

ETSI TS 123 501 V16.7.0 (2021-01)



5G; System architecture for the 5G System (5GS) (3GPP TS 23.501 version 16.7.0 Release 16)

[ETSI TS 123 501 V16.7.0 \(2021-01\)
https://standards.iteh.ai/catalog/standards/sist/0bcaba0d-2cee-4f80-b331-1df6eeclaf53/etsi-ts-123-501-v16-7-0-2021-01](https://standards.iteh.ai/catalog/standards/sist/0bcaba0d-2cee-4f80-b331-1df6eeclaf53/etsi-ts-123-501-v16-7-0-2021-01)



ReferenceRTS/TSGS-0223501vg70

Keywords

5G

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

iTeh STANDARD PREVIEW
(standards.iteh.ai)

Important notice

ETSI TS 123 501 V16.7.0 (2021-01)
<https://standards.iteh.ai/catalog/standards/sist/0bcaba0d-2cee-4f80-b331-1d6cc1a53/cis-ts-123-501-v16-7-0-2021-01>
The present document can be downloaded from:
<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at <https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:
<https://portal.etsi.org/People/CommitteeSupportStaff.aspx>

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2021.
All rights reserved.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members.
3GPP™ and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.

oneM2M™ logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners.

GSM® and the GSM logo are trademarks registered and owned by the GSM Association.

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Legal Notice

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

The present document may refer to technical specifications or reports using their 3GPP identities. These shall be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between 3GPP and ETSI identities can be found under <http://webapp.etsi.org/key/queryform.asp>.

<https://standards.iteh.ai/catalog/standards/sist/0bcaba0d-2cee-4f80-b331-1d8ccc1af53/etsi-ts-123-501-v16-7-0-2021-01>

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Contents

Intellectual Property Rights	2
Legal Notice	2
Modal verbs terminology.....	2
Foreword.....	16
1 Scope	17
2 References	17
3 Definitions and abbreviations.....	21
3.1 Definitions	21
3.2 Abbreviations	26
4 Architecture model and concepts	29
4.1 General concepts	29
4.2 Architecture reference model	29
4.2.1 General.....	29
4.2.2 Network Functions and entities	30
4.2.3 Non-roaming reference architecture	31
4.2.4 Roaming reference architectures.....	34
4.2.5 Data Storage architectures	38
4.2.5a Radio Capabilities Signalling optimisation.....	39
4.2.6 Service-based interfaces	40
4.2.7 Reference points	40
4.2.8 Support of non-3GPP access.....	42
4.2.8.0 General	42
4.2.8.1 General Concepts to Support Trusted and Untrusted Non-3GPP Access	43
4.2.8.1A General Concepts to support Wireline Access	44
4.2.8.2 Architecture Reference Model for Trusted and Untrusted Non-3GPP Accesses	45
4.2.8.2.1 Non-roaming Architecture.....	45
4.2.8.2.2 LBO Roaming Architecture.....	46
4.2.8.2.3 Home-routed Roaming Architecture	48
4.2.8.3 Reference Points for Non-3GPP Access	50
4.2.8.3.1 Overview	50
4.2.8.3.2 Requirements on TA.....	51
4.2.8.4 Architecture Reference Model for Wireline Access network.....	51
4.2.8.5 Access to 5GC from devices that do not support 5GC NAS over WLAN access.....	52
4.2.8.5.1 General	52
4.2.8.5.2 Reference Architecture	53
4.2.8.5.3 Network Functions	53
4.2.8.5.4 Reference Points.....	53
4.2.9 Network Analytics architecture	54
4.2.10 Architecture Reference Model for ATSSS Support.....	54
4.3 Interworking with EPC.....	55
4.3.1 Non-roaming architecture	55
4.3.2 Roaming architecture.....	56
4.3.3 Interworking between 5GC via non-3GPP access and E-UTRAN connected to EPC.....	58
4.3.3.1 Non-roaming architecture	58
4.3.3.2 Roaming architecture	59
4.3.4 Interworking between ePDG connected to EPC and 5GS	61
4.3.4.1 Non-roaming architecture	61
4.3.4.2 Roaming architectures.....	62
4.3.5 Service Exposure in Interworking Scenarios	64
4.3.5.1 Non-roaming architecture	64
4.3.5.2 Roaming architectures.....	65
4.4 Specific services	66
4.4.1 Public Warning System	66
4.4.2 SMS over NAS	66

