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Technical Specification

**LTE;
Evolved Universal Terrestrial Radio
Access Network (E-UTRAN);
S1 layer 1 general aspects and principles
(3GPP TS 36.410 version 8.2.0 Release 8)**

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Contents

Foreword

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

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1 Scope

The present document is an introduction to the 3GPP TS 36.41x series of technical specifications that define the S1 interface for the interconnection of the Evolved NodeB component of the Evolved Universal Terrestrial Radio Access Network (E UTRAN) to the Core Network of the SAE system.

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.

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    [1]   3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

    [2]   3GPP TS 36.401: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Architecture description".

    [3]   3GPP TS 36.411: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 layer 1".

    [4]   3GPP TS 36.412: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 signalling transport".

    [5]   3GPP TS 36.413: "Evolved Universal Terrestrial Access (E-UTRA) ; S1 Application Protocol (S1 AP)".

    [6]   3GPP TS 36.414: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 data transport".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

E-RAB: as defined in [2].

3.2 Symbols

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

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

E-RAB	E-UTRAN Radio Access Bearer
RNL	Radio Network Layer
TNL	Transport Network Layer
eNB	
EPC	
LTE	
MME	
SAE	
GTW	
GW	
S1-U	
ID	
QoS	
GTP-U	
RAT	
RIM	RAN Information Management
O&M	
S1AP	
SAP	
SCTP	

3.4 Specification notations

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

Procedure When referring to a procedure in the specification the Procedure Name is written with the first letters in each word in upper case characters followed by the word "procedure", e.g. Radio Network Layer procedures.

Message When referring to a message in the specification the MESSAGE NAME is written with all letters in upper case characters followed by the word "message", e.g. RADIO LINK SETUP REQUEST message.

4 General aspects

Editor's Note: Section captures S1 interface principles and characteristics.

4.1 E-UTRAN architecture

The E-UTRAN is layered into a Radio Network Layer (RNL) and a Transport Network Layer (TNL). The E-UTRAN architecture, i.e. the E-UTRAN logical nodes and interfaces between them, are defined as part of the Radio Network Layer.

The E-UTRAN architecture consists of a set of eNBs connected to the EPC through the S1. The overall LTE architecture and E-UTRAN architecture are described in [2]. This subclause specifies only the architecture of the S1 interface, and shall not constrain the network architecture of either core or radio access networks.

The S1 interface is specified at the boundary between the EPC and the E-UTRAN. Figure 1 depicts the logical division of the S1 interface. From the S1 perspective, the E-UTRAN access point is an eNB, and the EPC access point is either the control plane MME logical node or the user plane S-GW logical node. Two types of S1 interfaces are thus defined at the boundary depending on the EPC access point: S1-MME towards an MME and S1-U towards an S- GW.
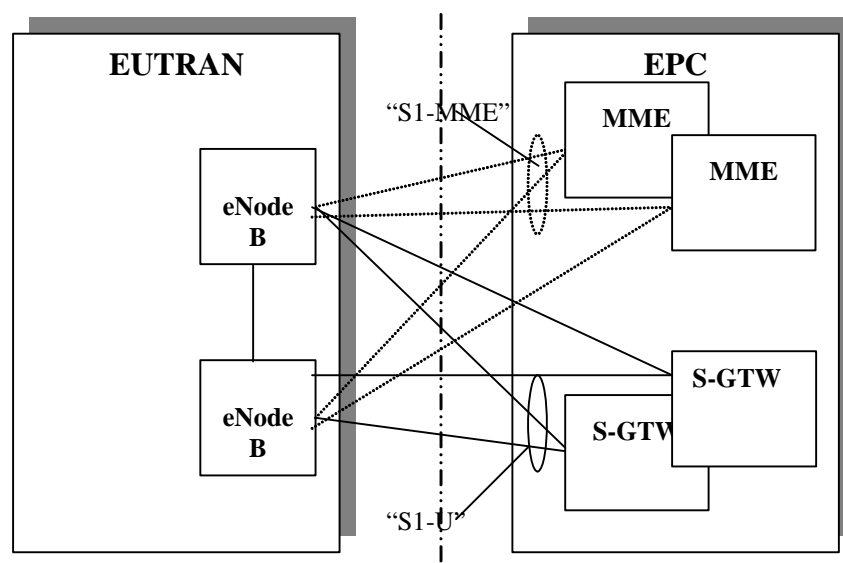
Figure1 S1 Interface architecture

The E-UTRAN may thus have several S1access points towards the EPC. As a minimum, each S1 access point (in E-UTRAN or EPC) shall independently fulfil the requirements of the relevant S1 specifications (36.41x series - see clause 7).

S1 is a logical interface.

There may be multiple S1-MME logical interfaces towards the EPC from any one eNB. The selection of the S1-MME interface is then determined by the NAS Node Selection Function as described in section 5.

