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Contents

Foreword

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1 Scope

The present document specifies the overall stage 2 level functionality for control and user plane separation of EPC's SGW, PGW and TDF. This enables a flexible placement of the separated control plane and user plane functions for supporting diverse deployment scenarios (e.g. central or distributed user plane function) without affecting the overall functionality provided by these EPC entities.

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

[2] 3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access".

[3] 3GPP TS 23.203: "Policy and charging control architecture".

[4] 3GPP TS 23.402: "Architecture enhancements for non-3GPP accesses".

[5] 3GPP TS 23.060: "General Packet Radio Service (GPRS); Service description; Stage 2".

[6] 3GPP TS 29.060: "GPRS Tunnelling Protocol (GTP) across the Gn and Gp interface".

[7] 3GPP TS 29.274: "3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3".

[8] 3GPP TS 32.251: "Telecommunication management; Charging management; Packet Switched (PS) domain charging".

[9] 3GPP TS 32.240: "Charging architecture and principles".

[10] 3GPP TS 33.107: "3G security; Lawful interception architecture and functions".

[11] 3GPP TS 29.212: "Policy and Charging Control (PCC); Reference points".

[12] 3GPP TS 29.244: "Interface between the Control Plane and the User Plane of EPC Nodes; Stage 3".

[13] 3GPP TS 28.708: "Telecommunication management; Evolved Packet Core (EPC) Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1], TS 23.401 [2], TS 23.203 [3] 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].

F-TEID: as defined in clause 8.22 of TS 29.274 [7].

F-TEIDu: The F-TEID of a GTP-u tunnel.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1], TS 23.401 [2], TS 23.203 [3] 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].

CP function	Control Plane function
PGW	PDN Gateway
PGW-C	PDN Gateway Control plane function
PGW-U	PDN Gateway User plane function
SGW	Serving Gateway
SGW-C	Serving Gateway Control plane function
SGW-U	Serving Gateway User plane function
TDF	Traffic Detection Function
TDF-C	Traffic Detection Function Control plane function
TDF-U	Traffic Detection Function User plane function
UP function	User Plane function

4 Architecture model and concepts

4.1 General concepts

The architecture and functionality for control and user plane separation of SGW, PGW and TDF is based on the following concepts:

- Interworking with networks not applying control and user plane separation is possible (i.e. in case of roaming scenarios);
- Split network entities can interwork with network entities that are not split within the same network;
- Split network entities have no requirement to update UE, and Radio Access Network;
- The SGW/PGW selection function of the MME/ePDG/TWAN described in TS 23.401 [2] and TS 23.402 [4] is used for the selection of the respective CP function;
- The configuration based mechanism (in PGW or PCRF) described in TS 23.203 [3] is used for the selection of the CP function of the TDF;
- A CP function can interface with one or more UP functions (e.g. to enable independent scalability of CP functions and UP functions).

4.2 Architecture reference model

4.2.1 Non-roaming and roaming architectures

This clause defines the complementary aspects of the architecture reference models specified in TS 23.401 [2] clause 4.2 and TS 23.402 [4] clauses 4.2.2 and 4.2.3 for GTP-based interfaces when SGW, PGW and TDF control and user planes are separated.

For S2a, S2b, S5 and S8 reference points, this architecture reference model is only supported with GTP-based interfaces. PMIP-based interfaces and S2c interface are not supported.

Figure 4.2.1-1 shows the architecture reference model in the case of separation between control plane and user plane. This architecture reference model covers non-roaming as well as home routed and local breakout roaming scenarios.

