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X2 general aspects and principles
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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 TSG RAN TS 36.42x series of UMTS Technical Specifications that define the X2 interface. It is an interface for the interconnection of two E-UTRAN NodeB (eNB) components within the Evolved Universal Terrestrial Radio Access Network (E-UTRAN) architecture (TS 36.401 [2]).

2 References

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

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

[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 36.421: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 layer 1".

[4] 3GPP TS 36.422: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 signaling transport".

[5] 3GPP TS 36.423: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 application protocol (X2AP)".

[6] 3GPP TS 36.424: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 data transport".

[7] IETF RFC 4960 (2007-09): "Stream Control Transmission Protocol".

[8] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA), Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".

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: Defined in TS 36.401 [2].

X2 GW: Defined in TS 36.300 [8].

3.2 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].

ECM	EPS Connection Management
E-RAB	E-UTRAN Radio Access Bearer
X2-C	X2 Control plane
X2 GW	X2 GateWay

4 General aspects

4.1 Introduction

The interface allowing to interconnect eNBs with each other is referred to as the X2 interface.

4.2 X2 interface general principles

The general principles for the specification of the X2 interface are as follows:

- the X2 interface should be open;
- the X2 interface shall support the exchange of signalling information between two eNBs, in addition the interface shall support the forwarding of PDUs to the respective tunnel endpoints;
- from a logical standpoint, the X2 is a point-to-point interface between two eNBs within the E-UTRAN. A point-to-point logical interface should be feasible even in the absence of a physical direct connection between the two eNBs.

4.3 X2 interface specification objectives

4.3.1 General

The X2 interface specifications shall facilitate the following:

- inter-connection of eNBs supplied by different manufacturers;
- support of continuation between eNBs of the E-UTRAN services offered via the S1 interface;
- separation of X2 interface Radio Network functionality and Transport Network functionality to facilitate introduction of future technology.

4.3.2 Addressing of eNBs over the X2 interface

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4.4 X2 interface capabilities

4.4.1 Radio application related signalling

The X2 interface provides capability to support radio interface mobility between eNBs, of UEs having a connection with E-UTRAN.

4.4.2 X2 tunnels

4.5 X2 interface characteristics

4.5.1 Uses of SCTP

4.5.1.1 General

The SCTP (IETF RFC 4960 [7]) is used to support the exchange of X2 Application Protocol (X2AP) signalling messages between two eNBs

A single SCTP association per X2-C interface instance shall be used, except when the X2 GW is used.

Only when the X2 GW is used to connect one eNB to one or more specific eNB(s), all X2-C interface instances from that eNB to the relevant eNB(s) are carried over the same SCTP association from that eNB to the X2 GW, and over separate SCTP association(s) from the X2 GW to the relevant eNB(s).

For X2-C interface instance(s) over one SCTP association one pair of stream identifiers shall be used for X2-C common procedures and only a few pairs of stream identifiers should be used for X2-C dedicated procedures.

Source-eNB communication context identifiers that are assigned by the source-eNB for X2-C dedicated procedures, and target-eNB communication context identifiers that are assigned by the target-eNB for X2-C dedicated procedures, shall be used to distinguish UE specific X2-C signalling transport bearers. The communication context identifiers are conveyed in the respective X2AP messages.

5 Functions of the X2 interface

5.1 Function list

The list of functions on the X2 interface is the following:

- Intra LTE-Access-System Mobility Support for ECM-CONNECTED UE:
  - Context transfer from source eNB to target eNB;
  - Control of user plane transport bearers between source eNB and target eNB;
  - Handover cancellation;
  - UE context release in source eNB.
- Load Management
- Inter-cell Interference Coordination
  - Uplink Interference Load Management;
  - Downlink interference avoidance.
- General X2 management and error handling functions:
  - Error indication;
  - Reset.
- Application level data exchange between eNBs
- Trace functions
- Data exchange for self-optimisation

5.2 Function description

5.2.1 Intra LTE-Access-System mobility support for ECM-CONNECTED UE

This function allows the eNB to handover the control of a certain UE to another eNB.

5.2.1.1 Context transfer from source eNB to target eNB

This function allows transferring information required to maintain the E-UTRAN services for an UE in ECM-CONNECTED from source to target eNB.

