

ETSI TS 123 501 V16.5.1 (2020-09)



**5G;
System architecture for the 5G System (5GS)
(3GPP TS 23.501 version 16.5.1 Release 16)**



ReferenceRTS/TSGS-0223501vg51

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

Important notice

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 2020.

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>.

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	71
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	74
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	82
5.3.4.1	Mobility Restrictions	82
5.3.4.1.1	General	82
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.....	90
5.4.3.3	Paging Priority.....	91
5.4.4	UE Radio Capability handling.....	91
5.4.4.1	UE radio capability information storage in the AMF.....	91
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.....	96
5.4.4b	UE 5GSM Core Network Capability handling.....	97
5.4.5	DRX (Discontinuous Reception) framework.....	97
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.....	99
5.4.8	Support for identification and restriction of using unlicensed spectrum.....	100
5.4.9	Wake Up Signal Assistance.....	101
5.5	Non-3GPP access specific aspects.....	101
5.5.0	General.....	101
5.5.1	Registration Management.....	101
5.5.2	Connection Management.....	102
5.5.3	UE Reachability.....	103
5.5.3.1	UE reachability in CM-IDLE.....	103
5.5.3.2	UE reachability in CM-CONNECTED.....	103
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.....	109
5.6.4.1	General.....	109
5.6.4.2	Usage of an UL Classifier for a PDU Session.....	110
5.6.4.3	Usage of IPv6 multi-homing for a PDU Session.....	111
5.6.5	Support for Local Area Data Network.....	113
5.6.6	Secondary authentication/authorization by a DN-AAA server during the establishment of a PDU Session.....	115
5.6.7	Application Function influence on traffic routing.....	116
5.6.7.1	General.....	116
5.6.7.2	Enhancement of UP path management based on the coordination with AFs.....	121
5.6.8	Selective activation and deactivation of UP connection of existing PDU Session.....	122
5.6.9	Session and Service Continuity.....	123
5.6.9.1	General.....	123
5.6.9.2	SSC mode.....	123
5.6.9.2.1	SSC Mode 1.....	123
5.6.9.2.2	SSC Mode 2.....	124
5.6.9.2.3	SSC Mode 3.....	124
5.6.9.3	SSC mode selection.....	124
5.6.10	Specific aspects of different PDU Session types.....	125
5.6.10.1	Support of IP PDU Session type.....	125
5.6.10.2	Support of Ethernet PDU Session type.....	125
5.6.10.3	Support of Unstructured PDU Session type.....	127
5.6.10.4	Maximum Transfer Unit size considerations.....	128
5.6.11	UE presence in Area of Interest reporting usage by SMF.....	128
5.6.12	Use of Network Instance.....	130
5.6.13	Always-on PDU session.....	130
5.6.14	Support of Framed Routing.....	131
5.7	QoS model.....	131
5.7.1	General Overview.....	131

