace Session activation from the EMS it should store the trace control and configuration parameters associated to the Trace Session.

If the MS registers to the network, by sending a LOCATION UPDATING REQUEST message to the MSC/VLR, the MSC Server/VLR updates the location information in the HSS by sending the MAP-UPDATE_LOCATION message to the HSS. After receiving the UPDATE_LOCATION message HSS shall propagate the trace control and configuration parameters by sending a Trace Session Activation message to the MSC Server/VLR.

When the MSC Server/VLR receives a Trace Session activation message from the HSS, it shall store the trace control and configuration parameters.

When any of the triggering event, defined in the trace control and configuration parameters, occurs (e.g. in case of Mobile Originating Call is started (i.e. the MSC Server receives the CM_SERVICE_REQUEST message with service type set to originating call establishment)) the MSC Server should propagate the trace control and configuration parameters to the MGW and to the radio network if it is defined in the trace control and configuration parameters (NE types to trace). Trace Session activation for UTRAN is described in sub clauses 4.1.3.4. In case of inter-MSC Server handover the MSC Server-A should propagate the trace control and configuration parameters to the MSC Server-B.

When HSS sends the Trace Session activation message to MSC Server it shall include the following parameters to the message:

- IMSI or IMEI (SV) (M).
- Trace reference (M).
- Triggering events (M).
- Trace Depth (M).
- List of NE types to trace (M).
- List of interfaces (O).

When the MSC Server sends the Trace Session activation message to MGW it shall include the following parameters to the message:

- IMSI or IMEI (SV) (M).
- Trace reference (M).
- Trace Recording Session Reference (M).
- Triggering events (M).
- Trace Depth (M).
- List of interfaces - (O).

4.1.3.7 Void

4.1.3.8 Tracing roaming subscribers

If a HPLMN operator activates a Trace Session for a home subscriber, while it (MS) is roaming in a VPLMN, it (HSS) may restrict the propagation of the Trace Session activation message to a MSC Server/VLR or to a SGSN located in the VPLMN.

Also, a MSC Server/VLR or a SGSN located in a VPLMN may accept any Trace Session activation message(s) coming from an HSS located in another PLMN. However, there shall be a capability to reject activations from another PLMN.

4.1.4 Management deactivation

4.1.4.1 UTRAN deactivation mechanisms

When last Trace session is requested to be ended for an IMEI(SV) or a list of IMEI(SV), the RNC shall send the requested IMEI(SV)/list of IMEI(SV)s in Uplink Information Transfer Indication to the interacting MSC Server(s) and SGSN(s). The MSC Servers and SGSNs shall remove the requested IMEI(SV)s for the RNC in question.

4.1.4.2 PS Domain deactivation mechanisms

When a SGSN or GGSN receives a Trace Session Deactivation from its EM, the Trace Session identified by the Trace Reference, shall be deactivated in SGSN/GGSN.

If a Trace Recording Session is active at the time of receiving a Trace Session deactivation from the EM, the SGSN/GGSN may choose to continue the Trace Recording Session till it ends gracefully or may stop it immediately. In all cases, the SGSN/GGSN shall deactivate the requested Trace Session immediately at the end of the Trace Recording Session.

4.1.4.3 CS Domain deactivation mechanisms

When a MSC Server receives a Trace Session Deactivation from its EM, the Trace Session identified by the Trace Reference, shall be deactivated in MSC Server.

If a Trace Recording Session is active at the time of receiving a Trace Session deactivation from the EM, the MSC Server may choose to continue the Trace Recording Session till it ends gracefully or may stop it immediately. In all cases, the MSC Server shall deactivate the requested Trace Session immediately at the end of the Trace Recording Session.

4.1.4.4 IP Multimedia Subsystem deactivation mechanisms

When a S-CSCF/P-CSCF receives a Trace Session deactivation from the EM, the Trace Session identified by the Trace Reference, shall be deactivated.

If a Trace Recording Session is active at the time of receiving a Trace Session deactivation from the EM, the S-CSCF/P-CSCF may choose to continue the Trace Recording Session till it ends gracefully or may stop it immediately. In all cases, the S-CSCF/P-CSCF shall deactivate the requested Trace Session immediately at the end of the Trace Recording Session.

Figure 4.1.7 illustrates how the Trace Session is deactivated when a Trace Recording Session is going on (e.g. a SIP INVITE method is being traced in S-CSCF).

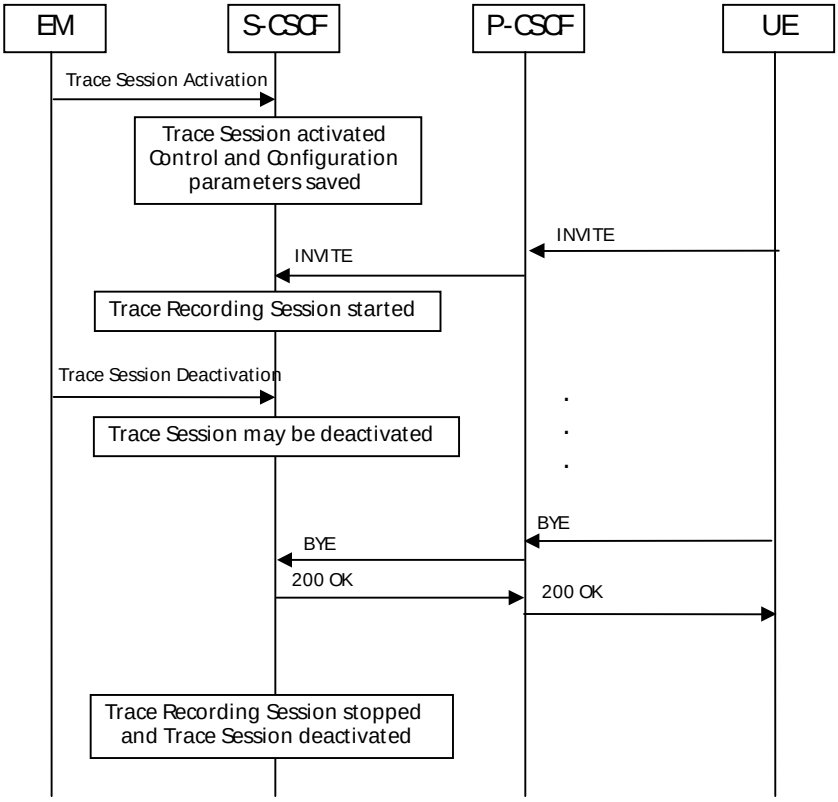


Figure 4.1.7: Trace session deactivation in IMS

4.1.5 Signalling deactivation

4.1.5.1 General

In Signalling deactivation, the Trace Deactivation shall always be carried out from the Core Network EM only [EM (PS), EM (CS), and EM (HSS) are generally considered to be in the Core Network. A Core Network EM can be any of these or their combinations]. In case of home subscriber trace (i.e. in the HPLMN) the Trace Session deactivation shall go to the HSS, MSC Server/VLR, or SGSN. In case of foreign subscriber trace (i.e. the HPLMN operator wishes to deactivate tracing on foreign subscribers roaming in his PLMN) the Trace Session deactivation shall go the MSC Server/VLR or SGSN. The Management System shall deactivate the Trace Session in the same NE where it activated the Trace Session.