5.2.1.2 Control of user plane transport bearers between source eNB and target eNB

This function allows establishing and releasing transport bearers between source and target eNB to allow for data forwarding. At most one user plane transport bearer per E-RAB allocated to the UE may be established for relaying DL data received from the EPC from the source eNB to the target eNB. At most one user plane transport bearer per E-RAB allocated to the UE may be established for relaying the UL data received from the UE from the source eNB to the target eNB.

5.2.1.3 Handover cancellation

This function allows informing an already prepared target eNB that a prepared handover will not take place. It allows releasing the resources allocated during a preparation.

5.2.1.4 UE context release in source eNB

This function allows the target eNB to trigger the release of the resources allocated to the UE in the source eNB.

5.2.2 Load management

This function allows exchanging overload and traffic load information between eNBs, such that the eNBs can control the traffic load appropriately. This information may be spontaneously sent to selected neighbour eNBs, or reported as configured by a neighbour eNB.

5.2.3 Inter-cell interference coordination

This function allows keeping inter-cell interference under control. For this neighbouring eNBs exchange appropriate information allowing that eNBs make radio resource assignments such that interference is mitigated.

5.2.3.1 Uplink interference load management

This function allows indicating an uplink interference overload and resource blocks especially sensitive to inter-cell interference between neighbouring eNBs, such that neighbour eNBs can co-ordinate with each other such that the mutual interference caused by their uplink radio resource allocations is mitigated.

5.2.3.2 Downlink interference avoidance

This function allows an eNB to inform its neighbour eNBs about downlink power restrictions in its own cells, per resource block or per subframe for interference aware scheduling by the neighbour eNBs.

5.2.4 General X2 management and error handling functions

These functions allow for managing of signalling associations between eNBs, surveying X2 interface and recovering from errors.

5.2.4.1 Error indication

This function allows the reporting of general error situations on application level.

5.2.4.2 Reset

This function allows an eNB_1 to inform another eNB_2 that it has recovered from an abnormal failure and that all the contexts (except the application level data – see section 5.2.6) related to eNB_1 and stored in eNB_2 shall be deleted, and the associated resources released.

5.2.5 Trace functions

Trace recoding sessions on E-UTRAN interfaces for a particular UE is initiated by the EPC. The trace initiation information is also propagated to the Target eNB during handover, attached to certain handover messages on X2.

5.2.6 Application level data exchange between eNBs

This function allows two eNBs to exchange application level data when an X2 connection is setup, and to update this information at any time.

5.2.7 Data exchange for self-optimisation

This function allows two eNBs to exchange information in order to support self-optimization functionality.

6 X2 interface protocols and protocol structure

6.1 General

There shall exist a clear separation between the Radio Network Layer and the Transport Layer. Therefore, the radio network signaling and X2 data streams are separated from the data transport resource and traffic handling as shown in Figure 6.1.1.

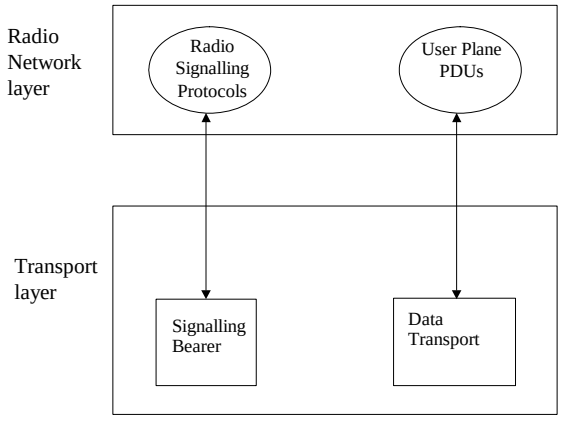

Figure 6.1.1: Separation of Radio Network Protocols and transport over X2

6.2 Radio signalling protocols

6.2.1 X2AP protocol

The protocol responsible for providing signalling information across the X2 interface is called the X2 Application Protocol (X2AP). The X2AP is terminated by the two eNBs inter-connected via the X2 interface X2AP Procedure Modules.

6.3 User plane protocol

6.3.1 Tunnelling protocol GTP-U

6.4 X2 interface protocol structure

The X2 interface protocol architecture consists of two functional layers:

- Radio Network Layer, defines the procedures related to the interaction between eNBs. The radio network layer consists of a Radio Network Control Plane and a Radio Network User Plane.
- The transport network layer provides services for user plane and signaling transport.