5.7.1.1	QoS Flow	131
5.7.1.2	QoS Profile.....	132
5.7.1.2a	Alternative QoS Profile.....	132
5.7.1.3	Control of QoS Flows	133
5.7.1.4	QoS Rules	133
5.7.1.5	QoS Flow mapping	134
5.7.1.6	DL traffic.....	135
5.7.1.7	UL Traffic	136
5.7.1.8	AMBR/MFBR enforcement and rate limitation.....	136
5.7.1.9	Precedence Value	137
5.7.2	5G QoS Parameters.....	137
5.7.2.1	5QI	137
5.7.2.2	ARP	137
5.7.2.3	RQA	138
5.7.2.4	Notification control	138
5.7.2.4.1	General	138
5.7.2.4.1a	Notification Control without Alternative QoS Profiles	138
5.7.2.4.1b	Notification control with Alternative QoS Profiles	139
5.7.2.4.2	Usage of Notification control with Alternative QoS Profiles at handover	139
5.7.2.5	Flow Bit Rates.....	140
5.7.2.6	Aggregate Bit Rates	140
5.7.2.7	Default values	141
5.7.2.8	Maximum Packet Loss Rate.....	141
5.7.2.9	Wireline access network specific 5G QoS parameters.....	142
5.7.3	5G QoS characteristics.....	142
5.7.3.1	General.....	142
5.7.3.2	Resource Type.....	142
5.7.3.3	Priority Level	142
5.7.3.4	Packet Delay Budget	143
5.7.3.5	Packet Error Rate	144
5.7.3.6	Averaging Window	144
5.7.3.7	Maximum Data Burst Volume	144
5.7.4	Standardized 5QI to QoS characteristics mapping.....	144
5.7.5	Reflective QoS.....	148
5.7.5.1	General.....	148
5.7.5.2	UE Derived QoS Rule	149
5.7.5.3	Reflective QoS Control.....	149
5.7.6	Packet Filter Set.....	151
5.7.6.1	General.....	151
5.7.6.2	IP Packet Filter Set.....	151
5.7.6.3	Ethernet Packet Filter Set.....	151
5.8	User Plane Management.....	152
5.8.1	General.....	152
5.8.2	Functional Description.....	152
5.8.2.1	General	152
5.8.2.2	UE IP Address Management	152
5.8.2.2.1	General	152
5.8.2.2.2	Routing rules configuration.....	154
5.8.2.2.3	The procedure of Stateless IPv6 Address Autoconfiguration	155
5.8.2.3	Management of CN Tunnel Info	155
5.8.2.3.1	General	155
5.8.2.3.2	Void.....	155
5.8.2.3.3	Management of CN Tunnel Info in the UPF	155
5.8.2.4	Traffic Detection	156
5.8.2.4.1	General	156
5.8.2.4.2	Traffic Detection Information	156
5.8.2.5	Control of User Plane Forwarding	156
5.8.2.5.1	General	156
5.8.2.5.2	Data forwarding between the SMF and UPF.....	157
5.8.2.5.3	Support of Ethernet PDU Session type.....	157
5.8.2.6	Charging and Usage Monitoring Handling	158
5.8.2.6.1	General	158

5.8.2.6.2	Activation of Usage Reporting in UPF.....	158
5.8.2.6.3	Reporting of Usage Information towards SMF	159
5.8.2.7	PDU Session and QoS Flow Policing	159
5.8.2.8	PCC Related Functions	160
5.8.2.8.1	Activation/Deactivation of predefined PCC rules	160
5.8.2.8.2	Enforcement of Dynamic PCC Rules	160
5.8.2.8.3	Redirection	160
5.8.2.8.4	Support of PFD Management	161
5.8.2.9	Functionality of Sending of "End marker"	161
5.8.2.9.0	Introduction	161
5.8.2.9.1	UPF Constructing the "End marker" Packets	161
5.8.2.9.2	SMF Constructing the "End marker" Packets.....	162
5.8.2.10	UP Tunnel Management	162
5.8.2.11	Parameters for N4 session management.....	163
5.8.2.11.1	General	163
5.8.2.11.2	N4 Session Context	164
5.8.2.11.3	Packet Detection Rule	164
5.8.2.11.4	QoS Enforcement Rule.....	167
5.8.2.11.5	Usage Reporting Rule.....	170
5.8.2.11.6	Forwarding Action Rule	173
5.8.2.11.7	Usage Report generated by UPF	176
5.8.2.11.8	Multi-Access Rule.....	177
5.8.2.11.9	Bridge Management Information	178
5.8.2.11.10	Port Management Information Container.....	178
5.8.2.11.11	Session Reporting Rule	178
5.8.2.11.12	Session reporting generated by UPF.....	179
5.8.2.12	Reporting of the UE MAC addresses used in a PDU Session.....	179
5.8.2.13	Support for 5G VN group communication	179
5.8.2.13.0	General	179
5.8.2.13.1	Support for unicast traffic forwarding of a 5G VN.....	180
5.8.2.13.2	Support for unicast traffic forwarding update due to UE mobility	182
5.8.2.13.3	Support for user plane traffic replication in a 5G VN	182
5.8.2.14	Inter PLMN User Plane Security functionality	184
5.8.3	Explicit Buffer Management.....	184
5.8.3.1	General.....	184
5.8.3.2	Buffering at UPF	184
5.8.3.3	Buffering at SMF	185
5.8.4	SMF Pause of Charging.....	185
5.9	Identifiers	185
5.9.1	General.....	185
5.9.2	Subscription Permanent Identifier	185
5.9.2a	Subscription Concealed Identifier.....	186
5.9.3	Permanent Equipment Identifier	186
5.9.4	5G Globally Unique Temporary Identifier	186
5.9.5	AMF Name	187
5.9.6	Data Network Name (DNN)	187
5.9.7	Internal-Group Identifier.....	187
5.9.8	Generic Public Subscription Identifier.....	188
5.9.9	AMF UE NGAP ID	188
5.9.10	UE Radio Capability ID.....	188
5.10	Security aspects	188
5.10.1	General.....	188
5.10.2	Security Model for non-3GPP access	189
5.10.2.1	Signalling Security.....	189
5.10.3	PDU Session User Plane Security.....	189
5.11	Support for Dual Connectivity, Multi-Connectivity.....	190
5.11.1	Support for Dual Connectivity.....	190
5.12	Charging.....	191
5.12.1	General.....	191
5.12.2	Usage Data Reporting for Secondary RAT.....	191
5.12.3	Secondary RAT Periodic Usage Data Reporting Procedure.....	192
5.13	Support for Edge Computing.....	192