When an HSS receives a Trace Session deactivation from its Management system, it shall deactivate the active Trace Session corresponding to the Trace Reference received in the deactivation message. The HSS shall delete all trace control and configuration parameters associated with this Trace Session. If a Trace Recording Session is active at the time of receiving a Trace Session deactivation message from the EM, the HSS may choose to continue the Trace Recording Session till it ends gracefully or may stop it immediately. In all cases, the HSS shall deactivate the requested Trace Session immediately at the end of the Trace Recording Session.

4.1.5.2 UTRAN deactivation mechanisms

When RNC receives the CN_DEACTIVATE_TRACE message it shall deactivate the Trace Session for the indicated Trace Reference in the CN_DEACTIVATE_TRACE message. In case of simultaneous CS/PS connections, the trace session for the indicated trace reference shall be closed upon reception of the CN DEACTIVATE TRACE message from any of the CN domain, whether it was the one which initiated trace session activation or not.

The Trace Session is also deactivated in the RNC when the Iu connection to the Core Network is released.

If CN_INVOKE_TRACE message is received for only one Iu connection (either CS or PS) the Trace Session shall be deactivated in the RNC when the IU_RELEASE_COMMAND message is received from the Core Network for that Iu connection where the CN_INVOKE_TRACE message is sent.

The following figure shows this behaviour:

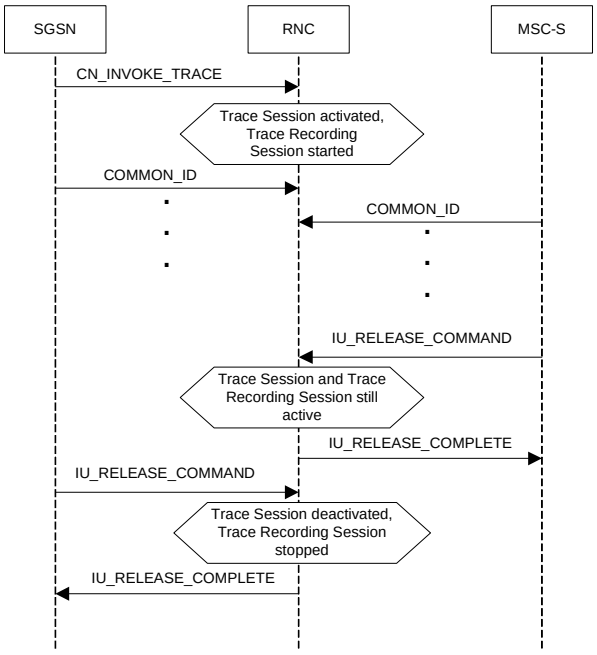


Figure 4.1.8: Trace session deactivation (Signalling) in UTRAN

If CN_INVOKE_TRACE message is received by the RNC for both Iu-CS and Iu-PS connection with the same Trace Reference number than the Trace Session shall not be deactivated in the RNC when any of the Iu connection is released (when the first IU_RELEASE_COMMAND message is received). The Trace Session shall be deactivated when the second Iu connection is released (the second IU_RELEASE_COMMAND message is received). The following figure shows the situation.

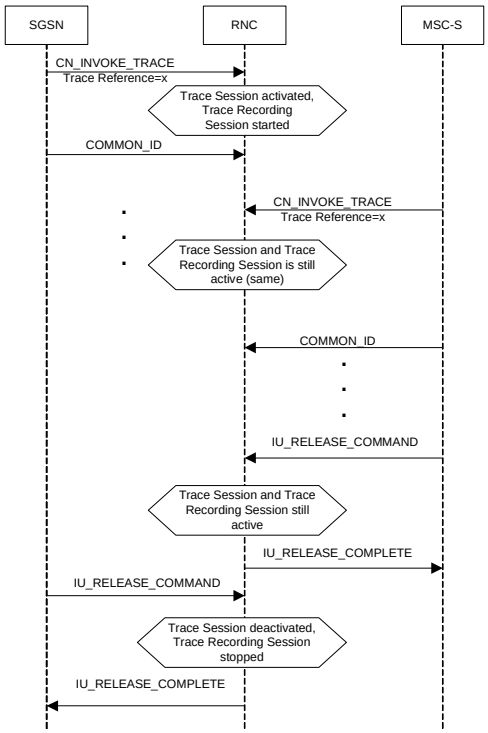


Figure 4.1.9: Trace session deactivation (Signalling) in PS Domain

Interaction with Soft-handover

The Trace Session should be deactivated in a Drift RNC when the DRNC receives the IUR_DEACTIVATE_TRACE message or the Iur connection is released.

When an RNC deactivates a Trace Session the Trace Recording Session shall also be stopped at the same time.

NOTE: In RNC the Trace Session and the Trace Recording Session always the same.

4.1.5.3 PS Domain deactivation mechanisms

When an HSS receives a Trace Session deactivation from the Management System it shall send a MAP_DEACTIVATE_TRACE_MODE message to the SGSN.

When the SGSN receives a MAP_DEACTIVATE_TRACE_MODE message it shall deactivate the Trace Session identified by the Trace reference received in the MAP_DEACTIVATE_TRACE_MODE message.

If a Trace Recording Session is active at the time of receiving a deactivation message, the SGSN (receiving it from the HSS) and/or the GGSN (receiving it from the SGSN) may choose to continue the Trace Recording Session till it ends gracefully or may stop it immediately. In all cases, the SGSN/GGSN shall deactivate the requested Trace Session immediately at the end of the Trace Recording Session. When the SGSN deactivates the Trace Session, it shall delete all trace control and configuration parameters associated with the corresponding Trace Session.

4.1.5.4 CS Domain deactivation mechanisms

When an HSS receives Trace Session deactivation from the Management System it shall send a MAP_DEACTIVATE_TRACE_MODE message to the MSC Server.

When the MSC Server receives a MAP_DEACTIVATE_TRACE_MODE message it shall deactivate the Trace Session identified by the Trace reference received in the MAP_DEACTIVATE_TRACE_MODE message.

If a Trace Recording Session is active at the time of receiving a MAP_DEACTIVATE_TRACE_MODE message from the HSS, the MSC Server may choose to continue the Trace Recording Session till it ends gracefully or may stop it immediately. In all cases, the MSC Server shall deactivate the requested Trace Session immediately at the end of the Trace Recording Session. When the MSC Server deactivates the Trace Session it shall delete all trace control and configuration parameters associated with the corresponding Trace Session.

4.1.5.5 Void

4.2 Trace recording session Start / Stop triggering

4.2.1 General

Editor's Note: For further study.