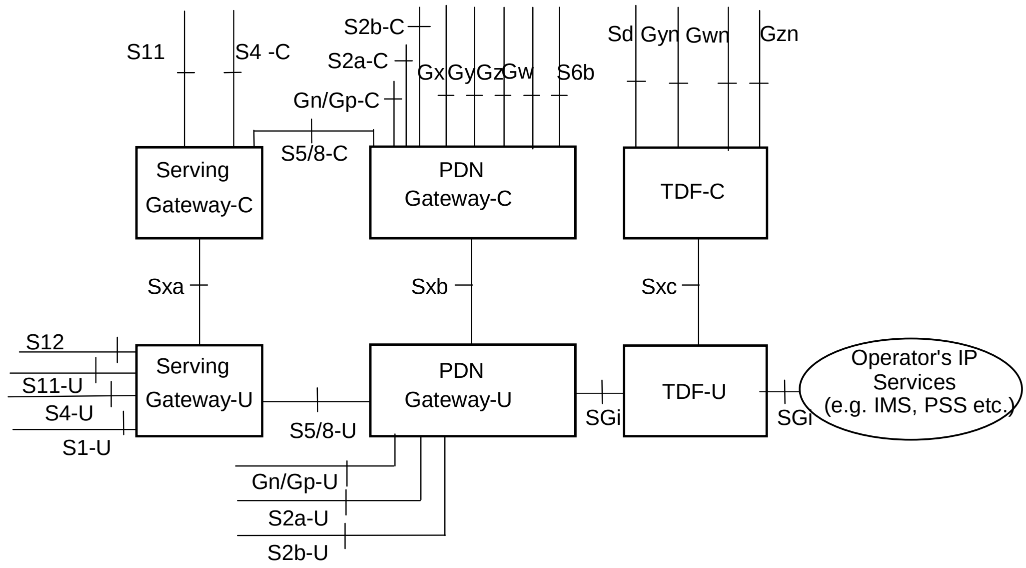

Figure 4.2.1-1: Architecture reference model with separation of user plane and control plane for non-roaming and roaming scenarios

NOTE 1: The -C or -U suffix appended to S2a, S2b, S5 and S8 existing reference points only indicate the control plane and user plane components of those interfaces.

NOTE 2: The architecture in figure 4.2.1-1 only depicts the case when the CP and UP functions of all SGW, PGW and TDF nodes are split. However, the other cases when the CP and UP function of only one of these nodes is split while the CP and UP function of the other interfacing node is not split, e.g. PGW's control plane and user plane is split while SGW's control plane and user plane is not split, are also supported. The split architecture of a node does not put any architectural requirements on the peer nodes with which it interfaces.

NOTE 3: TDF is an optional functional entity.

NOTE 4: Additional interfaces/reference points are documented in TS 23.401 [2], TS 23.402 [4], TS 23.060 [5] and TS 23.203 [3].

NOTE 5: For a roaming architecture with local breakout, the Gx interface is defined between the PGW-C and PCRF in the visited network.

NOTE 6: S11-U is the interface between MME and SGW-U, supporting CP CIoT EPS Optimisation (see TS 23.401 [2]).

4.2.2 Combined SGW/PGW architecture

The usage of a combined SGW/PGW documented in TS 23.401 [2] remains possible in a deployment with separated control and user planes. This is enabled by supporting an Sx interface with a common parameter structure for non-combined and combined cases. Figure 4.2.2-1 shows the architecture reference model for a combined SGW/PGW in the case of separation between control plane and user plane.

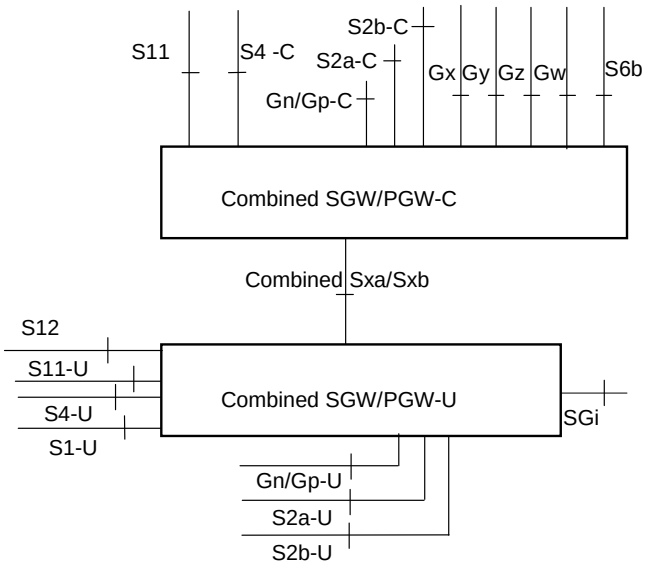

Figure 4.2.2-1: Architecture reference model with separation of user plane and control plane for a combined SGW/PGW

NOTE 1: The combined Sxa/Sxb shown in figure 4.2.2-1 only covers the functionality of Sxa and Sxb.