4.4.2.1	Architecture to support SMS over NAS	66
4.4.2.2	Reference point to support SMS over NAS	68
4.4.2.3	Service based interface to support SMS over NAS	68
4.4.3	IMS support	68
4.4.4	Location services	68
4.4.4.1	Architecture to support Location Services	68
4.4.4.2	Reference point to support Location Services	68
4.4.4.3	Service Based Interfaces to support Location Services	68
4.4.5	Application Triggering Services	69
4.4.6	5G LAN-type Services	69
4.4.6.1	User plane architecture to support 5G LAN-type service	69
4.4.6.2	Reference points to support 5G LAN-type service	69
4.4.7	MSISDN-less MO SMS Service	69
4.4.8	Time Sensitive Communication	70
4.4.8.1	General	70
4.4.8.2	Architecture to support Time Sensitive Communication	70
5	High level features	71
5.1	General	71
5.2	Network Access Control	71
5.2.1	General	71
5.2.2	Network selection	72
5.2.3	Identification and authentication	72
5.2.4	Authorisation	72
5.2.5	Access control and barring	72
5.2.6	Policy control	73
5.2.7	Lawful Interception	73
5.3	Registration and Connection Management	73
5.3.1	General	73
5.3.2	Registration Management	73
5.3.2.1	General	73
5.3.2.2	5GS Registration Management states	73
5.3.2.2.1	General	73
5.3.2.2.2	RM-DEREGISTERED state	73
5.3.2.2.3	RM-REGISTERED state	74
5.3.2.2.4	5GS Registration Management State models	75
5.3.2.3	Registration Area management	75
5.3.2.4	Support of a UE registered over both 3GPP and Non-3GPP access	76
5.3.3	Connection Management	78
5.3.3.1	General	78
5.3.3.2	5GS Connection Management states	78
5.3.3.2.1	General	78
5.3.3.2.2	CM-IDLE state	78
5.3.3.2.3	CM-CONNECTED state	79
5.3.3.2.4	5GS Connection Management State models	79
5.3.3.2.5	CM-CONNECTED with RRC Inactive state	80
5.3.3.3	NAS signalling connection management	82
5.3.3.3.1	General	82
5.3.3.3.2	NAS signalling connection establishment	82
5.3.3.3.3	NAS signalling connection Release	82
5.3.3.4	Support of a UE connected over both 3GPP and Non-3GPP access	82
5.3.4	UE Mobility	83
5.3.4.1	Mobility Restrictions	83
5.3.4.1.1	General	83
5.3.4.1.2	Management of Service Area Restrictions	85
5.3.4.2	Mobility Pattern	86
5.3.4.3	Radio Resource Management functions	86
5.3.4.4	UE mobility event notification	87
5.4	3GPP access specific aspects	88
5.4.1	UE reachability in CM-IDLE	88
5.4.1.1	General	88
5.4.1.2	UE reachability allowing mobile terminated data while the UE is CM-IDLE	89

5.4.1.3	Mobile Initiated Connection Only (MICO) mode.....	89
5.4.2	UE reachability in CM-CONNECTED.....	90
5.4.3	Paging strategy handling.....	90
5.4.3.1	General.....	90
5.4.3.2	Paging Policy Differentiation.....	91
5.4.3.3	Paging Priority.....	91
5.4.4	UE Radio Capability handling.....	92
5.4.4.1	UE radio capability information storage in the AMF.....	92
5.4.4.1a	UE radio capability signalling optimisation (RACS).....	92
5.4.4.2	Void.....	96
5.4.4.2a	UE Radio Capability Match Request.....	96
5.4.4.3	Paging assistance information.....	96
5.4.4a	UE MM Core Network Capability handling.....	97
5.4.4b	UE 5GSM Core Network Capability handling.....	97
5.4.5	DRX (Discontinuous Reception) framework.....	98
5.4.6	Core Network assistance information for RAN optimization.....	98
5.4.6.1	General.....	98
5.4.6.2	Core Network assisted RAN parameters tuning.....	98
5.4.6.3	Core Network assisted RAN paging information.....	99
5.4.7	NG-RAN location reporting.....	100
5.4.8	Support for identification and restriction of using unlicensed spectrum.....	100
5.4.9	Wake Up Signal Assistance.....	101
5.4.9.1	General.....	101
5.4.9.2	Group Wake Up Signal.....	101
5.5	Non-3GPP access specific aspects.....	102
5.5.0	General.....	102
5.5.1	Registration Management.....	102
5.5.2	Connection Management.....	102
5.5.3	UE Reachability.....	104
5.5.3.1	UE reachability in CM-IDLE.....	104
5.5.3.2	UE reachability in CM-CONNECTED.....	104
5.6	Session Management.....	104
5.6.1	Overview.....	104
5.6.2	Interaction between AMF and SMF.....	107
5.6.3	Roaming.....	109
5.6.4	Single PDU Session with multiple PDU Session Anchors.....	110
5.6.4.1	General.....	110
5.6.4.2	Usage of an UL Classifier for a PDU Session.....	111
5.6.4.3	Usage of IPv6 multi-homing for a PDU Session.....	112
5.6.5	Support for Local Area Data Network.....	114
5.6.6	Secondary authentication/authorization by a DN-AAA server during the establishment of a PDU Session.....	116
5.6.7	Application Function influence on traffic routing.....	117
5.6.7.1	General.....	117
5.6.7.2	Enhancement of UP path management based on the coordination with AFs.....	122
5.6.8	Selective activation and deactivation of UP connection of existing PDU Session.....	123
5.6.9	Session and Service Continuity.....	124
5.6.9.1	General.....	124
5.6.9.2	SSC mode.....	124
5.6.9.2.1	SSC Mode 1.....	124
5.6.9.2.2	SSC Mode 2.....	125
5.6.9.2.3	SSC Mode 3.....	125
5.6.9.3	SSC mode selection.....	125
5.6.10	Specific aspects of different PDU Session types.....	126
5.6.10.1	Support of IP PDU Session type.....	126
5.6.10.2	Support of Ethernet PDU Session type.....	126
5.6.10.3	Support of Unstructured PDU Session type.....	128
5.6.10.4	Maximum Transfer Unit size considerations.....	129
5.6.11	UE presence in Area of Interest reporting usage by SMF.....	130
5.6.12	Use of Network Instance.....	131
5.6.13	Always-on PDU session.....	131
5.6.14	Support of Framed Routing.....	132