The Trace Session activation contains the triggering events parameter. The actual start/stop triggering events corresponding to the values of the triggering events parameter are defined in triggering events tables in sub-clause 5.1 in the present document.

4.2.2 Starting a trace recording session - management based

4.2.2.1 UTRAN starting mechanisms

Editor's Note: For further study.

4.2.2.2 PS Domain starting mechanisms

In a SGSN/GGSN, a Trace Recording Session should start after the reception of a Trace Session Activation from EM and if any of the defined *start triggering events* occur. During the Trace Recording Session, the SGSN/GGSN shall record those signalling messages in the interfaces that are defined in the *list of interfaces* parameter. The *Trace Depth* parameter defines whether entire signalling messages or just some IEs need to be recorded.

The SGSN/GGSN may not start a Trace Recording Session if there are insufficient resources available for the recording.

If the SGSN/GGSN receives the Trace Session Activation during an established session (e.g. during an active PDP context), it *may* start the Trace Recording Session immediately. However, if any of the start triggering events occur in the SGSN/GGSN after receiving the Trace Session Activation, it shall start the Trace Recording Session.

When a Trace Recording Session is started, the SGSN/GGSN shall assign a Trace Recording Session Reference for the Trace Recording Session.

4.2.2.3 CS Domain starting mechanisms

In a MSC Server, a Trace Recording Session shall start after the reception of a Trace Session Activation from EM and if any of the defined *start triggering events* occur. During the Trace Recording Session, the MSC Server shall record those signalling messages in the interfaces that are defined in the *list of interfaces* parameter. The *Trace Depth* parameter defines whether entire signalling messages or just some IEs needs to be recorded.

The MSC Server may not start a Trace Recording Session if there are insufficient resources available for the recording.

If the MSC Server receives the Trace Session Activation during an established call, it *may* start the Trace Recording Session immediately. However, if any of the start triggering events occurs in MSC Server after receiving the Trace Session Activation, it shall start the Trace Recording Session.

When a Trace Recording Session is started, the MSC Server shall assign a Trace Recording Session Reference for the Trace Recording Session.

4.2.2.4 IP Multimedia Subsystem starting mechanisms

Editor's Note: For further study.

4.2.3 Starting a trace recording session - signalling based

4.2.3.1 UTRAN starting mechanisms

In an RNC the Trace Recording Session will always be the same as the Trace Session as no triggering events are defined in UTRAN. Therefore a Trace Recording Session should be started in an SRNC when the SRNC receives the CN_INVOKE_TRACE message from the Core Network. If the SRNC receives a second CN_INVOKE_TRACE message from the CN with the same Trace Reference that have been received in the first CN_INVOKE_TRACE message, a new Trace Recording Session should not be started as it is already started.

If the SRNC does not have enough resources it may not start a Trace Recording Session.

The Trace Recording Session Reference shall be the same as received in the CN_INVOKE_TRACE message.

In a DRNC the Trace Recording Session should be started when the DRNC receives the IUR_INVOKE_TRACE message. If the DRNC does not have enough resources it may not start a Trace Recording Session.

The Trace Session is activated to the RNC by sending a CN_INVOKE_TRACE message from the CN (MSC Server or SGSN). When RNC receives the CN_INVOKE_TRACE message it should immediately start a Trace Session and a Trace Recording Session according to the trace control and configuration parameters received in the CN_INVOKE_TRACE message.

If there are not enough resources in RNC to start a Trace Recording Session, the RNC may reject to start a Trace Recording Session. However the RNC shall start the Trace Session.

In the case RNC receives multiple CN INVOKE TRACE messages for the same subscriber or equipment (e.g. simultaneous CS/PS connections):

- If the Trace Reference is equal to an existing one, a new trace session and trace recording session shall not be started;
- If the Trace Reference is not equal to an existing one, a new trace session and trace recording session may be started.

The following figure shows an example for a CS call how the Trace Session is activated to RNC. In the example it is assumed that there is no PS connection at all during the CS call.

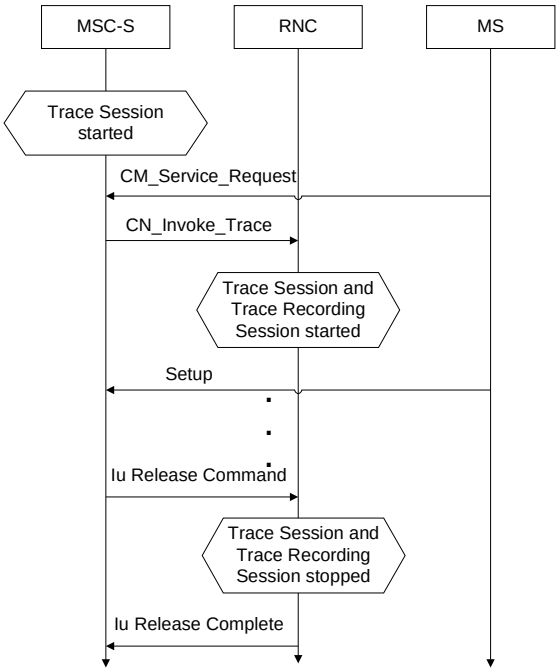


Figure 4.2.1: Starting a Trace Recording Session (Signalling) in UTRAN

Interaction with soft-handovers

If the subscriber or equipment, which is traced, makes a soft handover the SRNC should propagate the trace control and configuration parameters further to the DRNC by using the IUR_INVOKE_TRACE message. When the DRNC receives the IUR_INVOKE_TRACE message it should immediately start a Trace Session and a Trace Recording Session according to the trace control and configuration parameters received in the IUR_INVOKE_TRACE message.

If there are insufficient resources in the DRNC, the DRNC may not start a Trace Recording Session.

The Trace Recording Session Reference sent by the SRNC to the DRNC shall be the same what SRNC has received in the CN_INVOKE_TRACE message from the CN.

Interaction with Relocation

If the tracing shall continue also after the relocation has been performed, the CN Invoke Trace procedure shall be re-initiated from the CN towards the future SRNC after the Relocation Resource Allocation procedure has been executed successfully.

4.2.3.2 PS Domain starting mechanisms

In SGSN/GGSN a Trace Recording Session should start after the reception of a Trace Session Activation message and if any of the defined *start triggering events* occur. During the Trace Recording Session, the SGSN/GGSN shall record the signalling messages in the interfaces that are defined in the *list of interfaces* parameter. The *Trace Depth* parameter defines whether entire signalling messages or just some IEs need to be recorded.

The SGSN/GGSN may not start a Trace Recording Session if there are insufficient resources available for the recording.

In case of an established session, the SGSN may start the Trace Recording Session immediately after the reception of the Trace Session Activation message. However, if any of the start triggering events occurs in SGSN after receiving the Trace Session activation message, it shall start the Trace Recording.

