

ETSI TS 123 501 V16.20.0 (2024-07)



**5G;
System architecture for the 5G System (5GS)
(3GPP TS 23.501 version 16.20.0 Release 16)**

Document Preview

[ETSI TS 123 501 V16.20.0 \(2024-07\)](https://standards.iteh.ai/catalog/standards/etsi/c80d6d8f-3265-4809-9153-8723e726603d/etsi-ts-123-501-v16-20-0-2024-07)

<https://standards.iteh.ai/catalog/standards/etsi/c80d6d8f-3265-4809-9153-8723e726603d/etsi-ts-123-501-v16-20-0-2024-07>



ReferenceRTS/TSGS-0223501vgk0

Keywords5G

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 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

Important notice

The present document can be downloaded from the
ETSI [Search & Browse Standards application](#).

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 on [ETSI deliver](#).

Users should be aware that the present document may be revised or have its status changed,
this information is available in the [Milestones listing](#).

If you find errors in the present document, please send your comments to
the relevant service listed under [Committee Support Staff](#).

If you find a security vulnerability in the present document, please report it through our
[Coordinated Vulnerability Disclosure \(CVD\)](#) program.

Notice of disclaimer & limitation of liability

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.

No recommendation as to products and services or vendors is made or should be implied.

No representation or warranty is made that this deliverable is technically accurate or sufficient or conforms to any law and/or governmental rule and/or regulation and further, no representation or warranty is made of merchantability or fitness for any particular purpose or against infringement of intellectual property rights.

In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use of or inability to use the software.

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 2024.
All rights reserved.

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are 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 Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, 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.

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.

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. (2024-07)

The cross reference between 3GPP and ETSI identities can be found under <https://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.....	22
3.1 Definitions	22
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	42
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	44
4.2.8.2.1 Non-roaming Architecture.....	44
4.2.8.2.2 LBO Roaming Architecture.....	45
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.....	50
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).....	93
5.4.4.2	Void.....	96
5.4.4.2a	UE Radio Capability Match Request.....	96
5.4.4.3	Paging assistance information.....	97
5.4.4a	UE MM Core Network Capability handling.....	97
5.4.4b	UE 5GSM Core Network Capability handling.....	98
5.4.5	DRX (Discontinuous Reception) framework.....	98
5.4.6	Core Network assistance information for RAN optimization.....	99
5.4.6.1	General.....	99
5.4.6.2	Core Network assisted RAN parameters tuning.....	99
5.4.6.3	Core Network assisted RAN paging information.....	100
5.4.7	NG-RAN location reporting.....	100
5.4.8	Support for identification and restriction of using unlicensed spectrum.....	101
5.4.9	Wake Up Signal Assistance.....	102
5.4.9.1	General.....	102
5.4.9.2	Group Wake Up Signal.....	102
5.5	Non-3GPP access specific aspects.....	102
5.5.0	General.....	102
5.5.1	Registration Management.....	103
5.5.2	Connection Management.....	103
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.....	105
5.6	Session Management.....	105
5.6.1	Overview.....	105
5.6.2	Interaction between AMF and SMF.....	108
5.6.3	Roaming.....	110
5.6.4	Single PDU Session with multiple PDU Session Anchors.....	111
5.6.4.1	General.....	111
5.6.4.2	Usage of an UL Classifier for a PDU Session.....	112
5.6.4.3	Usage of IPv6 multi-homing for a PDU Session.....	113
5.6.5	Support for Local Area Data Network.....	115
5.6.6	Secondary authentication/authorization by a DN-AAA server during the establishment of a PDU Session.....	117
5.6.7	Application Function influence on traffic routing.....	118
5.6.7.1	General.....	118
5.6.7.2	Enhancement of UP path management based on the coordination with AFs.....	123
5.6.8	Selective activation and deactivation of UP connection of existing PDU Session.....	124
5.6.9	Session and Service Continuity.....	125
5.6.9.1	General.....	125
5.6.9.2	SSC mode.....	125
5.6.9.2.1	SSC Mode 1.....	125
5.6.9.2.2	SSC Mode 2.....	126
5.6.9.2.3	SSC Mode 3.....	126
5.6.9.3	SSC mode selection.....	126
5.6.10	Specific aspects of different PDU Session types.....	127
5.6.10.1	Support of IP PDU Session type.....	127
5.6.10.2	Support of Ethernet PDU Session type.....	128
5.6.10.3	Support of Unstructured PDU Session type.....	129
5.6.10.4	Maximum Transfer Unit size considerations.....	130
5.6.11	UE presence in Area of Interest reporting usage by SMF.....	131
5.6.12	Use of Network Instance.....	132
5.6.13	Always-on PDU session.....	133
5.6.14	Support of Framed Routing.....	133