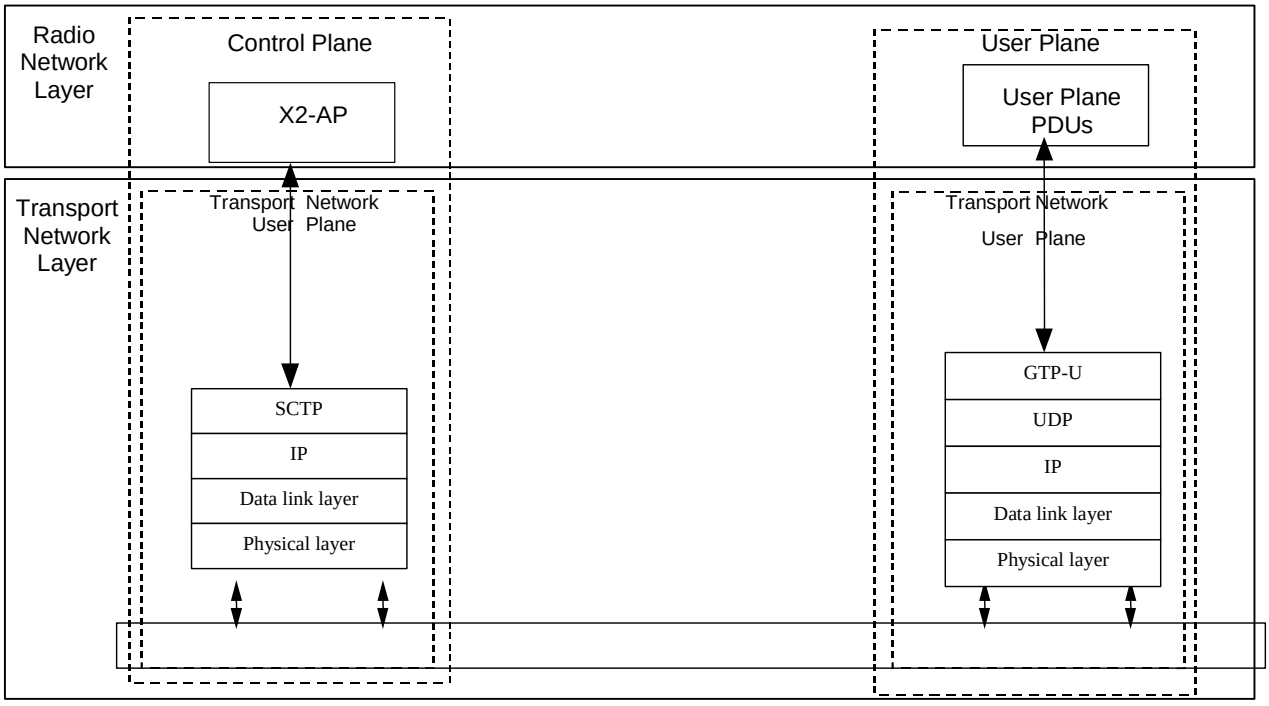

Figure 6.4.1: X2 Interface protocol structure

7 Other X2 interface specifications

7.1 E-UTRAN X2 interface: X2 layer 1 (TS 36.421)

TS 36.421 [3] specifies the range of physical layer technologies that may be used to support the X2 interface.

7.2 E-UTRAN X2 interface: X2 signaling transport (TS 36.422)

TS 36.422 [4] specifies how the X2AP signaling messages are transported over X2.

7.3 E-UTRAN X2 interface: X2 application protocol (X2AP) (TS 36.423)

TS 36.423 [5] specifies the radio network layer signaling procedures of the control plane between eNBs in E-UTRAN.

7.4 E-UTRAN X2 interface: X2 data transport (TS 36.424)

TS 36.424 [6] specifies the standards for user data transport protocols over the E-UTRAN X2 interface.

7.5 Summary of E-UTRAN X2 interface Technical Specifications

The relationship between the technical specifications that define the E-UTRAN X2 interface is shown in Figure 7.5.1.