When a Trace Recording Session is started in SGSN, it shall assign a Trace Recording Session Reference for the Trace Recording Session. When the SGSN propagates the Trace control and configuration parameters to GGSN or to UTRAN (I.e. activates a Trace Session in GGSN/UTRAN), it shall include the assigned Trace Recording Session Reference in the Trace Session Activation message. When an SGSN starts a Trace Recording Session and the list of NE types parameter requires GGSN tracing, it shall send the Trace Session activation message to GGSN. Also, when an SGSN

starts a Trace Recording Session and the list of NE types parameter requires RNC tracing, it shall send the Trace Session activation message to the RNC. In both cases the Trace Session and the Trace Recording Session in the receiving NE should start at the same time.

In case of SRNS relocation the SGSN shall send the CN_INVOKE_TRACE message to the new SRNC after the successful Relocation Resource Allocation procedure.

SGSN has to find the identity of the mobile before it activates a Trace Session towards other NE. The IMEI(SV) can be got from the Mobile by using the Identification procedure on the Iu interface.

When the SGSN sends the Trace Session activation (CN_INVOKE_TRACE) message to RNC it shall include the following parameters to the message:

- IMSI or IMEI (SV) (M).
- Trace reference (M).
- Trace Recording Session Reference (M).
- Trace Depth (M).
- List of interfaces (O).

4.2.3.3 CS Domain starting mechanisms

In MSC Server/MGW a Trace Recording Session should start after the reception of a Trace Session Activation message and if any of the defined *start triggering events* occur. During the Trace Recording Session the MSC Server/MGW shall record the signalling messages in the interfaces that are defined in the *list of interfaces* parameter. The *Trace Depth* parameter defines whether entire signalling messages or just some IEs need to be recorded.

The MSC Server may not start a Trace Recording Session if there are insufficient resources available for the recording.

In case of an established call, the MSC Server may start the Trace Recording Session immediately after the reception of the Trace Session Activation message. However, if any of the start triggering events occur in the MSC Server after receiving the Trace Session activation message, it shall start the Trace Recording Session.

When a Trace Recording Session is started in MSC Server, it shall assign a Trace Recording Session Reference for the Trace Recording Session. When the MSC Server propagates the Trace control and configuration parameters to MGW or to UTRAN (I.e. activates a Trace Session in MGW/UTRAN) it shall include the assigned Trace Recording Session Reference in the Trace Session Activation message.

When an MSC Server starts a Trace Recording Session and the list of NE types parameter requires MGW tracing, it shall send the Trace Session activation message to MGW. Also, when an MSC Server starts a Trace Recording Session and the list of NE types parameter requires RNC tracing, it shall send the Trace Session activation message to the RNC. In both cases the Trace Session and the Trace Recording Session in the receiving NE should start at the same time.

MSC Server has to find the identity of the mobile before it activates a Trace Session towards other NE. The IMEI(SV) can be got from the Mobile by using the Identification procedure on the Iu interface.

In case of SRNS relocation the MSC Server shall send the CN_INVOKE_TRACE message to the new SRNC after the successful Relocation Resource Allocation procedure. The following figure shows an example how the Trace Session is activated with CN_INVOKE_TRACE message in case of relocation.

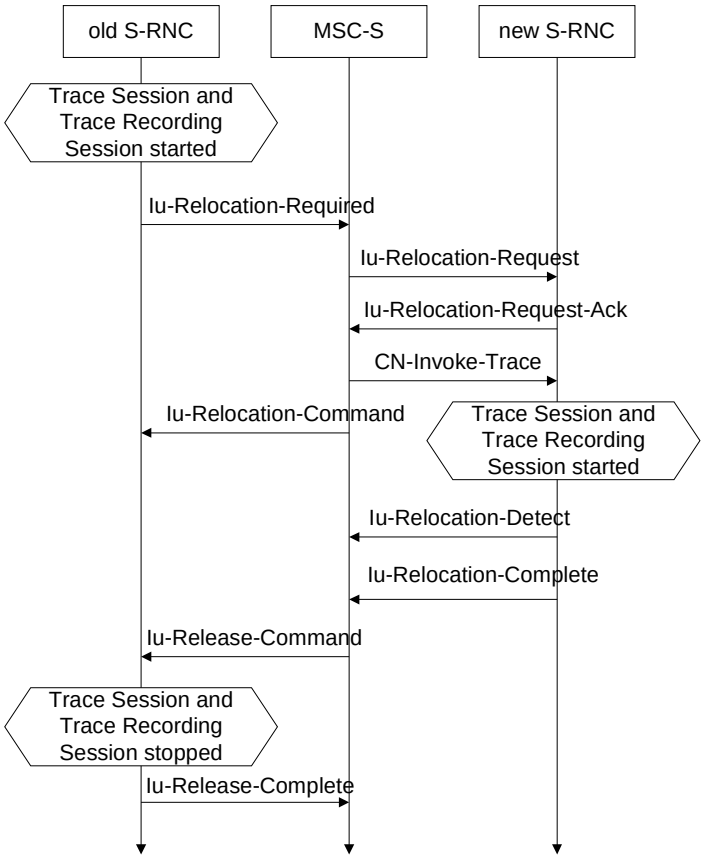


Figure 4.2.2: Starting a Trace Recording Session (Signalling) in CS Domain

When the new SRNC receives the CN_INVOKE_TRACE message it should start immediately a Trace Session and a Trace Recording session according to the trace control and configuration parameters received in the CN_INVOKE_TRACE message. The Trace Session shall automatically be deactivated in the old RNC when the Iu connection is released.

When the MSC Server sends the Trace Session activation (CN_INVOKE_TRACE) message to RNC it shall include the following parameters to the message:

- IMSI or IMEI (SV) (M).
- Trace reference (M).
- Trace Recording Session Reference (M).
- Trace Depth (M).
- List of interfaces to trace (O).

4.2.3.4 Void

4.2.4 Stopping a trace recording session - management based

4.2.4.1 UTRAN stopping mechanisms

Editor's Note: For further study.

4.2.4.2 PS Domain stopping mechanisms

In SGSN and GGSN a Trace Recording Session shall be stopped when any of the defined stop triggering events occur. If Trace Session deactivation is received during the Trace Recording Session, the SGSN is allowed to finish tracing of the on-going procedures (e.g. session). In this case the Trace Recording Session shall be stopped between the reception of the Trace Session deactivation and the appropriate stop-triggering event.

Figure 4.2.3 illustrates the successful case in tracing a PDP context when a Trace Recording Session is stopped.