NOTE 2: S11-U is the interface between MME and combined SGW/PGW-U, supporting CP CIoT EPS Optimisation (see TS 23.401 [2]).

4.2.3 Reference points

This clause defines the complementary reference points of the architecture reference models specified in TS 23.401 [2] clause 4.2 and TS 23.402 [4] clauses 4.2.2 and 4.2.3 for GTP-based interfaces when SGW, PGW and TDF control and user planes are separated.

The reference points added to the reference points defined in TS 23.401 [2], TS 23.402 [4] and TS 23.203 [3] are the following ones:

Sxa: Reference point between SGW-C and SGW-U.

Sxb: Reference point between PGW-C and PGW-U.

Sxc: Reference point between TDF-C and TDF-U.

4.3 High level functions

4.3.1 General

This clause documents the existing functionality of SGW, PGW and TDF as described in TS 23.401 [2], TS 23.402 [4] and TS 23.203 [3].

Table 4.3.1-1: Existing functionality of SGW, PGW and TDF

Main functionality	Sub-functionality	SGW	PGW	TDF
A. Session management (default & dedicated bearer establishment, bearer modification, bearer deactivation)	1. Resource management for bearer resources	X	X	
	2. IP address and TEID assignment for GTP-U	X	X	
	3. Packet forwarding	X	X	
	4. Transport level packet marking	X	X	
B. UE IP address management	1. IP address allocation from local pool		X	
	2. DHCPv4 / DHCPv6 client		X	
	3. DHCPv4 / DHCPv6 server		X	
	4. Router advertisement, router solicitation, neighbour advertisement, neighbour solicitation (as in RFC 4861)		X	
C. Support for UE mobility	1. Forwarding of "end marker" (as long as user plane to source eNB exists)	X		
	2. Sending of "end marker" after switching the path to target node	X	X	
	3. Forwarding of buffered packet	X		
	4. Change of target GTP-U endpoint within 3GPP accesses	X	X	
	5. Change of target GTP-U endpoint between 3GPP and non-3GPP access		X	
D. S1-Release / Buffering / Downlink Data Notification	1. ECM-IDLE mode DL packet buffering; Triggering of Downlink Data Notification message generation per bearer (multiple, if DL packet received on higher ARP than previous DDN); Inclusion of DSCP of packet in DDN message for Paging Policy Differentiation	X		
	2. Delay Downlink Data Notification Request (if terminating side replies to uplink data after UE service request before SGW gets updated)	X		
	3. Extended buffering of downlink data when the UE is in a power saving state and not reachable (high latency communication); dropping of downlink data (if MME has requested SGW to throttle downlink low priority traffic and if the downlink data packet is received on such a bearer (see clause 4.3.7.4.1a).	X		
	4. PGW pause of charging procedure based on operator policy/configuration the SGW (failed paging, abnormal radio link release, number/fraction of packets/bytes dropped at SGW)	X	X	
E. Bearer/APN policing	1. UL/DL APN-AMBR enforcement		X	X
	2. UL/DL bearer MBR enforcement (for GBR bearer)		X	
	3. UL/DL bearer MBR enforcement (for nonGBR bearer on Gn/Gp interface)		X	
F. PCC related functions	1. Service detection (DPI, IP-5-tuple)		X	X
	2. Bearer binding (bearer QoS & TFT)		X	
	3. UL bearer binding verification and mapping of DL traffic to bearers		X	
	4. UL and DL service level gating		X	X
	5. UL and DL service level MBR enforcement		X	X
	6. UL and DL service level charging (online & offline, per charging key)		X	X