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Contents

Foreword

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1 Scope

The present document specifies the stage 3 of the Evolved Packet System S101and S121 reference points between the MME and the HRPD Access Network. The S101 interface supports procedures for Pre-Registration, Session Maintenance and Active handoffs between E-UTRAN and HRPD networks. The S121 interface supports procedures for RIM information exchange between the MME and the HRPD Access Network.

It also specifies the S103 interface between the Serving GW and HSGW. This User Plane interface is used to forward DL data to minimize packet losses in mobility from E-UTRAN to HRPD. Signalling procedures on the S101 interface are used to set up tunnels on the S103 interface.

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 23.402: "Architecture enhancements for non-3GPP accesses".

[3] IETF RFC 3232: "Assigned Numbers".

[4] IETF RFC 2784: "Generic Routing Encapsulation (GRE)".

[5] IETF RFC 2890: "Key and Sequence Number Extensions to GRE".

[6] 3GPP TS 29.274: "Evolved GPRS Tunnelling Protocol for Control Plane (GTPv2-C); Stage 3".

[7] 3GPP2 C.S0024-B: "cdma2000 High Rate Packet Data Air Interface Specification".

[8] 3GPP TS 23.007: "Restoration procedures".

[9] 3GPP2 C.S0087-0 v2.0: "E-UTRAN - HRPD and CDMA2000 1x Connectivity and Interworking: Air Interface Aspects".

[10] 3GPP TS 24.301: "Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3".

[11] 3GPP TS 33.402: "3GPP System Architecture Evolution: Security Architecture".

[12] 3GPP TS 36.413: "Evolved Universal Terrestrial Radio Access (E-UTRA) ; S1 Application Protocol (S1AP)".

[13] 3GPP TS 24.008: " Mobile radio interface Layer 3 specification; Core network protocols; Stage 3".

[14] 3GPP TS 29.280: "3GPP EPS Sv interface (MME to MSC) for SRVCC".

[15] 3GPP TS 48.018: "General Packet Radio Service (GPRS); Base Station System (BSS) - Serving GPRS Support Node (SGSN); BSS GPRS protocol (BSSGP)".

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].

HRPD Access: Combination of the eAN - PCF of the cdma2000 access

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].

AN	Access Network
eAN	enhanced AN
eNodeB	enhanced Node B
E-UTRAN	Enhanced UMTS Terrestial Radio Access Network
GRE	Generic Routing Encapsulation
GW	Gateway
HO	HandOver
HRPD	High Rate Packet Data
HSGW	HRPD Serving GateWay
IMSI	International Mobile Station Identity
IP	Internet Protocol
MME	Mobility Management Entity
PCF	Packet Control Function
PDN	Packet data Network
PMIP	Proxy Mobile IP
RIM	RAN Information Management
TEID	Tunnel End Point Identifier
UDP	User Datagram Protocol
VS	Vendor Specific

4 General

The S101 and S121 reference points are defined between the MME and the HRPD access, enabling interactions between E-UTRAN Access and cdma2000 HRPD Access. The S101 interface is required to perform procedures related to optimise HO from the E-UTRAN Access to cdma2000 HRPD Access to allow for pre-registration and handover signalling with the target system. The S121 interface is required to perform procedures related to RIM information exchange between the E-UTRAN Access and cdma2000 HRPD Access.

The S103 interface is defined between the Serving GW and HSGW and supports the forwarding of DL data during mobility from E-UTRAN to HRPD. Signalling procedures on the S101 interface are used to set up tunnels on the S103 interface.

The requirements for these interfaces are defined in 3GPP TS 23.402 [2].

The protocol stack used for the S101 and S121 interfaces shall be based on GTPv2-C, see 3GPP TS 29.274 [6] Figure 4.2.0-1.

The UDP header and port numbers definitions shall be as defined in GTPv2-C, see 3GPP TS 29.274 [6] section 4. 2.1.

The IP header and IP addresses definitions shall be as defined in GTPv2-C, see 3GPP TS 29.274 [6] section 4.2.2.

Layer 1 and Layer 2 requirements shall as defined in GTPv2-C, see 3GPP TS 29.274 [6] sections 4.2.3 and 4.2.4.

5 Transmission Order and Bit Definitions

Transmission Order and Bit Definitions shall be as defined in GTPv2-C, see 3GPP TS 29.274 [6] section 4.3.

6 S101 Message Header

6.1 Introduction

The S101 Message Header is conformant to the GTPv2-C Message Header, see 3GPP TS 29.274 [6] section 5. All S101 messages shall have a header that includes specific parameters. The following list of header parameters are defined for the S101 interface:

- Version
- Flags (T = TEID Included)
- Message Type
- Length

6.2 S101 Message Header

The S101 header is a variable length header. The minimum length of the S101 header is eight octets. Space has been reserved for four flags that may be used in the future to signal the presence of additional optional header fields or utilities.

- Bit 4 (the T bit) may be set to one to indicate that a TEID is present in the header, as per 3GPP TS 29.274 [6]. The T bit shall be set to zero to indicate that the TEID field shall not be present in any message sent on the S101 interface.

If the header fields do not occupy a full eight octets, then spare octets shall be added after the last valid field in the S101 header to complete eight octets. Spare octets and bits shall be set to zero.

Always present fields:

- Version field: This field is used to determine the version of the S101 protocol. The version number shall be set to '010'.
- Message Type: This field indicates the type of S101 message. The valid values of the message type are defined in clause 7.1. Note that values chosen for Message Type shall be coordinated with and shall not overlap the Message Type values chosen for GTPv2-C in 3GPP TS 29.274 [6].
- Length: This field indicates the length in octets of the payload, i.e. the rest of the packet following the mandatory part of the S101 header (that is the first 4 octets).
- Sequence Number: This field enables the target system to identify any missing receipt of messages and is used also for acknowledgement of messages.