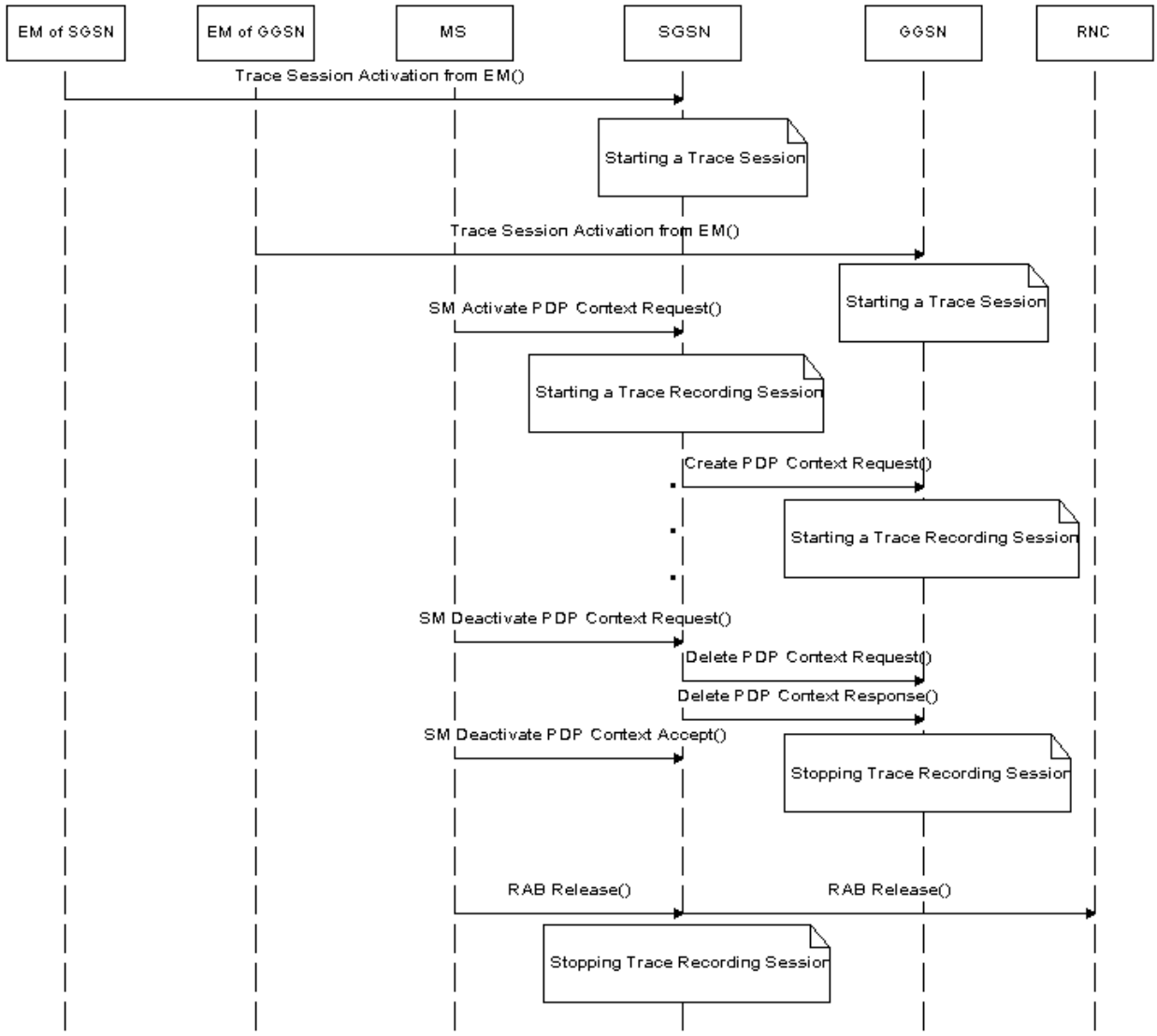


Figure 4.2.3: Stopping a Trace Recording Session (Management Based) - PS domain

4.2.4.3 CS Domain stopping mechanisms

In MSC Server a Trace Recording Session shall be stopped when any of the defined stop triggering events occur. If Trace Session deactivation is received during the Trace Recording Session, the MSC Server is allowed to finish tracing of the on-going procedures (e.g. calls). In this case the Trace Recording Session shall be stopped in MSC Server between the reception of the Trace Session deactivation and the appropriate stop-triggering event.

Figure 4.2.4 illustrates the successful case in tracing a call and the time of stopping a Trace Recording Session.

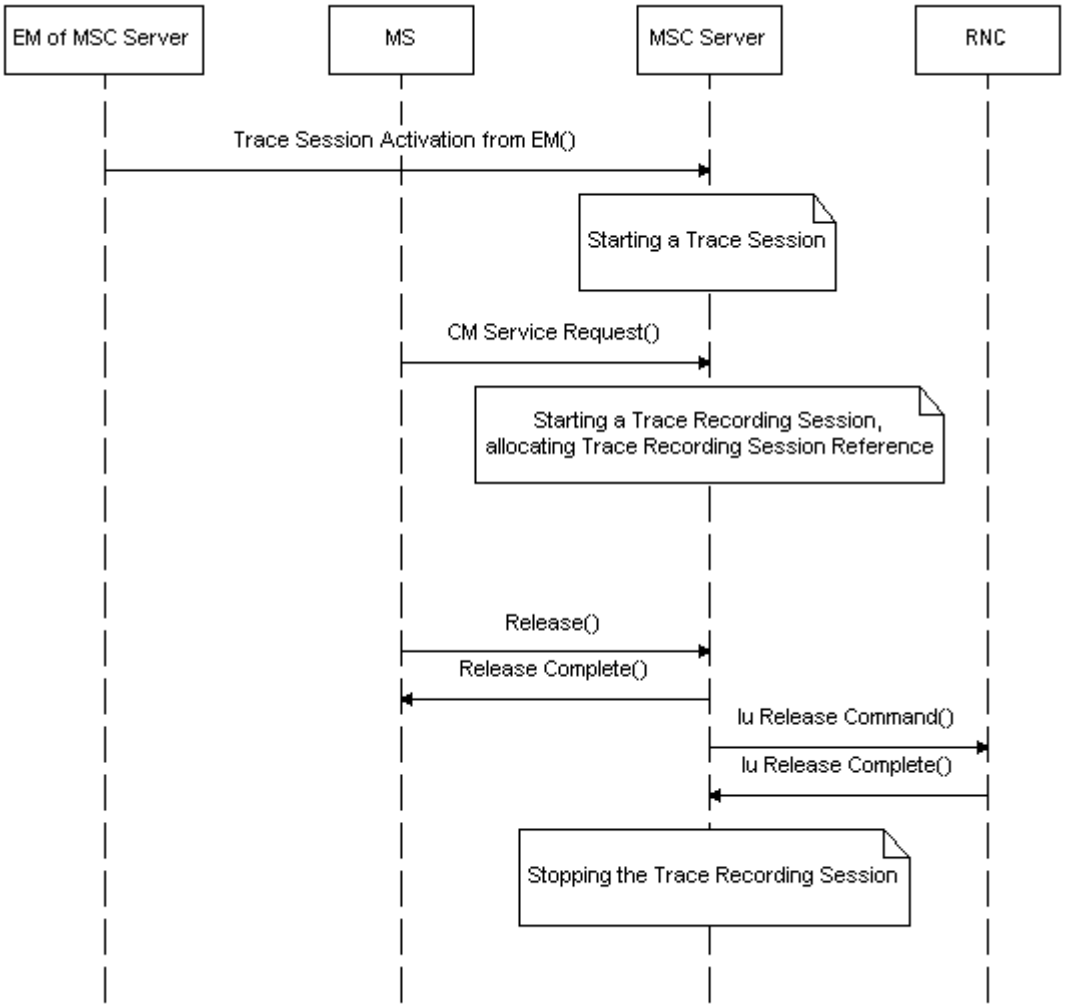


Figure 4.2.4: Stopping a Trace Recording Session (Management Based) - CS domain

4.2.4.4 IP Multimedia Subsystem stopping mechanisms

Editor's Note: For further study.