5.7	QoS model.....	132
5.7.1	General Overview.....	132
5.7.1.1	QoS Flow.....	132
5.7.1.2	QoS Profile.....	133
5.7.1.2a	Alternative QoS Profile.....	134
5.7.1.3	Control of QoS Flows.....	134
5.7.1.4	QoS Rules.....	134
5.7.1.5	QoS Flow mapping.....	135
5.7.1.6	DL traffic.....	137
5.7.1.7	UL Traffic.....	137
5.7.1.8	AMBR/MFBR enforcement and rate limitation.....	137
5.7.1.9	Precedence Value.....	138
5.7.2	5G QoS Parameters.....	138
5.7.2.1	5QI.....	138
5.7.2.2	ARP.....	138
5.7.2.3	RQA.....	139
5.7.2.4	Notification control.....	139
5.7.2.4.1	General.....	139
5.7.2.4.1a	Notification Control without Alternative QoS Profiles.....	139
5.7.2.4.1b	Notification control with Alternative QoS Profiles.....	140
5.7.2.4.2	Usage of Notification control with Alternative QoS Profiles at handover.....	141
5.7.2.4.3	Usage of Notification control with Alternative QoS Profiles during QoS Flow establishment and modification.....	141
5.7.2.5	Flow Bit Rates.....	142
5.7.2.6	Aggregate Bit Rates.....	142
5.7.2.7	Default values.....	142
5.7.2.8	Maximum Packet Loss Rate.....	143
5.7.2.9	Wireline access network specific 5G QoS parameters.....	143
5.7.3	5G QoS characteristics.....	143
5.7.3.1	General.....	143
5.7.3.2	Resource Type.....	144
5.7.3.3	Priority Level.....	144
5.7.3.4	Packet Delay Budget.....	144
5.7.3.5	Packet Error Rate.....	145
5.7.3.6	Averaging Window.....	145
5.7.3.7	Maximum Data Burst Volume.....	146
5.7.4	Standardized 5QI to QoS characteristics mapping.....	146
5.7.5	Reflective QoS.....	150
5.7.5.1	General.....	150
5.7.5.2	UE Derived QoS Rule.....	151
5.7.5.3	Reflective QoS Control.....	151
5.7.6	Packet Filter Set.....	153
5.7.6.1	General.....	153
5.7.6.2	IP Packet Filter Set.....	153
5.7.6.3	Ethernet Packet Filter Set.....	153
5.8	User Plane Management.....	154
5.8.1	General.....	154
5.8.2	Functional Description.....	154
5.8.2.1	General.....	154
5.8.2.2	UE IP Address Management.....	154
5.8.2.2.1	General.....	154
5.8.2.2.2	Routing rules configuration.....	156
5.8.2.2.3	The procedure of Stateless IPv6 Address Autoconfiguration.....	157
5.8.2.3	Management of CN Tunnel Info.....	157
5.8.2.3.1	General.....	157
5.8.2.3.2	Void.....	157
5.8.2.3.3	Management of CN Tunnel Info in the UPF.....	157
5.8.2.4	Traffic Detection.....	158
5.8.2.4.1	General.....	158
5.8.2.4.2	Traffic Detection Information.....	158
5.8.2.5	Control of User Plane Forwarding.....	158
5.8.2.5.1	General.....	158