Octets	Bits 8	7	6	5	4	3	2	1
1	Version=010			(*)	T=0	(*)	(*)	(*)
2	Message Type							
3	Length (1st Octet)							
4	Length (2nd Octet)							
5	Sequence Number (1st Octet)							
6	Sequence Number (2nd Octet)							
7	Sequence Number (3rd Octet)							
8	Spare							

NOTE 0: (*) This bit is a spare bit. It shall be sent as '0'. The receiver shall not evaluate this bit.

Figure 6.2-1: Layout of the S101 Message Header

6A S121 Message Header

6A.1 Introduction

The S121 Message Header is conformant to the GTPv2-C Message Header, see 3GPP TS 29.274 [6] section 5. All S121 messages shall have a header that includes specific parameters. The following header parameters are defined for the S121 interface:

- Version
- Flags (T = TEID Included)
- Message Type
- Length

6A.2 S121 Message Header

The S121 header is a variable length header. The minimum length of the S121 header is eight octets. Space has been reserved for four flags that may be used in the future to signal the presence of additional optional header fields or utilities.

- Bit 4 (the T bit) indicates whether a TEID is present in the header, as per 3GPP TS 29.274 [6]. The T bit shall be set to zero to indicate that the TEID field shall not be present in any message sent on the S121 interface.

If the header fields do not occupy a full eight octets, then spare octets shall be added after the last valid field in the S121 header to complete eight octets. Spare octets and bits shall be set to zero.

Always present fields:

- Version field: This field is used to determine the version of the S121 protocol. The version number shall be set to '010'.
- Message Type: This field indicates the type of S121 message. The valid values of the message type are defined in clause 7A.1. Note that values chosen for Message Type shall be coordinated with and shall not overlap the Message Type values chosen for GTPv2-C in 3GPP TS 29.274 [6].
- Length: This field indicates the length in octets of the payload, i.e. the rest of the packet following the mandatory part of the S121 header (that is the first 4 octets).
- Sequence Number: This field enables the target system to identify any missing receipt of messages and is used also for acknowledgement of messages.

Octets	Bits 8	7	6	5	4	3	2	1
1	Version=010			(*)	T=0	(*)	(*)	(*)
2	Message Type							
3	Length (1st Octet)							
4	Length (2nd Octet)							
5	Sequence Number (1st Octet)							
6	Sequence Number (2nd Octet)							
7	Sequence Number (3rd Octet)							
8	Spare							

NOTE 0: (*) This bit is a spare bit. It shall be sent as '0'. The receiver shall not evaluate this bit.

Figure 6A.2-1: Layout of the S121 Message Header

7 S101 Messages and Message Formats

7.1 Introduction

This section is divided into path management which defines the general messages for the pre-configured tunnel and a section for the specific messages used for information transfer over the control plane.

Table 7.1 specifies GTPv2-C message types that are used across the S101 interface.

Table 7.1: Message types for S101

Message Type value (Decimal)	Message	Reference
0	Reserved	3GPP TS 29.274 [6]
1	Echo Request	3GPP TS 29.274 [6]
2	Echo Response	3GPP TS 29.274 [6]
3	Version Not Supported Indication	3GPP TS 29.274 [6]
4	Direct Transfer Request message	7.3.2
5	Direct Transfer Response message	7.3.3
6	Notification Request message	7.3.4
7	Notification Response message	7.3.5
8-16	For future S101 interface use	
17-24	Reserved for S121 interface	7A
25-31	Reserved for Sv interface	3GPP TS 29.280 [14]
32-239	Reserved for GTPv2-C spec	3GPP TS 29.274 [6]
240 to 247	Reserved for Sv interface	3GPP TS 29.280 [14]
248 to 255	Reserved for GTPv2-C spec	3GPP TS 29.274 [6]

7.2 Path Management Messages

7.2.1 Introduction

The path from the MME to the non-3GPP Access Network operationally requires management capabilities. The following GTPv2-C messages support path management for the S101 interface:

- Echo Request
- Echo Response
- Version Not Supported Indication

These messages are defined for GTPv2-C and the handling and definition shall also be as defined in GTPv2-C, see 3GPP TS 29.274 [6].

7.2.2 Echo Request message

An MME or an HRPD access node may send an Echo Request to find out if the peer HRPD access node or MME is alive (see section Path Failure). When and how often an Echo Request message may be sent is implementation specific but an Echo Request shall not be sent more often than every 60 s on each path.

An MME or an HRPD access node shall be prepared to receive an Echo Request at any time and it shall reply with an Echo Response. The optional Private Extension contains vendor or operator specific information.

3GPP TS 29.274 [6] specifies the information elements included in the Echo Request message.

7.2.3 Echo Response message

The message shall be sent as a response to a received Echo Request.

3GPP TS 29.274 [6] specifies the information elements included in the Echo Response message.

The Recovery information element contains the local Restart Counter (see section Restoration and Recovery) value for the node that sends the Echo Response message.

The MME or an HRPD access node that receives an Echo Response from a peer MME or an HRPD access node shall compare the Restart Counter value received with the previous Restart Counter value stored for that peer MME or HRPD access node. If no previous value was stored, the Restart Counter value received in the Echo Response shall be stored for the peer MME or HRPD access node.