5.14	Policy Control	193
5.15	Network slicing	193
5.15.1	General.....	193
5.15.2	Identification and selection of a Network Slice: the S-NSSAI and the NSSAI	194
5.15.2.1	General	194
5.15.2.2	Standardised SST values	195
5.15.3	Subscription aspects.....	195
5.15.4	UE NSSAI configuration and NSSAI storage aspects	196
5.15.4.1	General	196
5.15.4.1.1	UE Network Slice configuration	196
5.15.4.1.2	Mapping of S-NSSAI values in the Allowed NSSAI and in the Requested NSSAI to the S-NSSAI values used in the HPLMN.....	198
5.15.4.2	Update of UE Network Slice configuration	198
5.15.5	Detailed Operation Overview	199
5.15.5.1	General.....	199
5.15.5.2	Selection of a Serving AMF supporting the Network Slices.....	199
5.15.5.2.1	Registration to a set of Network Slices.....	199
5.15.5.2.2	Modification of the Set of Network Slice(s) for a UE	203
5.15.5.2.3	AMF Re-allocation due to Network Slice(s) Support.....	204
5.15.5.3	Establishing a PDU Session in a Network Slice	205
5.15.6	Network Slicing Support for Roaming	206
5.15.7	Network slicing and Interworking with EPS	207
5.15.7.1	General	207
5.15.7.2	Idle mode aspects	207
5.15.7.3	Connected mode aspects	207
5.15.8	Configuration of Network Slice availability in a PLMN	208
5.15.9	Operator-controlled inclusion of NSSAI in Access Stratum Connection Establishment.....	208
5.15.10	Network Slice-Specific Authentication and Authorization.....	209
5.16	Support for specific services	210
5.16.1	Public Warning System	210
5.16.2	SMS over NAS	211
5.16.2.1	General	211
5.16.2.2	SMS over NAS transport	211
5.16.3	IMS support	211
5.16.3.1	General.....	211
5.16.3.2	IMS voice over PS Session Supported Indication over 3GPP access	211
5.16.3.2a	IMS voice over PS Session Supported Indication over non-3GPP access	212
5.16.3.3	Homogeneous support for IMS voice over PS Session supported indication	212
5.16.3.4	P-CSCF address delivery	213
5.16.3.5	Domain selection for UE originating sessions / calls.....	213
5.16.3.6	Terminating domain selection for IMS voice.....	214
5.16.3.7	UE's usage setting	214
5.16.3.8	Domain and Access Selection for UE originating SMS.....	214
5.16.3.8.1	UE originating SMS for IMS Capable UEs supporting SMS over IP	214
5.16.3.8.2	Access Selection for SMS over NAS	214
5.16.3.9	SMF support for P-CSCF restoration procedure.....	215
5.16.3.10	IMS Voice Service via EPS Fallback or RAT fallback in 5GS.....	215
5.16.3.11	P-CSCF discovery and selection	215
5.16.3.12	HSS discovery and selection.....	216
5.16.4	Emergency Services.....	216
5.16.4.1	Introduction.....	216
5.16.4.2	Architecture Reference Model for Emergency Services	218
5.16.4.3	Mobility Restrictions and Access Restrictions for Emergency Services.....	218
5.16.4.4	Reachability Management.....	219
5.16.4.5	SMF and UPF selection function for Emergency Services	219
5.16.4.6	QoS for Emergency Services	219
5.16.4.7	PCC for Emergency Services.....	219
5.16.4.8	IP Address Allocation	219
5.16.4.9	Handling of PDU Sessions for Emergency Services.....	219
5.16.4.9a	Handling of PDU Sessions for normal services for Emergency Registered UEs.....	220
5.16.4.10	Support of eCall Only Mode	220
5.16.4.11	Emergency Services Fallback	220