4.2.5 Stopping a trace recording session - signalling based

4.2.5.1 UTRAN stopping mechanisms

In an RNC the Trace Recording Session will always be the same as the Trace Session as no triggering events are defined in UTRAN. Therefore a Trace Recording Session shall always be stopped in an RNC when the RNC deactivates the Trace Session. For more information on Trace Session deactivation in UTRAN see subclause 4.1.5.2.

4.2.5.2 PS Domain stopping mechanisms

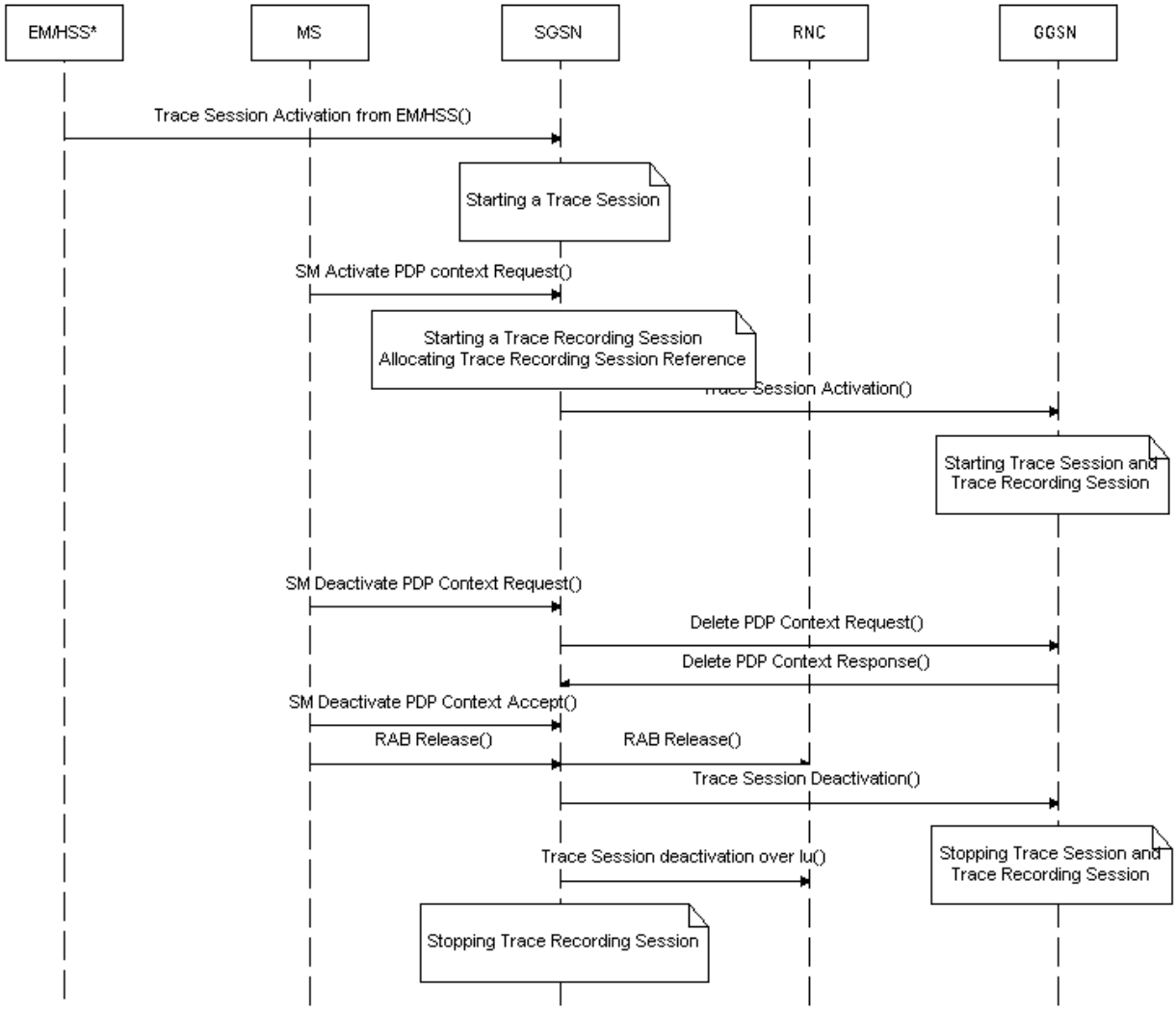
A Trace Recording Session shall be stopped when the SGSN/GGSN detect any of the stop triggering events.

However, if a SGSN receives a Trace Session deactivation either from its EM (in case of tracing roaming subscribers) or from HSS (in case of tracing home subscribers) during an ongoing Trace Recording Session, it may stop it immediately or at any time until the occurrence of an appropriate stop-triggering event.

A GGSN shall stop a Trace Recording Session when it receives a Trace Session deactivation message from the SGSN or at any time until the occurrence of an appropriate stop-triggering event.

When a Trace Recording Session is stopped in a SGSN, the SGSN shall send a Trace Session deactivation message to the NEs where tracing was required, as defined in the "List of NE types" configuration parameter, received in the Trace Session activation message. The Trace Reference, used for the deactivation procedure, shall be the same as used in the SGSN for the activation of the Trace Session.

Figure 4.2.5 illustrates a successful case in tracing a PDP context, when a Trace Recording Session is stopped. (Reference 3GPP TS 23.060 [6].)



NOTE: The activation to SGSN can come from EM-SGSN (in the figure just EM) or from the HSS.

Figure 4.2.5: Stopping a Trace Recording Session (Signalling based) - PS domain

4.2.5.3 CS Domain stopping mechanisms

A Trace Recording Session shall be stopped when the MSC Server and MGW detect any of the stop triggering events.

However, if a MSC Server receives a Trace Session deactivation either from its EM (in case of tracing roaming subscribers) or from HSS (in case of tracing home subscribers) during an ongoing Trace Recording Session, it may stop it immediately or at any time until the occurrence of an appropriate stop-triggering event.

A MGW shall stop a Trace Recording Session when it receives a Trace Session deactivation message from the MSC Server or at any time until the occurrence of an appropriate stop-triggering event.

When a Trace Recording Session is stopped in a MSC Server, the MSC Server shall send a Trace Session deactivation message to the NEs where tracing was required, as defined in the "List of NE types" configuration parameter, received in the Trace Session activation message. The Trace Reference, used for the deactivation procedure, shall be the same as used in the MSC Server for the activation of the Trace Session.