The value of a Restart Counter previously stored for a peer MME or HRPD access node may differ from the Restart Counter value received in the Echo Response from that peer MME or HRPD access node. In this case, the MME or HRPD access node shall handle the Restart Counter as specified in clause 18 of 3GPP TS 23.007 [3].

The optional Private Extension contains vendor or operator specific information.

7.2.4 Version Not Supported Indication message

This message contains only the S101 header and indicates the latest S101 version that the MME or HRPD access node entity on the identified UDP/IP address can support (see 3GPP TS 29.274 [6] subclause 7.1.3).

3GPP TS 29.274 [6] specifies the detailed handling and information elements included in the Version Not Supported Indication message.

7.3 S101 Messages

7.3.1 Introduction

The following messages are used to support interworking between the MME and the non-3GPP access network:

- Direct Transfer Request
- Direct Transfer Response
- Notification Request
- Notification Response

7.3.2 Direct Transfer Request message

A Direct Transfer Request shall be sent from an MME or HRPD access node to transport an HRPD or an E-UTRAN message to the peer HRPD access node or MME.

One of the IEs Session ID or Session ID2 but not both shall be included in the message.

Table 7.3.2-1 specifies the information elements included in the Direct Transfer message.

Table 7.3.2-1: Information Elements in a Direct Transfer Request

Information elements	Presence Requirement	Reference	Instance
Session ID	Conditional	7.5.2	0
Session ID2	Conditional	7.5.2A	0
HRPD Sector ID	Conditional	7.5.5	0
S101 Transparent Container	Mandatory	7.5.6	0
PDN GW PMIP GRE Tunnel Info	Conditional	7.5.9	0
S103 GRE Tunnel Info	Conditional	7.5.10	0
S103 HSGW IP Address	Conditional	7.5.11	0
Handover Indicator	Conditional	7.5.7	0
EUTRAN Round Trip Delay	Conditional	7.5.14	0
Unauthenticated IMSI	Conditional	7.5.13	0
Recovery	Conditional	7.5.4	0
Private Extension	Optional	7.5.8	VS

The HRPD Sector ID parameter shall be included if this message is being sent from the MME to the HRPD access node in case of handover from E-UTRAN to HRPD.

If an HRPD message is being tunnelled between an MME and an HRPD access node, the S101 Transparent Container shall contain the HRPD message.

If the MME receives the EUTRAN Round Trip Delay Estimation Info IE in a message from the eNodeB, the MME shall copy that round trip delay estimation value into the EUTRAN Round Trip Delay parameter and shall include the EUTRAN Round Trip Delay parameter in this message.

If an E-UTRAN message is being tunnelled between an MME and an HRPD access node, the S101 Transparent Container shall contain the E-UTRAN message.

If the Direct Transfer Request message is sent from the MME to the HRPD AN and the MME has the PDN GW IP Address and the PDN GW GRE Key for a PDN Connection, the PDN GW PMIP GRE Tunnel Info IE shall be included when the MME receives CDMA2000 HO Required Indication from the eNodeB, see 3GPP TS 36.413 [12]. The PDN GW PMIP GRE Tunnel Info shall include the PDN Identity and the PDN GW GRE Key for the PDN connection. For each PDN Connection of the UE, there shall be a PDN GW PMIP GRE Tunnel Info Information Element included in the message. The Handover Indicator shall indicate Handover Required in this case. For each PDN GW PMIP GRE Tunnel of the UE, there shall be a PDN GW PMIP GRE Tunnel Info Information Element included in the message.

If the Handover Indicator IE indicates HO Ready during optimized active handover from E-UTRAN to HRPD, the S101 Transparent Container shall contain the HRPD message (=HRPD TCA message). If data forwarding applies, the S103 GRE Tunnel Info IE shall be included. The S103 GRE Tunnel Info IE shall include the PDN Identity and the HSGW GRE Key for a PDN connection. The S103 HSGW IP Address IE shall also be included in this case in the message but only one occurrence. For each PDN connection of the UE which requires data forwarding towards the HSGW, there shall be a S103 GRE Tunnel Info Information Element included in the message.

The Handover Indicator parameter shall be included, if the encapsulated message being carried will cause the UE to leave the source system and tune its radio to the target system. It shall also be included for the case of LTE to HRPD handover, if a Direct Transfer Request message is sent from the MME to the HRPD AN, the MME shall include a Handover Required indication in the Handover Indicator IE, if a Handover Required was received by the MME from the eNodeB.

If the node is contacting its peer for the first time or if the node has restarted recently and the new Restart Counter value has not yet been indicated to the peer, the Recovery IE shall be included.

If the Handover is for an emergency attached UE and the IMSI is available but not authenticated, then unauthenticated IMSI IE shall be included which shall contain the unauthenticated IMSI of the UE.

7.3.3 Direct Transfer Response message

The message shall be sent from an MME or HRPD access node to its peer HRPD access node or MME as a response to a Direct Transfer Request.

One of the IEs Session ID or Session ID2 but not both shall be included in the message.

Table 7.3.3-1 specifies the information elements included in the Direct Transfer Response message.

Table 7.3.3-1: Information Elements in a Direct Transfer Response message

Information elements	Presence Requirement	Reference	Instance
Session ID	Conditional	7.5.2	0
Session ID2	Conditional	7.5.2A	0
Cause	Mandatory	7.5.3	0
Recovery	Optional	7.5.4	0
Private Extension	Optional	7.5.8	VS

The Cause value indicates that the encapsulated message was received. Possible Cause values are:

- "Request Accepted".
- "System failure".
- "Mandatory IE incorrect".
- "Mandatory IE missing".
- "Invalid message format".
- "Conditional IE missing".