5.16.5	Multimedia Priority Services	221
5.16.6	Mission Critical Services	222
5.17	Interworking and Migration	223
5.17.1	Support for Migration from EPC to 5GC.....	223
5.17.1.1	General	223
5.17.1.2	User Plane management to support interworking with EPS.....	225
5.17.2	Interworking with EPC	225
5.17.2.1	General	225
5.17.2.2	Interworking Procedures with N26 interface	228
5.17.2.2.1	General	228
5.17.2.2.2	Mobility for UEs in single-registration mode	229
5.17.2.3	Interworking Procedures without N26 interface	230
5.17.2.3.1	General	230
5.17.2.3.2	Mobility for UEs in single-registration mode	231
5.17.2.3.3	Mobility for UEs in dual-registration mode	231
5.17.2.3.4	Redirection for UEs in connected state	232
5.17.2.4	Mobility between 5GS and GERAN/UTRAN	233
5.17.3	Interworking with EPC in presence of Non-3GPP PDU Sessions	233
5.17.4	Network sharing support and interworking between EPS and 5GS.....	233
5.17.5	Service Exposure in Interworking Scenarios	234
5.17.5.1	General	234
5.17.5.2	Support of interworking for Monitoring Events.....	235
5.17.5.2.1	Interworking with N26 interface	235
5.17.5.2.2	Interworking without N26 interface	235
5.17.5.3	Availability or expected level of a service API	235
5.17.6	Void	236
5.17.7	Configuration Transfer Procedure between NG-RAN and E-UTRAN.....	236
5.17.7.1	Architecture Principles for Configuration Transfer between NG-RAN and E-UTRAN.....	236
5.17.7.2	Addressing, routing and relaying	237
5.17.7.2.1	Addressing.....	237
5.17.7.2.2	Routing	237
5.17.7.2.3	Relaying.....	237
5.18	Network Sharing	237
5.18.1	General concepts.....	237
5.18.2	Broadcast system information for network sharing	238
5.18.2a	PLMN list handling for network sharing.....	238
5.18.3	Network selection by the UE	239
5.18.4	Network selection by the network.....	239
5.18.5	Network Sharing and Network Slicing	239
5.19	Control Plane Load Control, Congestion and Overload Control.....	240
5.19.1	General.....	240
5.19.2	TNLA Load Balancing and TNLA Load Re-Balancing	240
5.19.3	AMF Load Balancing	240
5.19.4	AMF Load Re-Balancing.....	240
5.19.5	AMF Control Of Overload	241
5.19.5.1	General	241
5.19.5.2	AMF Overload Control	241
5.19.6	SMF Overload Control	242
5.19.7	NAS level congestion control	242
5.19.7.1	General	242
5.19.7.2	General NAS level congestion control.....	242
5.19.7.3	DNN based congestion control	244
5.19.7.4	S-NSSAI based congestion control	245
5.19.7.5	Group specific NAS level congestion control	246
5.19.7.6	Control Plane data specific NAS level congestion control.....	246
5.20	External Exposure of Network Capability.....	247
5.20a	Data Collection from an AF	248
5.21	Architectural support for virtualized deployments	248
5.21.0	General.....	248
5.21.1	Architectural support for N2.....	249
5.21.1.1	TNL associations.....	249
5.21.1.2	NGAP UE-TNLA-binding	249