5.8.2.5.2	Data forwarding between the SMF and UPF	159
5.8.2.5.3	Support of Ethernet PDU Session type	159
5.8.2.6	Charging and Usage Monitoring Handling	160
5.8.2.6.1	General	160
5.8.2.6.2	Activation of Usage Reporting in UPF	160
5.8.2.6.3	Reporting of Usage Information towards SMF	161
5.8.2.7	PDU Session and QoS Flow Policing	161
5.8.2.8	PCC Related Functions	162
5.8.2.8.1	Activation/Deactivation of predefined PCC rules	162
5.8.2.8.2	Enforcement of Dynamic PCC Rules	162
5.8.2.8.3	Redirection	163
5.8.2.8.4	Support of PFD Management	163
5.8.2.9	Functionality of Sending of "End marker"	163
5.8.2.9.0	Introduction	163
5.8.2.9.1	UPF Constructing the "End marker" Packets	164
5.8.2.9.2	SMF Constructing the "End marker" Packets	164
5.8.2.10	UP Tunnel Management	164
5.8.2.11	Parameters for N4 session management	165
5.8.2.11.1	General	165
5.8.2.11.2	N4 Session Context	166
5.8.2.11.3	Packet Detection Rule	166
5.8.2.11.4	QoS Enforcement Rule	169
5.8.2.11.5	Usage Reporting Rule	172
5.8.2.11.6	Forwarding Action Rule	175
5.8.2.11.7	Usage Report generated by UPF	178
5.8.2.11.8	Multi-Access Rule	179
5.8.2.11.9	Bridge Information	180
5.8.2.11.10	Void	180
5.8.2.11.11	Session Reporting Rule	180
5.8.2.11.12	Session reporting generated by UPF	181
5.8.2.11.13	Void	181
5.8.2.11.14	TSC Management Information	181
5.8.2.12	Reporting of the UE MAC addresses used in a PDU Session	181
5.8.2.13	Support for 5G VN group communication	182
5.8.2.13.0	General	182
5.8.2.13.1	Support for unicast traffic forwarding of a 5G VN	183
5.8.2.13.2	Support for unicast traffic forwarding update due to UE mobility	184
5.8.2.13.3	Support for user plane traffic replication in a 5G VN	184
5.8.2.14	Inter PLMN User Plane Security functionality	186
5.8.3	Explicit Buffer Management	186
5.8.3.1	General	186
5.8.3.2	Buffering at UPF	187
5.8.3.3	Buffering at SMF	187
5.8.4	SMF Pause of Charging	187
5.9	Identifiers	188
5.9.1	General	188
5.9.2	Subscription Permanent Identifier	188
5.9.2a	Subscription Concealed Identifier	188
5.9.3	Permanent Equipment Identifier	188
5.9.4	5G Globally Unique Temporary Identifier	189
5.9.5	AMF Name	189
5.9.6	Data Network Name (DNN)	190
5.9.7	Internal-Group Identifier	190
5.9.8	Generic Public Subscription Identifier	190
5.9.9	AMF UE NGAP ID	190
5.9.10	UE Radio Capability ID	190
5.10	Security aspects	191
5.10.1	General	191
5.10.2	Security Model for non-3GPP access	191
5.10.2.1	Signalling Security	191
5.10.3	PDU Session User Plane Security	191
5.11	Support for Dual Connectivity, Multi-Connectivity	193

5.11.1	Support for Dual Connectivity.....	193
5.12	Charging.....	194
5.12.1	General.....	194
5.12.2	Usage Data Reporting for Secondary RAT.....	194
5.12.3	Secondary RAT Periodic Usage Data Reporting Procedure.....	195
5.13	Support for Edge Computing.....	195
5.14	Policy Control	195
5.15	Network slicing	195
5.15.1	General.....	195
5.15.2	Identification and selection of a Network Slice: the S-NSSAI and the NSSAI	196
5.15.2.1	General	196
5.15.2.2	Standardised SST values	197
5.15.3	Subscription aspects.....	198
5.15.4	UE NSSAI configuration and NSSAI storage aspects	198
5.15.4.1	General	198
5.15.4.1.1	UE Network Slice configuration	198
5.15.4.1.2	Mapping of S-NSSAIs values in the Allowed NSSAI and in the Requested NSSAI to the S-NSSAIs values used in the HPLMN.....	200
5.15.4.2	Update of UE Network Slice configuration	201
5.15.5	Detailed Operation Overview	201
5.15.5.1	General	201
5.15.5.2	Selection of a Serving AMF supporting the Network Slices.....	201
5.15.5.2.1	Registration to a set of Network Slices.....	201
5.15.5.2.2	Modification of the Set of Network Slice(s) for a UE	206
5.15.5.2.3	AMF Re-allocation due to Network Slice(s) Support.....	207
5.15.5.3	Establishing a PDU Session in a Network Slice	207
5.15.6	Network Slicing Support for Roaming	208
5.15.7	Network slicing and Interworking with EPS	209
5.15.7.1	General	209
5.15.7.2	Idle mode aspects	210
5.15.7.3	Connected mode aspects	210
5.15.8	Configuration of Network Slice availability in a PLMN.....	210
5.15.9	Operator-controlled inclusion of NSSAI in Access Stratum Connection Establishment	211
5.15.10	Network Slice-Specific Authentication and Authorization.....	212
5.16	Support for specific services	213
5.16.1	Public Warning System	213
5.16.2	SMS over NAS	213
5.16.2.1	General	213
5.16.2.2	SMS over NAS transport	213
5.16.3	IMS support	214
5.16.3.1	General	214
5.16.3.2	IMS voice over PS Session Supported Indication over 3GPP access	214
5.16.3.2a	IMS voice over PS Session Supported Indication over non-3GPP access	215
5.16.3.3	Homogeneous support for IMS voice over PS Session supported indication	215
5.16.3.4	P-CSCF address delivery	215
5.16.3.5	Domain selection for UE originating sessions / calls.....	216
5.16.3.6	Terminating domain selection for IMS voice.....	216
5.16.3.7	UE's usage setting	217
5.16.3.8	Domain and Access Selection for UE originating SMS.....	217
5.16.3.8.1	UE originating SMS for IMS Capable UEs supporting SMS over IP	217
5.16.3.8.2	Access Selection for SMS over NAS	217
5.16.3.9	SMF support for P-CSCF restoration procedure.....	217
5.16.3.10	IMS Voice Service via EPS Fallback or RAT fallback in 5GS.....	217
5.16.3.11	P-CSCF discovery and selection	218
5.16.3.12	HSS discovery and selection	218
5.16.4	Emergency Services.....	218
5.16.4.1	Introduction.....	218
5.16.4.2	Architecture Reference Model for Emergency Services	221
5.16.4.3	Mobility Restrictions and Access Restrictions for Emergency Services.....	221
5.16.4.4	Reachability Management.....	221
5.16.4.5	SMF and UPF selection function for Emergency Services	221
5.16.4.6	QoS for Emergency Services	222