'No resources available' indicates that not enough resources are available within the receiving system.

7.3.4 Notification Request message

A Notification Request message shall be sent from an MME or HRPD access node to its peer HRPD access node or MME to notify its peer of a fact or event.

One of the IEs Session ID or Session ID2 but not both shall be included in the message.

Table 7.3.4-1 specifies the information elements included in the Notification Request message.

Table 7.3.4-1: Information Elements in a Notification Request

Information elements	Presence Requirement	Reference	Instance
Session ID	Conditional	7.5.2	0
Session ID2	Conditional	7.5.2A	0
Handover Indicator	Conditional	7.5.7	0
Recovery	Conditional	7.5.4	0
Private Extension	Optional	7.5.8	VS

The Handover Indicator information element (=HO Complete) shall be included if the sending system needs to notify the receiving system of the completion of a handover.

The Handover Indicator information element (=Redirection) shall be included if the sending system needs to notify the receiving system of the S101 tunnel end point redirection.

The optional Private Extension contains vendor or operator specific information.

If the Handover Indicator IE (= Redirection) and the node is contacting its peer for the first time or if the node has restarted recently and the new Restart Counter value has not yet been indicated to the peer , the Recovery IE shall be included.

7.3.5 Notification Response message

A Notification Response message shall be sent from an MME or HRPD access node to its peer HRPD access node or MME to acknowledge receipt of a Notification Request message.

One of the IEs Session ID or Session ID2 but not both shall be included in the message.

Table 7.3.5-1 specifies the information elements included in the Notification Response message.

Table 7.3.5-1: Information Elements in a Notification Response message

Information elements	Presence Requirement	Reference	Instance
Session ID	Conditional	7.5.2	0
Session ID2	Conditional	7.5.2A	0
Cause	Mandatory	7.5.3	0
Recovery	Optional	7.5.4	0
Private Extension	Optional	7.5.8	VS

If the MME or HRPD access node receives a Notification Response with a Cause value other than 'Notification Accepted', it should note and log the event and response.

Possible Cause values are:

- "Notification Accepted".
- "System failure".
- "Mandatory IE incorrect".
- "Mandatory IE missing".
- "Conditional IE missing".
- "Invalid message format".

7.4 Reliable Delivery of Signalling Messages

For the S101 interface protocol, the reliable delivery of signalling messages shall have the same handling as GTPv2-C. See 3GPP TS 29.274 [6] but with S101 node replacing GTPv2-C node as appropriate.

For certain types of messages, i.e. Direct Transfer messages, retransmission at this layer level would be harmful to the session so for Direct Transfer messages retransmissions shall not be allowed and their N3-REQUESTS value shall be set to one, i.e. message is only sent once.

7.5 Information Elements

7.5.1 Information Element Assignments

An S101 message may contain several information elements. The TLIV (Type, Length, Instance, Value) encoding format shall be used for all S101 information elements. See TS 29.274 [6] subclause 8.2 for the general encoding of the IEs.

Within information elements, certain fields may be described as spare. These bits shall be transmitted with the value defined for them. To allow for future features, the receiver shall not evaluate these bits.

Table 7.5-1: Information Elements

IE Type Value	Information Element	Comment / Reference	Number of Fixed Octets
1	Session ID	Variable Length / 7.5.2	Not Applicaple
2	Cause	Variable Length / 7.5.3	Not Applicaple
3	Recovery	Variable Length / 7.5.4	Not Applicaple
4	HRPD Sector ID	Fixed Length / 7.5.5	16
5	S101 Transparent Container	Variable Length / 7.5.6	Not Applicaple
6	Handover Indicator	Fixed Length / 7.5.7	1
7	PDN GW PMIP GRE Tunnel Info	Variable Length / 7.5.9	Not Applicaple
8	S103 GRE Tunnel Info	Variable Length / 7.5.10	Not Applicaple
9	S103 HSGW IP Address	Variable Length / 7.5.11	Not Applicaple
10	Reserved (NOTE 3)		
11 See NOTE 1	Session ID2	Variable Length / 7.5.2A	Not Applicaple
12	Unauthenticated IMSI	Variable Length / 7.5.13	Not Applicaple
13	EUTRAN Round Trip Delay	Variable Length / 7.5.14	Not Applicaple
14-34	For future use. Shall not be sent. If received, shall be treated as an Unknown IE.		
35-50	Reserved for the S121 interface	7A	
51-70	Reserved for Sv interface. Shall not be sent. If received, shall be treated as an Unknown IE.	3GPP TS 29.280 [14]	3GPP TS 29.280 [14]
71-254	Reserved for GTPv2-C. Shall not be sent. If received, shall be treated as an Unknown IE.	3GPP TS 29.274 [6]	3GPP TS 29.274 [6]
255	Private Extension	7.5.8	3GPP TS 29.274 [6]

NOTE 1: Although Session ID2 is encoded as per MEI IE in 3GPP TS 29.274 [6], the IE type value used is as defined here, i.e. not 75.
NOTE 2: The size of the TLI (Type, Length and Instance) fields, i.e "4" octets, has been subtracted from the number of the fixed octets of the "Fixed Length" and "Extendable" IEs.
NOTE 3: This value was allocated in an earlier version of the protocol and shall not be used.

7.5.2 Session ID

For the S101 interface, the Session ID Information Element is conditional for all S101 messages apart from the path management messages and, if present, shall always be the first IE following the S101 Header.

The IMSI IE shall be used for the parameter Session ID for a UE with an authenticated IMSI. The Session ID IE shall be encoded as per the International Mobile Station Identity information element, as defined in 3GPP TS 29.274 [6].