5.21.1.3	N2 TNL association selection	249
5.21.2	AMF Management	249
5.21.2.1	AMF Addition/Update	249
5.21.2.2	AMF planned removal procedure	250
5.21.2.2.1	AMF planned removal procedure with UDSF deployed	250
5.21.2.2.2	AMF planned removal procedure without UDSF	252
5.21.2.3	Procedure for AMF Auto-recovery	253
5.21.3	Network Reliability support with Sets	255
5.21.3.1	General	255
5.21.3.2	NF Set and NF Service Set	255
5.21.3.3	Reliability of NF instances within the same NF Set	255
5.21.3.4	Reliability of NF Services	255
5.21.4	Network Function/NF Service Context Transfer	256
5.21.4.1	General	256
5.22	System Enablers for priority mechanism	256
5.22.1	General	256
5.22.2	Subscription-related Priority Mechanisms	256
5.22.3	Invocation-related Priority Mechanisms	257
5.22.4	QoS Mechanisms applied to established QoS Flows	258
5.23	Supporting for Asynchronous Type Communication	258
5.24	3GPP PS Data Off	259
5.25	Support of OAM Features	260
5.25.1	Support of Tracing: Signalling Based Activation/Deactivation of Tracing	260
5.25.2	Support of OAM-based 5G VN group management	260
5.26	Configuration Transfer Procedure	261
5.26.1	Architecture Principles for Configuration Transfer	261
5.26.2	Addressing, routing and relaying	261
5.26.2.1	Addressing	261
5.26.2.2	Routing	262
5.26.2.3	Relaying	262
5.27	Time Sensitive Communications	262
5.27.0	General	262
5.27.1	TSN Time Synchronization	262
5.27.1.1	General	262
5.27.1.2	Distribution of timing information	263
5.27.1.2.1	Distribution of 5G internal system clock	263
5.27.1.2.2	Distribution of TSN clock and time-stamping	263
5.27.1.3	Support for multiple TSN working domains	264
5.27.1a	Periodic deterministic QoS	264
5.27.2	TSC Assistance Information (TSCAI)	265
5.27.3	Support for TSC QoS Flows	266
5.27.4	Hold and Forward Buffering mechanism	266
5.27.5	5G System Bridge delay	266
5.28	Support of integration with TSN	267
5.28.1	5GS TSN bridge management	267
5.28.2	5GS Bridge configuration	269
5.28.3	Port and bridge management information exchange in 5GS	270
5.28.3.1	General	270
5.28.3.2	Transfer of port or bridge management information	276
5.28.3.3	VLAN Configuration Information	277
5.28.4	QoS mapping tables	277
5.29	Support for 5G LAN-type service	278
5.29.1	General	278
5.29.2	5G VN group management	279
5.29.3	PDU Session management	280
5.29.4	User Plane handling	280
5.30	Support for non-public networks	281
5.30.1	General	281
5.30.2	Stand-alone non-public networks	282
5.30.2.1	Identifiers	282
5.30.2.2	Broadcast system information	282
5.30.2.3	UE configuration and subscription aspects	282

5.30.2.4	Network selection in SNPN access mode	283
5.30.2.5	Network access control	283
5.30.2.6	Cell (re-)selection in SNPN access mode.....	283
5.30.2.7	Access to PLMN services via stand-alone non-public networks.....	284
5.30.2.8	Access to stand-alone non-public network services via PLMN	284
5.30.3	Public Network Integrated NPN	285
5.30.3.1	General	285
5.30.3.2	Identifiers	285
5.30.3.3	UE configuration, subscription aspects and storage.....	285
5.30.3.4	Network and cell (re-)selection, and access control.....	286
5.30.3.5	Support of emergency services in CAG cells.....	287
5.31	Support for Cellular IoT	288
5.31.1	General.....	288
5.31.2	Preferred and Supported Network Behaviour	288
5.31.3	Selection, steering and redirection between EPS and 5GS	289
5.31.4	Control Plane CIoT 5GS Optimisation	289
5.31.4.1	General	289
5.31.4.2	Establishment of N3 data transfer during Data Transport in Control Plane CIoT 5GS Optimisation	290
5.31.4.3	Control Plane Relocation Indication procedure.....	291
5.31.5	Non-IP Data Delivery (NIDD).....	291
5.31.6	Reliable Data Service.....	292
5.31.7	Power Saving Enhancements.....	292
5.31.7.1	General	292
5.31.7.2	Extended Discontinuous Reception (DRX) for CM-IDLE and CM-CONNECTED with RRC- INACTIVE.....	293
5.31.7.2.1	Overview	293
5.31.7.2.2	Paging for extended idle mode DRX in E-UTRA connected to 5GC.....	294
5.31.7.2.3	Paging for a UE registered in a tracking area with heterogeneous support of extended idle mode DRX.....	295
5.31.7.3	MICO mode with Extended Connected Time	295
5.31.7.4	MICO mode with Active Time.....	295
5.31.7.5	MICO mode and Periodic Registration Timer Control	296
5.31.8	High latency communication	296
5.31.9	Support for Monitoring Events	297
5.31.10	NB-IoT UE Radio Capability Handling.....	297
5.31.11	Inter-RAT idle mode mobility to and from NB-IoT	297
5.31.12	Restriction of use of Enhanced Coverage	298
5.31.13	Paging for Enhanced Coverage.....	299
5.31.14	Support of rate control of user data.....	299
5.31.14.1	General	299
5.31.14.2	Serving PLMN Rate Control.....	299
5.31.14.3	Small Data Rate Control	300
5.31.15	Control Plane Data Transfer Congestion Control	301
5.31.16	Service Gap Control.....	301
5.31.17	Inter-UE QoS for NB-IoT.....	303
5.31.18	User Plane CIoT 5GS Optimisation.....	303
5.31.19	QoS model for NB-IoT	304
5.31.20	Category M UEs differentiation.....	304
5.32	Support for ATSSS.....	305
5.32.1	General.....	305
5.32.2	Multi Access PDU Sessions	305
5.32.3	Policy for ATSSS Control	308
5.32.4	QoS Support.....	308
5.32.5	Access Network Performance Measurements.....	310
5.32.5.1	General principles	310
5.32.5.2	Round Trip Time Measurements.....	310
5.32.5.3	Access Availability/Unavailability Report.....	311
5.32.5.4	Protocol stack for user plane measurements and measurement reports.....	312
5.32.6	Support of Steering Functionalities	312
5.32.6.1	General	312
5.32.6.2	High-Layer Steering Functionalities	314