Figure 4.2.6 illustrates a successful case in tracing a call, when a Trace Recording Session is stopped. (Reference 3GPP TS 23.205 [7] and 3GPP TS 23.108 [8].)

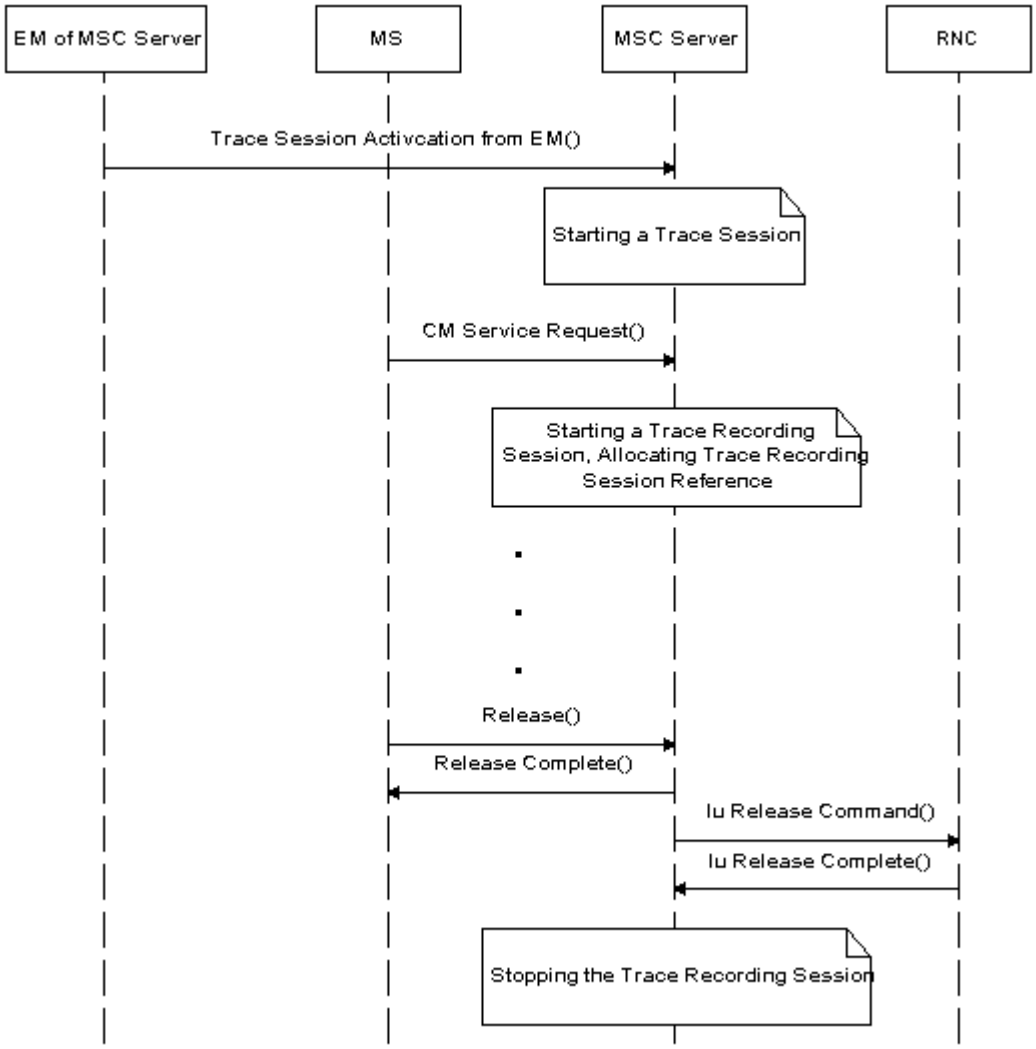


Figure 4.2.6: Stopping a Trace Recording Session (Signalling based) - CS domain

4.2.5.4 Void

5 Trace control and configuration parameters

5.1 Triggering events (M)

This mandatory parameter defines when to start a Trace Recording Session and which message shall be recorded first, when to stop a Trace Recording Session and which message shall be recorded last respectively. The messages in the start triggering event tables indicate the transaction to be recorded first and the starting time of the Trace Recording Session within a Trace Session for the traced MS/subscriber in the given NE.

The messages in the stop triggering event tables indicate the transaction to be recorded last and the stopping time of the Trace Recording Session.

MSC Server	Start triggering events	Stop triggering events
Mobile Originated Call	Receipt of the CM SERVICE-REQUEST message with service type set to originating call establishment	Reception of CC-RELEASE COMPLETE or CM-SERVICE ABORT message
Mobile Terminated Call	Sending of PAGING REQUEST message	Reception of CC-RELEASE COMPLETE or CM-SERVICE ABORT message
Mobile Originated SMS	Receipt of the CM SERVICE-REQUEST message with service type set to Short Message service	Transmission of RP-ACK/RP-NACK message
Mobile Terminated SMS	Sending of PAGING REQUEST message	Reception of RP-ACK/RP-NACK message
IMSI Attach	Receipt of the MM-LOCATION UPDATING REQUEST message	Sending of MM-LOCATION-UPDATING ACCEPT or MM-LOCATION-UPDATING-REJECT message
Location Update	Receipt of the MM-LOCATION UPDATING REQUEST message	Sending of MM-LOCATION-UPDATING ACCEPT or MM-LOCATION-UPDATING-REJECT message
IMSI Detach	Receipt of the MM-IMSI DETACH INDICATION message	Reception of MM-IMSI DETACH INDICATION message
Handover	Receipt of the BSSMAP-HANDOVER-REQUIRED message in case of GSM or RANAP-RELOCATION-REQUIRED message in case of UMTS	Reception of BSSMAP-CLEAR COMPLETE message in case of GSM or RANAP-IU RELEASE COMPLETE message in case of UMTS or BSSMAP-HANDOVER FAILURE in case of GSM or RANAP-RELOCATION FAILURE in case of UMTS.
Supplementary Service	TBD	TBD
Vendor Specific extensions	Vendor Specific extension	Vendor Specific extension

MGW	Start triggering events	Stop triggering events
Context	Reception of Megaco-ADD command, or reception of Megaco MODIFY command	Sending of Megaco- EXTRACT reply
Vendor specific extensions	Vendor specific extension	Vendor specific extension