7.5.2A Session ID2

For emergency attached UEs which do not have an IMSI or have an IMSI but not one authenticated by the network, the MEI IE shall be used as the Session ID2, i.e. using the IMEI as the Session ID. The Session ID2 IE is conditional and if present, shall always be the first IE following the S101 Header.

In this case, the Session ID2 IE shall be encoded as per the Mobile Equipment Identity Type IE, as defined in 3GPP TS 29.274 [6].

7.5.3 Cause

In a response, the Cause Value shall indicate the acceptance or the rejection of the corresponding request. The Cause value shall be included in the response message.

"Request accepted" shall be returned when an MME or an HRPD Access has accepted a Direct Transfer request.

"Notification accepted" shall be returned when an MME or an HRPD Access has accepted a notification.

"No memory available" shall indicate that the MME or an HRPD Access does not have enough memory to use.

"System failure" shall indicate that a generic permanent error condition has occurred.

"Invalid message format", "Mandatory IE incorrect", "Mandatory IE missing" and "Conditional IE missing" shall indicate protocol errors as described in the section on Error handling.

Refer to 3GPP TS 29.274 [6] for the encoding of this Information Element.

Table 7.5.3-1 Cause Values used on the S101 Interface

Message Type	Cause value (decimal)	Meaning
	0	Reserved. Shall not be sent and if received the Cause shall be treated as an invalid IE
Request		
	1-15	Spare. This value range is reserved for Cause values in a request message
Acceptance Response	16	Request accepted
	17	Request accepted partially
	18	Notification accepted
	19-63	Spare. This value range is reserved for Cause values in acceptance response message
Rejection Response	64	Context Non Existent/Found
	65	Invalid Message Format
	66	Spare
	67	Invalid length
	68	Service not supported
	69	Mandatory IE incorrect
	70	Mandatory IE missing
	71	Reserved (See NOTE 1.)
	72	System failure
	73	No resources available
	74	No memory available
	75-102	Spare
	103	Conditional IE missing
	104-255	Spare. This value range is reserved for Cause values in rejection response message
NOTE 1: This value was allocated in an earlier version of the specification.		

NOTE: In the first release of the present document the value of the length field of this IE is 1 for cause values without "offending IE", and 4 + the length of the offending IE for those including it. In future releases of the specification additional octets may be specified. The legacy receiving entity simply ignores the unknown octets and values in the spare bits.

7.5.4 Recovery

The Recovery information element shall indicate if the peer MME or HRPD Access has restarted. Refer to 3GPP TS 29.274 [6] for the encoding of this Information Element.

7.5.5 HRPD Sector ID

The HRPD Sector ID information element shall provide a reference in the target system that can be used to create a unique mapping to an HRPD Access or MME that is appropriate to operate as the peer entity for an S101 interface tunnel.

The HRPD Sector Identifier is defined in 3GPP2 C.S0024-B [7] section 13.9.

The E-UTRAN Access makes the HRPD Sector ID available by provisioning this in the E-UTRAN Access equipment.

Table 7.5.5-1: HRPD Sector ID IE

Octets	Bits 8	7	6	5	4	3	2	1
1	Type = 4							
2 to 3	Length = 16							
4	Spare				Instance			
5 to 20	HRPD Sector Identifier							

7.5.6 S101 Transparent Container

The S101 Transparent Container information element shall contain an encapsulated HRPD message or an encapsulated E-UTRAN message that is either generated by the UE and is being transferred to the MME or HRPD access, or is generated by the MME or HRPD access and is being transferred to the UE. It is variable in length and shall always be an integral number of octets. The highest numbered octet shall be filled, if necessary, with extra bits set to '0' in the low order bit positions to create an integral number of octets.

Table 7.5.6-1: S101 Transparent Container IE

Octets	Bits 8	7	6	5	4	3	2	1
1	Type = 5							
2 to 3	Length = n							
4	Spare				Instance			
5 to (n+4)	S101 Transparent Container							

The format of an encapsulated E-UTRAN message is defined in 3GPP TS 24.301 [10].

The format of the encapsulated HRPD messages is defined in 3GPP2 C.S0087-0 [9].

7.5.7 Handover Indicator

The Handover Indicator information element shall indicate the status of the Handover to the receiving system as a result of the encapsulated message carried in an S101 Transparent Container message.

Table 7.5.7-1: Handover Indicator IE

Octets	Bits 8	7	6	5	4	3	2	1
1	Type = 6							
2 to 3	Length = 1							
4	Spare				Instance			
5	Handover Indicator							

Table 7.5.7-2: Handover Indicator

Handover Indicator (Decimal)	Meaning
0	Not Used
1	HO Ready
2	HO Failure
3	HO Complete
4	Redirection
5	HO Required
All Others	Spare

7.5.8 Private Extension

The Private Extension information element shall contain vendor specific information. Refer to 3GPP TS 29.274 [6] for the encoding of this Information Element.

7.5.9 PDN GW PMIP GRE Tunnel Info

The PDN GW PMIP GRE Tunnel Info shall contain: the PDN Identity, i.e. APN, the PDN GW Address and the PDN GW GRE Key, which identifies a PMIP GRE tunnel towards a PDN GW.