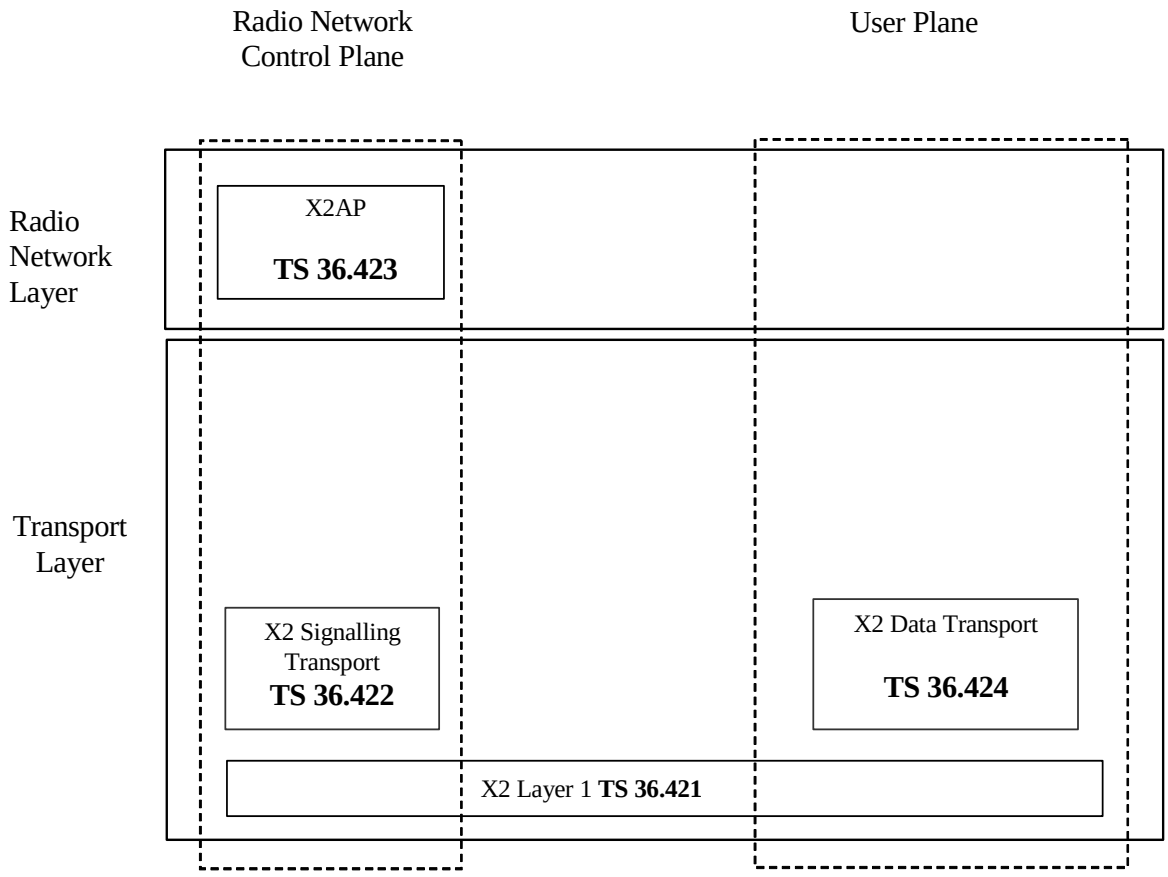

Figure 7.5.1: X2 Interface Technical Specifications

Annex A (informative): Change history

Change history						
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**New**
2007-11	38	RP-070853			specification presented to TSG-RAN for information and approval	1.0.0
2007-12	38				specification approved at TSG-RAN and placed under change control	8.0.0
2008-12	42	RP-080845	0002	2	Correction of SAE Bearer and Update of the list of X2 functions	8.1.0
2009-12	-	-	-	-	Creation of Rel-9 version based on v.8.1.0	9.0.0
2010-12					Creation of Rel-10 version based on v. 9.0.0	10.0.0
2011-03	SP-49	SP-100629			Clarification on the use of References (TS 21.801 CR#0030)	10.0.1
2011-06	52	RP-110684	0003	1	Correction of References	10.1.0
2011-09	53	RP-111196	0005	2	Update of the list of X2 functions	10.2.0
2011-09	53	RP-111197	0009	1	Correction of SCTP description for X2 Control Plane protocol	10.2.0
2012-09					Update to Rel-11 version (MCC)	11.0.0
2014-06	64	RP-140897	0010	6	Introduction of the X2 GW	12.0.0

History

Document history		
V12.0.0	September 2014	Publication