5.16.4.7	PCC for Emergency Services	222
5.16.4.8	IP Address Allocation	222
5.16.4.9	Handling of PDU Sessions for Emergency Services	222
5.16.4.9a	Handling of PDU Sessions for normal services for Emergency Registered UEs	222
5.16.4.10	Support of eCall Only Mode	222
5.16.4.11	Emergency Services Fallback	223
5.16.5	Multimedia Priority Services	223
5.16.6	Mission Critical Services	225
5.17	Interworking and Migration	226
5.17.1	Support for Migration from EPC to 5GC	226
5.17.1.1	General	226
5.17.1.2	User Plane management to support interworking with EPS	227
5.17.2	Interworking with EPC	228
5.17.2.1	General	228
5.17.2.2	Interworking Procedures with N26 interface	231
5.17.2.2.1	General	231
5.17.2.2.2	Mobility for UEs in single-registration mode	231
5.17.2.3	Interworking Procedures without N26 interface	232
5.17.2.3.1	General	232
5.17.2.3.2	Mobility for UEs in single-registration mode	233
5.17.2.3.3	Mobility for UEs in dual-registration mode	234
5.17.2.3.4	Redirection for UEs in connected state	235
5.17.2.4	Mobility between 5GS and GERAN/UTRAN	235
5.17.3	Interworking with EPC in presence of Non-3GPP PDU Sessions	236
5.17.4	Network sharing support and interworking between EPS and 5GS	236
5.17.5	Service Exposure in Interworking Scenarios	236
5.17.5.1	General	236
5.17.5.2	Support of interworking for Monitoring Events	237
5.17.5.2.1	Interworking with N26 interface	237
5.17.5.2.2	Interworking without N26 interface	237
5.17.5.3	Availability or expected level of a service API	238
5.17.6	Void	238
5.17.7	Configuration Transfer Procedure between NG-RAN and E-UTRAN	238
5.17.7.1	Architecture Principles for Configuration Transfer between NG-RAN and E-UTRAN	238
5.17.7.2	Addressing, routing and relaying	239
5.17.7.2.1	Addressing	239
5.17.7.2.2	Routing	239
5.17.7.2.3	Relaying	240
5.18	Network Sharing	240
5.18.1	General concepts	240
5.18.2	Broadcast system information for network sharing	241
5.18.2a	PLMN list handling for network sharing	241
5.18.3	Network selection by the UE	241
5.18.4	Network selection by the network	242
5.18.5	Network Sharing and Network Slicing	242
5.19	Control Plane Load Control, Congestion and Overload Control	242
5.19.1	General	242
5.19.2	TNLA Load Balancing and TNLA Load Re-Balancing	243
5.19.3	AMF Load Balancing	243
5.19.4	AMF Load Re-Balancing	243
5.19.5	AMF Control Of Overload	244
5.19.5.1	General	244
5.19.5.2	AMF Overload Control	244
5.19.6	SMF Overload Control	245
5.19.7	NAS level congestion control	245
5.19.7.1	General	245
5.19.7.2	General NAS level congestion control	245
5.19.7.3	DNN based congestion control	246
5.19.7.4	S-NSSAI based congestion control	248
5.19.7.5	Group specific NAS level congestion control	249
5.19.7.6	Control Plane data specific NAS level congestion control	249
5.20	External Exposure of Network Capability	250