Table 7.5.9-1: PDN GW PMIP GRE Tunnel Info IE

Octets	Bits 8	7	6	5	4	3	2	1
1	Type = 7							
2 to 3	Length = n							
4	Spare				Instance			
5	PDN Identity Length = m							
6 to (m+5)	PDN Identity (=APN)							
m+6	PDN GW IP Address Length = k							
(m+7) to (k+m+6)	PDN GW IP Address							
(k+m+7) to (k+m+10)	PDN GW GRE Key							

7.5.10 S103 GRE Tunnel Info

The S103 GRE Tunnel Info IE shall contain the PDN Identity and HSGW GRE Key, which identifies a GRE tunnel towards a HSGW.

Table 7.5.10-1: S103 GRE Tunnel Info IE

Octets	Bits 8	7	6	5	4	3	2	1
1	Type = 8							
2 to 3	Length = n							
4	Spare				Instance			
5	PDN Identity Length = m							
6 to (m+5)	PDN Identity (=APN)							
(m+6) to (m+9)	HSGW GRE Key							

7.5.11 S103 HSGW IP Address

The S103 HSGW IP Address IE shall contain S103 HSGW IP Address.

Table 7.5.11-1: S103 HSGW IP Address

Octets	Bits 8	7	6	5	4	3	2	1
1	Type = 9							
2 to 3	Length = n							
4	Spare				Instance			
5 to (n+4)	S103 HSGW IP Address							

7.5.12 Void

7.5.13 Unauthenticated IMSI

The unauthenticated IMSI IE includes the IMSI of UE when UE is emergency attached and contains an IMSI which is not authenticated.

Table 7.5.13-1: Unauthenticated IMSI IE

Octets	Bits 8	7	6	5	4	3	2	1
1	Type = 12 (decimal)							
2 to 3	Length = n							
4	Spare				Instance			
5	Number digit 2				Number digit 1			
6	Number digit 4				Number digit 3			
…	…				…			
n+4	Number digit m				Number digit m-1			

Octets 5 to (n+4) represent the IMSI value in international number format as described in ITU-T Rec E.164 [25], encoded as TBCD digits, i.e. digits from 0 through 9 are encoded "0000" to "1001". When there is an odd number of digits, bits 8 to 5 of the last octet are encoded with the filler "1111". The maximum number of digits is 15.

7.5.14 EUTRAN Round Trip Delay

The EUTRAN Round Trip Delay information element provides an estimate of the radio round trip delay from the UE to the serving eNB.

Table 7.5.14-1: EUTRAN Round Trip Delay IE

Octets	Bits 8	7	6	5	4	3	2	1
1	Type = 13							
2 to 3	Length = n							
4	Spare				Instance			
5 to 6	EUTRAN Round Trip Delay Estimation Info - Integer (0..2047) as specified in 3GPP TS 36.413 [12]							

7A S121 Messages and Message Formats

7A.1 Introduction

This section is divided into path management which defines the general messages for the pre-configured tunnel and a section for the specific messages used for information transfer over the control plane.

Table 7A.1 specifies GTPv2-C message types that are used across the S121 interface.

Table 7A.1: Message types for S121

Message Type value (Decimal)	Message	Reference
0	Reserved	3GPP TS 29.274 [6]
1	Echo Request	3GPP TS 29.274 [6]
2	Echo Response	3GPP TS 29.274 [6]
3	Version Not Supported Indication	3GPP TS 29.274 [6]
4-16	Reserved for S101 interface	7
17	RIM Information Transfer	7A.3.1
18-24	For future S121 interface use	
25 to 31	Reserved for Sv interface	3GPP TS 29.280 [14]
32-239	Reserved for GTPv2-C spec	3GPP TS 29.274 [6]
240-247	Reserved for Sv interface	3GPP TS 29.280 [14]
248-255	Reserved for GTPv2-C spec	3GPP TS 29.274 [6]

7A.2 Path Management Messages

7A.2.1 Introduction

The path from the MME to the non-3GPP Access Network operationally requires management capabilities. The following GTPv2-C messages support path management for the S121 interface:

- Echo Request
- Echo Response
- Version Not Supported Indication

These messages are defined for GTPv2-C and the handling and definition shall also be as defined in GTPv2-C, see 3GPP TS 29.274 [6].

7A.2.2 Echo Request message

An MME or an HRPD access node may send an Echo Request to find out if the peer HRPD access node or MME is alive (see subclause 9.2). When and how often an Echo Request message may be sent is implementation specific but an Echo Request shall not be sent more often than every 60 s on each path.

An MME or an HRPD access node shall be prepared to receive an Echo Request at any time and it shall reply with an Echo Response. The optional Private Extension contains vendor or operator specific information.

3GPP TS 29.274 [6] specifies the information elements included in the Echo Request message.

7A.2.3 Echo Response message

The message shall be sent as a response to a received Echo Request.

3GPP TS 29.274 [6] specifies the information elements included in the Echo Response message.

The Recovery information element contains the local Restart Counter (see subclause 9.3) value for the node that sends the Echo Response message.

In this release of the specification, the MME and HRPD access node do not need to determine whether the peer node has restarted or not, i.e. they may ignore the Recovery information element.

The optional Private Extension contains vendor or operator specific information.

7A.2.4 Version Not Supported Indication message

This message contains only the S121 header and indicates the latest S121 version that the MME or HRPD access node entity on the identified UDP/IP address can support (see 3GPP TS 29.274 [6] subclause 7.1.3).

3GPP TS 29.274 [6] specifies the detailed handling and information elements included in the Version Not Supported Indication message.

7A.3 S121 Messages

7A.3.1 Introduction

The following message is used to support RIM information exchange between the MME and the HRPD Access Network:

- RIM Information Transfer

7A.3.2 RIM Information Transfer

The RIM Information Transfer message shall be sent on the S121 interface between MME and the HRPD Access Network to transfer RIM information between an eNodeB and the HRPD Access Network (see 3GPP TS 23.402 [2]).