SGSN	Start triggering events	Stop triggering events
PDP Context	Reception of SM-ACTIVATE PDP CONTEXT REQUEST or sending SM-REQUEST PDP CONTEXT ACTIVATION or reception of SM-MODIFY PDP CONTEXT REQUEST	Reception or sending of SM- DEACTIVATE PDP CONTEXT REQUEST or sending SM-ACTIVATE PDP CONTEXT REJECT
Mobile Originated SMS	Receipt of RP-DATA message	Transmission of RP-ACK/RP-NACK message
Mobile Terminated SMS	Transmission of RP-DATA message	Reception of RP-ACK/RP-NACK message
GPRS Attach	Reception of MM-ATTACH-REQUEST	Sending MM-ATTACH-ACCEPT or MM-ATTACH-REJECT
Routing Area Update	Reception of MM-ROUTING AREA UPDATE REQUEST	Sending MM-ROUTING AREA UPDATE ACCEPT or MM-ROUTING AREA UPDATE REJECT
GPRS Detach	Reception MM-DETACH REQUEST	Reception of MM-DETACH ACCEPT
Vendor specific extensions	Vendor specific extension	Vendor specific extension

GGSN	Start triggering events	Stop triggering events
PDP Context	Reception of GTP Create PDP context request or reception of GTP Update PDP context request	Sending of GTP Delete PDP context response
Vendor specific extensions	Vendor specific extension	Vendor specific extension

S-CSCF	Start triggering events	Stop triggering events
SIP INVITE method	Reception of the initial SIP INVITE request	Sending of the SIP response to the SIP BYE request (sending or receiving) or any other error response
SIP REGISTER method	Reception of SIP REGISTER request	Sending the SIP response to the SIP REGISTER request
SIP MESSAGE method	Reception of SIP MESSAGE request	Sending the SIP response to the SIP MESSAGE request
SIP SUBSCRIBE method	Reception of SIP SUBSCRIBE request	Sending the SIP response to the final SIP NOTIFY request
other SIP methods	Reception of any other SIP requests (e.g. OPTIONS, REFER, INFO)	Sending the SIP response to the appropriate SIP request

P-CSCF	Start triggering events	Stop triggering events
SIP INVITE session	Reception of the initial SIP INVITE request	Sending of the SIP response to the SIP BYE request (sending or receiving) or any other error response
SIP REGISTER method	Reception of SIP REGISTER request	Sending the SIP response to the SIP REGISTER request
SIP MESSAGE method	Reception of SIP MESSAGE request	Sending the SIP response to the SIP MESSAGE request
SIP SUBSCRIBE method	Reception of SIP SUBSCRIBE request	Sending the SIP response to the final SIP NOTIFY request
other SIP methods	Reception of any other SIP requests (e.g. OPTIONS, REFER, INFO)	Sending the SIP response to the appropriate SIP request

Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
MSC Server							
MGW							
SGSN							
GGSN							
spare							
spare							

MSC Server							
Bit 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**
spare		Vendor specific	SS	Handovers	LU, IMSI attach, IMSI detach	MO and MT SMS	MO and MT calls
spare							

MGW							
Bit 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**
spare						Vendor Specific	Context

SGSN							
Bit 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**
spare				Vendor Specific	RAU, GPRS attach, GPRS detach	MO and MT SMS	PDP context
Reserved							

GGSN							
Bit 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**
spare						Vendor Specific	PDP Context

If a bit is set to 1 the given event shall be traced, i.e. a Trace Recording Session shall be started for that event.

If a bit is set to 0 the given event should not be traced, i.e. Trace Recording Session should not be started.

5.2 Trace Depth (M)

This mandatory parameter defines how detailed information should be recorded in the Network Element. The following table describes the values of the Trace Depth parameter.

Trace Depth	Meaning
Minimum	Recording of some IEs in the signalling messages plus any vendor specific extensions to this definition, in decoded format.
Medium	Recording of some IEs in the signalling messages together with the radio measurement IEs plus any vendor specific extensions to this definition, in decoded format.
Maximum	Recording entire signalling messages plus any vendor specific extensions to this definition, in encoded format.
Vendor Specific data	Recording of any vendor specific trace data outside the scope of this specification.

At least one of Minimum, Medium or Maximum trace Depth shall be supported depending on the NE type (see trace record description in TS 32.423 [3] for details).

Trace depth shall be an enumerated parameter with the following possible values:

1 - Minimum,

2 - Medium,

3 - Maximum and

4 - Vendor specific

5.3 List of NE types (M)

This mandatory parameter defines the Network Element types where Trace Session activation is needed. This parameter has meaning only in the signalling based activation mechanism and it is used to determined whether the Trace Session Activation shall be propagated further to other Network Elements. In management based activation mechanism this parameter is not needed.

The following list contains the Network Element types:

- MSC Server
- MGW
- RNC
- SGSN
- GGSN

Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
spare	spare	spare	RNC	GGSN	SGSN	MGW	MSC-S
Spare							

If a bit is set to 1, Trace Session to that Network Element shall be activated.

If a bit is set to 0, Trace Session is not needed in that Network Element.

5.4 List of interfaces (O)

This is an optional parameter, which defines the interfaces to be recorded in the Network Element.

The following list contains the list of interfaces in each Network Element:

- MSC Server: A, Iu-CS, Mc and MAP (G, B, E, F) interfaces, CAP.

- MGW: ATM, IP and TDM interfaces for user plane characteristics.
- RNC: Iu-CS, Iu-PS, Iur, Iub and Uu interfaces.
- SGSN: Gb, Iu-PS, Gn, MAP (Gr, Gd, Gf), CAP (Ge) and Gs interfaces.
- GGSN: Gn and Gi interfaces.
- S-CSCF: Mw, Mg, Mr and Mi interfaces.
- P-CSCF: Gm and Go interfaces.
- HSS: MAP (C, D, Gc, Gr) and Cx interfaces and location and subscription information.

Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
MSC Server							
MGW							
SGSN							
GGSN							
RNC							
Spare							

MSC Server							
Bit 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**
CAP	MAP-F	MAP-E	MAP-B	MAP-G	Mc	Iu	A
spare							

SGSN							
Bit 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**
Ge	Gs	MAP-Gf	MAP-Gd	MAP-Gr	Gn	Iu	Gb
spare							

MGW							
Bit 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**
spare						Nb	Mc

GGSN							
Bit 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**
spare						Gi	Gn

RNC							
Bit 8	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**
spare				Uu	Iub	Iur	Iu

If a bit is set to 1, the interface should be traced in the given Network Element.

If a bit is set to 0, that interface should not be traced in the given Network Element.

5.5 Trace Reference (M)

This parameter shall be a 3 byte Octet String.

5.6 Trace Recording Session Reference (M)

This parameter shall be a 2 byte Octet String.

Annex A (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
Mar 2004	S_23	SP-040117	--	--	Submitted to TSG SA#23 for Information	1.0.0	
Sep 2004	S_25	SP-040543	--	--	Submitted to TSG SA#25 for Approval	2.0.0	6.0.0
Dec 2004	SA_26	SP-040770	001	--	Remove IMS entities from the Signalling Based Activation of the Trace functionality	6.0.0	6.1.0
Dec 2004	SA_26	SP-040770	002	--	Align Management Based Activation for Trace with RAN3"s 25.413 (UTRAN Iu interface RANAP signalling)	6.0.0	6.1.0

History

Document history		
V6.1.0	December 2004	Publication