5.20a	Data Collection from an AF	251
5.21	Architectural support for virtualized deployments	251
5.21.0	General.....	251
5.21.1	Architectural support for N2.....	251
5.21.1.1	TNL associations.....	251
5.21.1.2	NGAP UE-TNLA-binding	252
5.21.1.3	N2 TNL association selection	252
5.21.2	AMF Management	252
5.21.2.1	AMF Addition/Update	252
5.21.2.2	AMF planned removal procedure	253
5.21.2.2.1	AMF planned removal procedure with UDSF deployed	253
5.21.2.2.2	AMF planned removal procedure without UDSF.....	254
5.21.2.3	Procedure for AMF Auto-recovery	256
5.21.3	Network Reliability support with Sets.....	257
5.21.3.1	General.....	257
5.21.3.2	NF Set and NF Service Set.....	258
5.21.3.3	Reliability of NF instances within the same NF Set.....	258
5.21.3.4	Reliability of NF Services	258
5.21.4	Network Function/NF Service Context Transfer	259
5.21.4.1	General	259
5.22	System Enablers for priority mechanism.....	259
5.22.1	General.....	259
5.22.2	Subscription-related Priority Mechanisms	259
5.22.3	Invocation-related Priority Mechanisms	260
5.22.4	QoS Mechanisms applied to established QoS Flows	261
5.23	Supporting for Asynchronous Type Communication.....	261
5.24	3GPP PS Data Off	262
5.25	Support of OAM Features	262
5.25.1	Support of Tracing: Signalling Based Activation/Deactivation of Tracing	262
5.25.2	Support of OAM-based 5G VN group management.....	263
5.26	Configuration Transfer Procedure.....	263
5.26.1	Architecture Principles for Configuration Transfer.....	263
5.26.2	Addressing, routing and relaying	264
5.26.2.1	Addressing	264
5.26.2.2	Routing.....	264
5.26.2.3	Relaying.....	264
5.27	Time Sensitive Communications.....	265
5.27.0	General.....	265
5.27.1	TSN Time Synchronization	265
5.27.1.1	General	265
5.27.1.2	Distribution of timing information.....	266
5.27.1.2.1	Distribution of 5G internal system clock.....	266
5.27.1.2.2	Distribution of TSN grandmaster clock and time-stamping	266
5.27.1.3	Support for multiple TSN working domains	267
5.27.1a	Periodic deterministic QoS	267
5.27.2	TSC Assistance Information (TSCAI).....	267
5.27.3	Support for TSC QoS Flows	269
5.27.4	Hold and Forward Buffering mechanism.....	269
5.27.5	5G System Bridge delay	270
5.28	Support of integration with TSN	270
5.28.1	5GS TSN bridge management	270
5.28.2	5GS Bridge configuration.....	272
5.28.3	Port and bridge management information exchange in 5GS.....	273
5.28.3.1	General	273
5.28.3.2	Transfer of port or bridge management information.....	281
5.28.3.3	VLAN Configuration Information	282
5.28.4	QoS mapping tables.....	282
5.29	Support for 5G LAN-type service	283
5.29.1	General.....	283
5.29.2	5G VN group management	284
5.29.3	PDU Session management.....	285
5.29.4	User Plane handling	286

5.30	Support for non-public networks.....	286
5.30.1	General.....	286
5.30.2	Stand-alone non-public networks	287
5.30.2.0	General	287
5.30.2.1	Identifiers	287
5.30.2.2	Broadcast system information.....	287
5.30.2.3	UE configuration and subscription aspects	288
5.30.2.4	Network selection in SNPN access mode	288
5.30.2.5	Network access control	288
5.30.2.6	Cell (re-)selection in SNPN access mode.....	289
5.30.2.7	Access to PLMN services via stand-alone non-public networks.....	289
5.30.2.8	Access to stand-alone non-public network services via PLMN	289
5.30.3	Public Network Integrated NPN	290
5.30.3.1	General	290
5.30.3.2	Identifiers	290
5.30.3.3	UE configuration, subscription aspects and storage.....	291
5.30.3.4	Network and cell (re-)selection, and access control.....	291
5.30.3.5	Support of emergency services in CAG cells.....	292
5.31	Support for Cellular IoT	293
5.31.1	General.....	293
5.31.2	Preferred and Supported Network Behaviour	293
5.31.3	Selection, steering and redirection between EPS and 5GS	294
5.31.4	Control Plane CIoT 5GS Optimisation	295
5.31.4.1	General	295
5.31.4.2	Establishment of N3 data transfer during Data Transport in Control Plane CIoT 5GS Optimisation	296
5.31.4.3	Control Plane Relocation Indication procedure	296
5.31.5	Non-IP Data Delivery (NIDD).....	296
5.31.6	Reliable Data Service.....	297
5.31.7	Power Saving Enhancements.....	298
5.31.7.1	General	298
5.31.7.2	Extended Discontinuous Reception (DRX) for CM-IDLE and CM-CONNECTED with RRC-INACTIVE.....	298
5.31.7.2.1	Overview	298
5.31.7.2.2	Paging for extended idle mode DRX in E-UTRA connected to 5GC.....	299
5.31.7.2.3	Paging for a UE registered in a tracking area with heterogeneous support of extended idle mode DRX.....	300
5.31.7.3	MICO mode with Extended Connected Time	300
5.31.7.4	MICO mode with Active Time	301
5.31.7.5	MICO mode and Periodic Registration Timer Control	301
5.31.8	High latency communication	301
5.31.9	Support for Monitoring Events	302
5.31.10	NB-IoT UE Radio Capability Handling.....	302
5.31.11	Inter-RAT idle mode mobility to and from NB-IoT	303
5.31.12	Restriction of use of Enhanced Coverage	303
5.31.13	Paging for Enhanced Coverage.....	304
5.31.14	Support of rate control of user data.....	304
5.31.14.1	General.....	304
5.31.14.2	Serving PLMN Rate Control.....	305
5.31.14.3	Small Data Rate Control	305
5.31.15	Control Plane Data Transfer Congestion Control	306
5.31.16	Service Gap Control.....	307
5.31.17	Inter-UE QoS for NB-IoT.....	308
5.31.18	User Plane CIoT 5GS Optimisation.....	308
5.31.19	QoS model for NB-IoT	309
5.31.20	Category M UEs differentiation.....	310
5.32	Support for ATSSS.....	310
5.32.1	General.....	310
5.32.2	Multi Access PDU Sessions	311
5.32.3	Policy for ATSSS Control	313
5.32.4	QoS Support.....	314
5.32.5	Access Network Performance Measurements.....	315