For handling of protocol errors the RIM Information Transfer message is treated as a Response message.

Table 7A.3.2-1 specifies the information elements included in the RIM Information Transfer message.

Table 7A.3.2-1: Information Elements in a RIM Information Transfer

Information elements	Presence Requirement	Reference	Instance
S121 Transparent Container	Mandatory	7A.5.2	0
RIM Routing Address	Mandatory	7A.5.3	0
Private Extension	Optional	7A.5.4	VS

The S121 Transparent Container information element shall contain encapsulated RIM Information exchanged between the MME and the HRPD Access Network, i.e. all information elements from the BSSGP RIM PDU, starting from and including the BSSGP "PDU type" (see 3GPP TS 48.018 [15]).

The RIM Routing Address IE shall identify the destination RAN node where the RIM information needs to be sent to. It shall contain:

- an eNodeB ID when the message is sent from the HRPD Access Network to the MME;
- an HRPD Sector ID when the message is sent from the MME to the HRPD Access Network.

7A.4 Reliable Delivery of Signalling Messages

For the S121 interface protocol, the reliable delivery of signalling messages shall have the same handling as GTPv2-C. See 3GPP TS 29.274 [6] but with S121 node replacing GTPv2-C node as appropriate.

NOTE: In this release of the specification, the MME and HRPD access node do not need to and can not determine whether the peer node has received the RIM Information Transfer message.

7A.5 Information Elements

7A.5.1 Information Element Assignments

An S121 message may contain several information elements. The TLIV (Type, Length, Instance, Value) encoding format shall be used for all S121 information elements. See TS 29.274 [6] subclause 8.2 for the general encoding of the IEs.

Within information elements, certain fields may be described as spare. These bits shall be transmitted with the value defined for them. To allow for future features, the receiver shall not evaluate these bits.

Table 7A.5-1: Information Elements

IE Type Value	Information Element	Comment / Reference	Number of Fixed Octets
0	Reserved	3GPP TS 29.274 [3]	3GPP TS 29.274 [3]
1-3	Reserved for GTPv2-C.	3GPP TS 29.274 [3]	3GPP TS 29.274 [3]
4-34	Reserved for S101 interface		
35	S121 Transparent Container	Variable Length / 7A.5.2	Not Applicaple
36	RIM Routing Address	Variable Length / 7A.5.3	Not Applicaple
37-50	For future use for the S121 interface.		
51-70	Reserved for Sv interface.	3GPP TS 29.280 [14]	3GPP TS 29.280 [14]
71-254	Reserved for GTPv2-C.	3GPP TS 29.274 [6]	3GPP TS 29.274 [6]
255	Private Extension	7A.5.4	3GPP TS 29.274 [6]

7A.5.2 S121 Transparent Container

The S121 Transparent Container information element shall contain encapsulated RIM information, i.e. a transparent copy of the BSSGP RIM PDU as specified in 3GPP TS 48.018 [15].

It is variable in length and shall always be an integral number of octets. The highest numbered octet shall be filled, if necessary, with extra bits set to '0' in the low order bit positions to create an integral number of octets.

Table 7A.5.2-1: S121 Transparent Container IE

Octets	Bits 8	7	6	5	4	3	2	1
1	Type = 35							
2 to 3	Length = n							
4	Spare				Instance			
5 to (n+4)	S121 Transparent Container							

7A.5.3 RIM Routing Address

The RIM Routing Address IE shall identify the destination RAN node to which the RIM Information needs to be sent to.

The RIM Routing Address information element is coded as depicted in Table 7A.5.3-1

Table 7A.5.3-1: RIM Routing Address IE

Octets	Bits 8	7	6	5	4	3	2	1
1	Type = 36							
2 to 3	Length = n							
4	Spare				Instance			
5	Routing Address Type							
6 to (n+4)	Routing Address							

Routing Address Type values are specified in Table 7A.5.3-2.

Table 7A.5.3-2: Routing Address Type values

Target Types	Values (Decimal)
Macro eNodeB ID	0
Home eNodeB ID	1
HRPD Sector Identifier	2
<spare>	3 to 255

The Routing Address Type is either a Macro eNodeB ID or a Home eNodeB ID for RIM Information Transfer towards E-UTRAN. In this case the Routing Address field includes Macro or Home eNodeB ID as defined in Figure 8.51-2 and 8.51-3 of 3GPP TS 29.274 [6].

The Routing Address Type is HRPD Sector Identifier for RIM Information Transfer towards HRPD Access Network. In this case the Routing Address field includes HRPD Sector Identifier which is defined in 3GPP2 C.S0024-B [7] section 13.9.

7A.5.4 Private Extension

The Private Extension information element shall contain vendor specific information. Refer to 3GPP TS 29.274 [6] for the encoding of this Information Element.

8 Path Protocols

Path handling is specified in 3GPP TS 29.274 [6].

9 Error Handling

9.1 Protocol Errors

See 3GPP TS 29.274 [6] section 7.7 for the complete specification of protocol error handling.

9.2 Path Failure

See 3GPP TS 29.274 [6] for the complete specification of the path failure procedures.

9.3 Restoration and Recovery

See 3GPP TS 23.007 [8] for the complete specification of the restoration and recovery procedures.

10 Security provided to Communication over the S101/S121 Interface

Protection of communication over the S101 interfaces shall be provided according to security mechanisms defined in 3GPP TS 33.402 [11].

Protection of communication over the S121 interface shall be secured as described in clause 11 of 3GPP TS 33.402 [11].