There may be multiple S1-U logical interfaces towards the EPC from any one eNB. The selection of the S1-U interface is done within the EPC and signalled to the eNB by the MME.

4.2   S1 interface general principles

4.3   S1 interface specification objectives

4.4   S1 interface capabilities

4.5   S1 interface characteristics

5   Functions of the S1 interface protocols and functional split

Editor's Note: Description for S1 functions.

5.1   General

5.2   S1 UE context management function

In order to support UEs in the LTE_ACTIVE state, UE contexts need to be managed, i.e. established and released in the eNodeB and in the EPC to support user individual signalling on S1. This includes security context management.

The S1 UE context management function supports the establishment of the necessary overall initial UE context including E-RAB context, security context, roaming restriction, UE S1 signalling connection ID(s), etc. in the eNB to enable fast idle-to-active transition.

The establishment of the overall initial UE context is initiated by the MME.

The S1 UE context management function also supports the release of the context previously established in the eNB to enable the active-to-idle transition. The release of the context is triggered by the MME either directly or following a request received from the eNB.

5.3   E-RAB management functions

The E-RAB service management function is responsible for establishing, modifying and releasing E-UTRAN resources for user data transport once a UE context is available in the eNB. The establishment and modification of E-UTRAN resources is triggered by the MME and requires respective QoS information to be provided to the eNB. The release of E-UTRAN resources is triggered by the MME either directly or following a request received from the eNB (optional).

5.4   S1 link management function

5.4.1   GTP-U tunnels management function

This function is used to establish and release GTP-U tunnels between the EPC and the E-UTRAN upon an E-RAB service request. This involves assigning a tunnel identifier for each direction.

5.4.2   S1 Signalling link management function

The S1 signalling link management function provides a reliable transfer of the radio network signalling between E-UTRAN and EPC.

5.5   Mobility functions for UEs in LTE_Active

5.5.1   Intra-LTE handover

The Intra-LTE handover function supports mobility for UEs in LTE_ACTIVE and comprises the preparation, execution and completion of handover via the X2 and S1 interfaces.

5.5.2   Inter-3GPP RAT handover

The Inter-3GPP-RAT handover function supports mobility to and from other 3GPP-RATs for UEs in LTE_ACTIVE and comprises the preparation, execution and completion of handover via the S1 interface.

5.5.3   Mobility to CDMA2000 System

The mobility to non-3GPP radio system function supports mobility to and from other non-3GPP radio technologies for UEs in LTE_ACTIVE, namely to and from CDMA2000 systems. This comprises signalling for pre-registration of UE with CDMA2000 HRPD network and signalling for handover preparation for handover from E-UTRAN to CDMA2000 HRPD/1xRTT.

5.6 Paging function

The paging function supports the sending of paging requests to the eNodeBs having one or more cells which correspond to one of the TAs in which the UE is registered.

5.7 Roaming and area restriction support functions

5.8 S1 interface management function

The error indication function is used by the eNB (respectively the MME) to indicate to the MME (respectively the eNB) that a logical error has occurred.

The reset function is used to initialize the peer entity after node setup and after a failure event occurred. This procedure can be used by both the eNB and MME.

The S1 Setup (respectively the eNB and MME configuration update) function allows to exchange (respectively update) application level data needed for the eNB and MME to interoperate correctly on the S1 interface.

5.9 Coordination functions

5.9.1 Network sharing function

5.9.2 NAS node selection function

The interconnection of eNBs to multiple MME / S-GWs is supported by the LTE/SAE architecture. Therefore a NAS node selection function is located in the eNB to determine the MME association of the UE.

This functionality is located in the eNB to determine and establish an association between a given UE and one of the MME nodes that comprise the pool area the eNB belongs to.

It then enables proper routeing via the S1-MME interface.

On S1, no specific procedure corresponds to the NAS node selection function.

5.10 Security function

5.10.1 Data confidentiality

5.10.1.1 Radio interface ciphering function

The radio interface shall be ciphered upon request of the EPC. Both Signalling and user data may be subject to ciphering. The ciphering shall be done within the E-UTRAN.

5.10.1.2 Ciphering key management function

The ciphering key shall be supplied by the EPC.

5.10.2 Data integrity

5.10.2.1 Integrity checking

The purpose of the integrity check is to make sure that the signalling continues between the same elements as by authentication. The integrity check shall be done within the E-UTRAN.

5.10.2.2 Integrity key management

The integrity key shall be supplied by the EPC.

5.11 Service and network access function

5.11.1 Core network signalling data transfer function

The NAS EPC signalling data shall be transparently conveyed between the EPC and the UE. Over the S1 interface, the same S1 interface channel that is used for the E-UTRAN–EPC signalling shall be used.