5.32.5.1	General principles	315
5.32.5.2	Round Trip Time Measurements.....	316
5.32.5.3	Access Availability/Unavailability Report.....	317
5.32.5.4	Protocol stack for user plane measurements and measurement reports.....	317
5.32.6	Support of Steering Functionalities	318
5.32.6.1	General	318
5.32.6.2	High-Layer Steering Functionalities	320
5.32.6.2.1	MPTCP Functionality.....	320
5.32.6.3	Low-Layer Steering Functionalities.....	321
5.32.6.3.1	ATSSS-LL Functionality.....	321
5.32.7	Interworking with EPS.....	321
5.32.7.1	General	321
5.32.7.2	Interworking with N26 Interface.....	321
5.32.7.3	Interworking without N26 Interface.....	322
5.32.8	ATSSS Rules	322
5.33	Support for Ultra Reliable Low Latency Communication.....	324
5.33.1	General.....	324
5.33.2	Redundant transmission for high reliability communication	325
5.33.2.1	Dual Connectivity based end to end Redundant User Plane Paths.....	325
5.33.2.2	Support of redundant transmission on N3/N9 interfaces	327
5.33.2.3	Support for redundant transmission at transport layer	328
5.33.3	QoS Monitoring to Assist URLLC Service	329
5.33.3.1	General	329
5.33.3.2	Per QoS Flow per UE QoS Monitoring.....	329
5.33.3.3	GTP-U Path Monitoring.....	330
5.34	Support of deployments topologies with specific SMF Service Areas.....	331
5.34.1	General.....	331
5.34.2	Architecture	332
5.34.2.1	SBA architecture	332
5.34.2.2	Non-roaming architecture	332
5.34.2.3	Roaming architecture	333
5.34.3	I-SMF selection, V-SMF reselection	333
5.34.4	Usage of an UL Classifier for a PDU Session controlled by I-SMF	334
5.34.5	Usage of IPv6 multi-homing for a PDU Session controlled by I-SMF	335
5.34.6	Interaction between I-SMF and SMF for the support of traffic offload by UPF controlled by the I-SMF	335
5.34.6.1	General	335
5.34.6.2	N4 information sent from SMF to I-SMF for local traffic offload.....	336
5.34.7	Event Management	337
5.34.7.1	UE's Mobility Event Management	337
5.34.7.2	SMF event exposure service	337
5.34.7.3	AMF implicit subscription about events related with the PDU Session	337
5.34.8	Support for Cellular IoT	337
5.34.9	Support of the Deployment Topologies with specific SMF Service Areas feature within and between PLMN(s).....	338
5.34.10	Support for 5G LAN-type service.....	338
5.35	Support for Integrated access and backhaul (IAB).....	338
5.35.1	IAB architecture and functional entities	338
5.35.2	5G System enhancements to support IAB	339
5.35.3	Data handling and QoS support with IAB	340
5.35.4	Mobility support with IAB	340
5.35.5	Charging support with IAB.....	340
5.35.6	IAB operation involving EPC.....	340
5.36	RIM Information Transfer.....	341
6	Network Functions	341
6.1	General	341
6.2	Network Function Functional description	341
6.2.1	AMF.....	341
6.2.2	SMF	342
6.2.3	UPF	344
6.2.4	PCF	344