11 IP - The Networking Technology used by S101/S121

11.1 IP Version

See 3GPP TS 29.274 [6] for the complete specification of the IP versions supported over the GTPv2-C like S101 and S121 reference points.

11.2 IP Fragmentation

See 3GPP TS 29.274 [6] for the complete specification of the fragmentation procedures used in S101 and S121.

12 S101 Parameters

12.1 General

The S101 interface system parameters defined and their recommended values shall not be fixed but it shall be possible to configure them as described in 3GPP TS 29.274 [6].

12.2 Timers

See 3GPP TS 29.274 [6] for the complete specification of the timers and their recommended values used over S101, e.g. response time to wait for a request message.

12.3 Others

See 3GPP TS 29.274 [6] for the complete specification of the maximum number of retry attempts to resend a request message used over S101.

13 S103 Interface Specification

13.1 Introduction

The S103 interface is defined between the Serving GW and HSGW and supports the forwarding of DL data during mobility from E-UTRAN to HRPD access networks. Signalling procedures on the S101 interface, documented in 3GPP TS 23.402 [2], are used to set up tunnels on the S103 user plane interface.

13.2 S103 Interface

The S103 interface protocol stack and signalling requirements are specified in 3GPP TS 23.402 [2]. The S103 interface shall use Generic Routing Encapsulation as specified in IETF RFC 2784 [4] including the Key and Sequence Number Extensions to GRE in IETF RFC 2890 [5]. The Key Field value of each GRE packet header shall uniquely identify the UE-PDN connection.

Annex A (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2008-09	CT#41	CP-080477				V2.0.0 approved in CT#41	8.0.0
2008-12	CT#42	CP-080693	0001	1		Adding references to the GTP-C specification for S101Revised from agreed version in C4-082683	8.1.0
			0003			Private Extension IE in the Direct Transfer Request	
			0005			Path Management Messages and Version Not Supported Cause	
			0006	2		Reliable Delivery of Signalling MessagesWas agreed version of C4-082756	
			0008	3		GRE Tunnel KeysRevised from agreed version C4-083145	
			0009	2		S101 Sector ID	
			0011			S101 Session ID	
			0012	2		S101 interface messages and UEs	
			0013			Removal of APN Editor's Notes	
			0014			Sorting of Type Fields	
			0015			DTR and NR IE restriction	
			0018			S Bit Removal	
			0019			Handover Required Indication from the MME	
			0021			HRPD air interface reference specification correction	
			0022	1		Recovery IE over S101	
2009-03	CT#43	CP-090053	0023			Editorial clean-up of S101	8.2.0
			0024	1		Making Session ID Generic and Adding Instance Value to the Messages	
2009-09	CT#45	CP-090530	0031	1		Sequence Number to be 3 Octets and Removal of Header Extension	8.3.0
2009-09	CT#45	CP-090562	0028	6		Emergency Session Id	9.0.0
		CP-090562	0030	2		Unauthenticated IMSI for emergency in S101	
2009-12	CT#46	CP-090764	0036			GRE Keys CR Misimplementation	9.1.0
			0033			Adding the RTD information in UPLINK CDMA2000 TUNNELING	
2010-03	CT#47	CP-100019	0038	1		Reference for HRPD Sector ID	9.2.0
		CP-100019	0041	1		Correcting Cause values for S101	
		CP-100039	0039	1		EUTRAN Round Trip Delay Estimation Info	
2010-06	CT#48	CP-100263	0043			Correction to 3GPP2 references	9.3.0
2010-07						Editorial correction to previous entry in history table	9.3.1
2010-09	CT#49	CP-100451	0044	1		Reference to GTPv2	9.4.0
2011-03	CT#51	CP-110071	0045			Correct the endpoint node of S103 tunnel	10.0.0
2011-06	CT#52	CP-110355	0051	1		IE Type Extandable Corrections	10.1.0
2011-09	CT#53	CP-110567	0052	1		Conditional IE missing cause value	10.2.0
2011-12	CT#54	CP-110790	0056	2		Handling of Extendable IEs	10.3.0
2012-09	-	-	-	-		Automatic update from previous version 10.3.0 (MCC)	11.0.0
2013-09	CT#61	CP-130470	0057	1		Path management messages over the S121 reference point	12.0.0
			0062	1		Definition of S121 Messages and Message Formats	
			0058	1		Security requirements for the S121 reference point	

			0059	1		Networking Technology for the S121 reference point	
			0060	1		Update scope to cover the S121 reference point	
			0061	1		Definition of S121 Message Header	
			0063	1		GTP-C message types for rSRVCC	
2013-12	CT#62	CP-130635	0064	1		HRPD Sector ID definition	12.1.0
2014-06	CT#64	CP-140250	0065	-		HRPD Sector ID definition	12.2.0
		CP-140261	0066	1		Version Not Supported Indication	
		CP-140261	0067	1		Correct the handling of Restart Counter	
2014-12	CT#66	CP-140972	0068	1		Removal of Optimized HO procedure from HRPD to EUTRAN	12.3.0
2015-12	CT#70	-	-	-		Update to Rel-13 version (MCC)	13.0.0
2017-03	CT#75	-	-	-		Update to Rel-14 version (MCC)	14.0.0
2018-06	CT#80	-	-	-		Update to Rel-15 version (MCC)	15.0.0
2020-07	CT#88e	-	-	-		Update to Rel-16 version (MCC)	16.0.0
2022-04	-	-	-	-	-	Update to Rel-17 version (MCC)	17.0.0

History

Document history		
V17.0.0	April 2022	Publication