5.32.6.2.1	MPTCP Functionality.....	314
5.32.6.3	Low-Layer Steering Functionalities.....	315
5.32.6.3.1	ATSSS-LL Functionality.....	315
5.32.7	Interworking with EPS.....	316
5.32.7.1	General.....	316
5.32.7.2	Interworking with N26 Interface.....	316
5.32.7.3	Interworking without N26 Interface.....	317
5.32.8	ATSSS Rules.....	317
5.33	Support for Ultra Reliable Low Latency Communication.....	319
5.33.1	General.....	319
5.33.2	Redundant transmission for high reliability communication.....	319
5.33.2.1	Dual Connectivity based end to end Redundant User Plane Paths.....	319
5.33.2.2	Support of redundant transmission on N3/N9 interfaces.....	321
5.33.2.3	Support for redundant transmission at transport layer.....	322
5.33.3	QoS Monitoring to Assist URLLC Service.....	323
5.33.3.1	General.....	323
5.33.3.2	Per QoS Flow per UE QoS Monitoring.....	323
5.33.3.3	GTP-U Path Monitoring.....	324
5.34	Support of deployments topologies with specific SMF Service Areas.....	325
5.34.1	General.....	325
5.34.2	Architecture.....	326
5.34.2.1	SBA architecture.....	326
5.34.2.2	Non-roaming architecture.....	326
5.34.2.3	Roaming architecture.....	327
5.34.3	I-SMF selection, V-SMF reselection.....	328
5.34.4	Usage of an UL Classifier for a PDU Session controlled by I-SMF.....	329
5.34.5	Usage of IPv6 multi-homing for a PDU Session controlled by I-SMF.....	329
5.34.6	Interaction between I-SMF and SMF for the support of traffic offload by UPF controlled by the I-SMF.....	330
5.34.6.1	General.....	330
5.34.6.2	N4 information sent from SMF to I-SMF for local traffic offload.....	330
5.34.7	Event Management.....	331
5.34.7.1	UE's Mobility Event Management.....	331
5.34.7.2	SMF event exposure service.....	331
5.34.7.3	AMF implicit subscription about events related with the PDU Session.....	332
5.34.8	Support for Cellular IoT.....	332
5.34.9	Support of the Deployment Topologies with specific SMF Service Areas feature within and between PLMN(s).....	332
5.34.10	Support for 5G LAN-type service.....	332
5.35	Support for Integrated access and backhaul (IAB).....	332
5.35.1	IAB architecture and functional entities.....	332
5.35.2	5G System enhancements to support IAB.....	334
5.35.3	Data handling and QoS support with IAB.....	334
5.35.4	Mobility support with IAB.....	334
5.35.5	Charging support with IAB.....	335
5.35.6	IAB operation involving EPC.....	335
5.36	RIM Information Transfer.....	335
6	Network Functions.....	335
6.1	General.....	335
6.2	Network Function Functional description.....	335
6.2.1	AMF.....	335
6.2.2	SMF.....	337
6.2.3	UPF.....	338
6.2.4	PCF.....	339
6.2.5	NEF.....	339
6.2.5.1	Support for CAPIF.....	340
6.2.5a	Void.....	340
6.2.6	NRF.....	340
6.2.6.1	General.....	340
6.2.6.2	NF profile.....	341
6.2.6.3	SCP profile.....	342