6.2.5	NEF.....	345
6.2.5.0	NEF functionality.....	345
6.2.5.1	Support for CAPIF.....	346
6.2.5a	Void.....	346
6.2.6	NRF.....	346
6.2.6.1	General.....	346
6.2.6.2	NF profile.....	347
6.2.6.3	SCP profile.....	348
6.2.7	UDM.....	348
6.2.8	AUSF.....	349
6.2.9	N3IWF.....	349
6.2.9A	TNGF.....	350
6.2.10	AF.....	350
6.2.11	UDR.....	350
6.2.12	UDSF.....	351
6.2.13	SMSF.....	351
6.2.14	NSSF.....	351
6.2.15	5G-EIR.....	351
6.2.16	LMF.....	351
6.2.16A	GMLC.....	351
6.2.17	SEPP.....	351
6.2.18	Network Data Analytics Function (NWDAF).....	352
6.2.19	SCP.....	352
6.2.20	W-AGF.....	353
6.2.21	UE radio Capability Management Function (UCMF).....	353
6.2.22	TWIF.....	353
6.2.23	NSSAAF.....	353
6.3	Principles for Network Function and Network Function Service discovery and selection.....	354
6.3.1	General.....	354
6.3.1.0	Principles for Binding, Selection and Reselection.....	355
6.3.1.1	NF Discovery and Selection aspects relevant with indirect communication.....	357
6.3.1.2	Location information.....	357
6.3.2	SMF discovery and selection.....	358
6.3.3	User Plane Function Selection.....	360
6.3.3.1	Overview.....	360
6.3.3.2	SMF Provisioning of available UPF(s).....	360
6.3.3.3	Selection of an UPF for a particular PDU Session.....	360
6.3.4	AUSF discovery and selection.....	362
6.3.5	AMF discovery and selection.....	362
6.3.6	N3IWF selection.....	364
6.3.6.1	General.....	364
6.3.6.2	Stand-alone N3IWF selection.....	365
6.3.6.2a	SNPN N3IWF selection.....	365
6.3.6.3	Combined N3IWF/ePDG Selection.....	366
6.3.6.4	PLMN Selection for emergency services.....	367
6.3.7	PCF discovery and selection.....	368
6.3.7.0	General principles.....	368
6.3.7.1	PCF discovery and selection for a UE or a PDU Session.....	368
6.3.7.2	Providing policy requirements that apply to multiple UE and hence to multiple PCF.....	370
6.3.7.3	Binding an AF request targeting a UE address to the relevant PCF.....	371
6.3.8	UDM discovery and selection.....	371
6.3.9	UDR discovery and selection.....	371
6.3.10	SMSF discovery and selection.....	372
6.3.11	CHF discovery and selection.....	372
6.3.12	Trusted Non-3GPP Access Network selection.....	373
6.3.12.1	General.....	373
6.3.12.2	Access Network Selection Procedure.....	375
6.3.12a	Access Network selection for devices that do not support 5GC NAS over WLAN.....	377
6.3.12a.1	General.....	377
6.3.12a.2	Access Network Selection Procedure.....	377
6.3.13	NWDAF discovery and selection.....	378
6.3.14	NEF Discovery.....	379

6.3.15	UCMF Discovery and Selection	379
6.3.16	SCP discovery and selection	379
6.3.17	NSSAAF discovery and selection	379
7	Network Function Services and descriptions	380
7.1	Network Function Service Framework	380
7.1.1	General	380
7.1.2	NF Service Consumer - NF Service Producer interactions	381
7.1.3	Network Function Service discovery	383
7.1.4	Network Function Service Authorization	383
7.1.5	Network Function and Network Function Service registration and de-registration	384
7.2	Network Function Services	384
7.2.1	General	384
7.2.2	AMF Services	385
7.2.3	SMF Services	386
7.2.4	PCF Services	386
7.2.5	UDM Services	387
7.2.6	NRF Services	388
7.2.7	AUSF Services	389
7.2.8	NEF Services	389
7.2.8A	Void	390
7.2.9	SMSF Services	390
7.2.10	UDR Services	391
7.2.11	5G-EIR Services	391
7.2.12	NWDAF Services	391
7.2.13	UDSF Services	391
7.2.14	NSSF Services	392
7.2.15	BSF Services	392
7.2.16	LMF Services	392
7.2.16A	GMLC Services	392
7.2.17	CHF Services	393
7.2.18	UCMF Services	393
7.2.19	AF Services	393
7.2.20	NSSAAF Services	394
7.3	Exposure	394
8	Control and User Plane Protocol Stacks	394
8.1	General	394
8.2	Control Plane Protocol Stacks	394
8.2.1	Control Plane Protocol Stacks between the 5G-AN and the 5G Core: N2	394
8.2.1.1	General	394
8.2.1.2	5G-AN - AMF	395
8.2.1.3	5G-AN - SMF	396
8.2.2	Control Plane Protocol Stacks between the UE and the 5GC	396
8.2.2.1	General	396
8.2.2.2	UE - AMF	398
8.2.2.3	UE - SMF	398
8.2.3	Control Plane Protocol Stacks between the network functions in 5GC	399
8.2.3.1	The Control Plane Protocol Stack for the service based interface	399
8.2.3.2	The Control Plane protocol stack for the N4 interface between SMF and UPF	399
8.2.4	Control Plane for untrusted non 3GPP Access	399
8.2.5	Control Plane for trusted non-3GPP Access	400
8.2.6	Control Plane for W-5GAN Access	401
8.3	User Plane Protocol Stacks	401
8.3.1	User Plane Protocol Stack for a PDU Session	401
8.3.2	User Plane for untrusted non-3GPP Access	403
8.3.3	User Plane for trusted non-3GPP Access	403
8.3.4	User Plane for W-5GAN Access	403
8.3.5	User Plane for N19-based forwarding of a 5G VN group	404
Annex A (informative):	Relationship between Service-Based Interfaces and Reference Points...	405
Annex B (normative):	Mapping between temporary identities	407