5.11.2 UE tracing

This function allows tracing of various events related to the UE and its activities. This is an O&M functionality.

5.11.3 Location reporting function

The positioning function performs the determination of the geographical position of the UE.

This function allows the MME to request the eNB for a given UE either to report directly the current serving cell or to report upon change of serving cell.

5.12 RAN Information Management function

The RAN Information Management (RIM) function is a generic mechanism that allows the request and transfer of information (e.g. GERAN System information) between two RAN nodes via the core network.

6 S1 interface protocol structure

Editor's Note: Protocol Structure following the structure defined in [2].

6.1 General

The radio network signalling over S1consists of the S1 Application Part (S1AP). The S1AP protocol consists of mechanisms to handle all procedures between the EPC and E-UTRAN. It is also capable of conveying messages transparently between the EPC and the UE without interpretation or processing by the E-UTRAN.

Over the S1 interface the S1AP protocol is, e.g., used to:

- Facilitate a set of general E-UTRAN procedures from the EPC such as paging-notification as defined by the notification SAP.

- Separate each User Equipment (UE) on the protocol level for mobile specific signalling management as defined by the dedicated SAP.

- Transfer of transparent non-access signalling as defined in the dedicated SAP.

- Request of various types of E-RABs through the dedicated SAP.

- Perform the mobility function.

The E-RABs are provided by the Access Stratum.

6.2 S1-MME

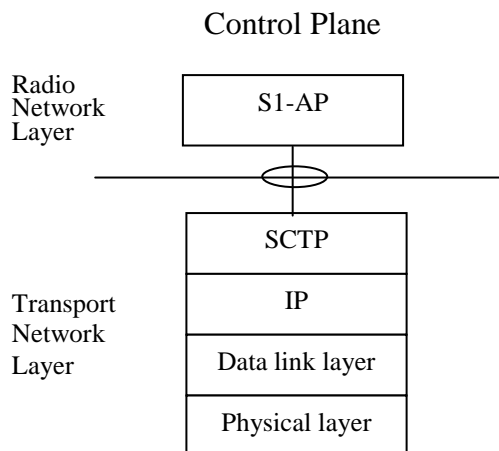Figure 6.1 shows the protocol structure for S1-MME, following the structure described in [2].

Control Plane

Figure 6.1: Interface protocol structure for S1-MME

The Transport Network Layer is based on IP transport, comprising SCTP on top of IP.

6.3 S1-U

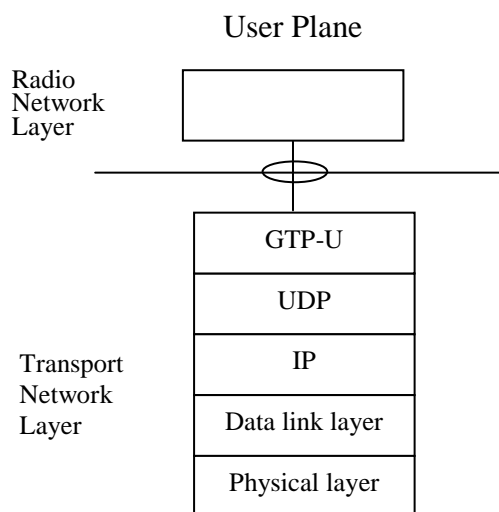Figure 6.2 shows the protocol structure for S1-U, following the structure described in [2].

User Plane

Figure 6.2: Interface protocol structure for S1-U

7 Other S1 interface specifications

Editor's Note: Description of the other related specifications.

7.1 E-UTRAN S1 interface: layer 1 (3GPP TS 36.411)

3GPP TS 36.411 [3] specifies the physical layer technologies that may be used to support the S1 interface.

7.2 E-UTRAN S1 interface: signalling transport (3GPP TS 36.412)

3GPP TS 36.412 [4] specifies the signalling bearers for the S1AP for the S1-MME interface.

7.3 E-UTRAN S1 Interface: S1AP Specification (3GPP TS 36.413)

3GPP TS 36.413 [5] specifies the S1AP protocol for radio network control plane signalling over the S1 interface.

7.4 E-UTRAN S1 interface: data transport and transport signalling (3GPP TS 36.414)

3GPP TS 36.414 [6] specifies the transport bearers for the user plane of the S1-U interface.

Annex A (informative): Change history

TSG #	TSG Doc.	CR	Rev	Subject/Comment	New
38				Specification approved at TSG-RAN 38 and placed under change control	8.0.0
42	RP-080845	0001		Correction of SAE Bearers	8.1.0
42	RP-080844	0002	1	Rapporteurs update of TS36.410	8.1.0
42	RP-080844	0003	1	RIM support in E-UTRAN	8.1.0
43	RP-090090	0004	2	Paging function clarification in E-UTRAN CR36.410	8.2.0

History

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