5.7	QoS model.....	134
5.7.1	General Overview.....	134
5.7.1.1	QoS Flow.....	134
5.7.1.2	QoS Profile.....	134
5.7.1.2a	Alternative QoS Profile.....	135
5.7.1.3	Control of QoS Flows.....	135
5.7.1.4	QoS Rules.....	135
5.7.1.5	QoS Flow mapping.....	136
5.7.1.6	DL traffic.....	138
5.7.1.7	UL Traffic.....	138
5.7.1.8	AMBR/MFBR enforcement and rate limitation.....	139
5.7.1.9	Precedence Value.....	139
5.7.2	5G QoS Parameters.....	139
5.7.2.1	5QI.....	139
5.7.2.2	ARP.....	140
5.7.2.3	RQA.....	140
5.7.2.4	Notification control.....	140
5.7.2.4.1	General.....	140
5.7.2.4.1a	Notification Control without Alternative QoS Profiles.....	140
5.7.2.4.1b	Notification control with Alternative QoS Profiles.....	141
5.7.2.4.2	Usage of Notification control with Alternative QoS Profiles at handover.....	142
5.7.2.4.3	Usage of Notification control with Alternative QoS Profiles during QoS Flow establishment and modification.....	143
5.7.2.5	Flow Bit Rates.....	143
5.7.2.6	Aggregate Bit Rates.....	143
5.7.2.7	Default values.....	144
5.7.2.8	Maximum Packet Loss Rate.....	144
5.7.2.9	Wireline access network specific 5G QoS parameters.....	144
5.7.3	5G QoS characteristics.....	145
5.7.3.1	General.....	145
5.7.3.2	Resource Type.....	145
5.7.3.3	Priority Level.....	145
5.7.3.4	Packet Delay Budget.....	146
5.7.3.5	Packet Error Rate.....	147
5.7.3.6	Averaging Window.....	147
5.7.3.7	Maximum Data Burst Volume.....	147
5.7.4	Standardized 5QI to QoS characteristics mapping.....	147
5.7.5	Reflective QoS.....	151
5.7.5.1	General.....	151
5.7.5.2	UE Derived QoS Rule.....	152
5.7.5.3	Reflective QoS Control.....	153
5.7.6	Packet Filter Set.....	154
5.7.6.1	General.....	154
5.7.6.2	IP Packet Filter Set.....	154
5.7.6.3	Ethernet Packet Filter Set.....	154
5.8	User Plane Management.....	155
5.8.1	General.....	155
5.8.2	Functional Description.....	155
5.8.2.1	General.....	155
5.8.2.2	UE IP Address Management.....	155
5.8.2.2.1	General.....	155
5.8.2.2.2	Routing rules configuration.....	158
5.8.2.2.3	The procedure of Stateless IPv6 Address Autoconfiguration.....	158
5.8.2.3	Management of CN Tunnel Info.....	159
5.8.2.3.1	General.....	159
5.8.2.3.2	Void.....	159
5.8.2.3.3	Management of CN Tunnel Info in the UPF.....	159
5.8.2.4	Traffic Detection.....	159
5.8.2.4.1	General.....	159
5.8.2.4.2	Traffic Detection Information.....	159
5.8.2.5	Control of User Plane Forwarding.....	160
5.8.2.5.1	General.....	160

5.8.2.5.2	Data forwarding between the SMF and UPF.....	160
5.8.2.5.3	Support of Ethernet PDU Session type.....	160
5.8.2.6	Charging and Usage Monitoring Handling	161
5.8.2.6.1	General	161
5.8.2.6.2	Activation of Usage Reporting in UPF.....	162
5.8.2.6.3	Reporting of Usage Information towards SMF	162
5.8.2.7	PDU Session and QoS Flow Policing	163
5.8.2.8	PCC Related Functions	163
5.8.2.8.1	Activation/Deactivation of predefined PCC rules	163
5.8.2.8.2	Enforcement of Dynamic PCC Rules	163
5.8.2.8.3	Redirection	164
5.8.2.8.4	Support of PFD Management	164
5.8.2.9	Functionality of Sending of "End marker"	165
5.8.2.9.0	Introduction	165
5.8.2.9.1	UPF Constructing the "End marker" Packets	165
5.8.2.9.2	SMF Constructing the "End marker" Packets.....	165
5.8.2.10	UP Tunnel Management	165
5.8.2.11	Parameters for N4 session management.....	166
5.8.2.11.1	General	166
5.8.2.11.2	N4 Session Context	167
5.8.2.11.3	Packet Detection Rule	167
5.8.2.11.4	QoS Enforcement Rule.....	170
5.8.2.11.5	Usage Reporting Rule.....	173
5.8.2.11.6	Forwarding Action Rule	176
5.8.2.11.7	Usage Report generated by UPF	179
5.8.2.11.8	Multi-Access Rule	180
5.8.2.11.9	Bridge Information	181
5.8.2.11.10	Void.....	181
5.8.2.11.11	Session Reporting Rule	181
5.8.2.11.12	Session reporting generated by UPF.....	182
5.8.2.11.13	Void.....	182
5.8.2.11.14	TSC Management Information.....	182
5.8.2.11.15	Downlink Data Report generated by UPF	182
5.8.2.12	Reporting of the UE MAC addresses used in a PDU Session.....	183
5.8.2.13	Support for 5G VN group communication.....	183
5.8.2.13.0	General	183
5.8.2.13.1	Support for unicast traffic forwarding of a 5G VN.....	184
5.8.2.13.2	Support for unicast traffic forwarding update due to UE mobility	185
5.8.2.13.3	Support for user plane traffic replication in a 5G VN	186
5.8.2.14	Inter PLMN User Plane Security functionality	188
5.8.3	Explicit Buffer Management.....	188
5.8.3.1	General	188
5.8.3.2	Buffering at UPF	188
5.8.3.3	Buffering at SMF	189
5.8.4	SMF Pause of Charging.....	189
5.9	Identifiers	189
5.9.1	General.....	189
5.9.2	Subscription Permanent Identifier	189
5.9.2a	Subscription Concealed Identifier.....	190
5.9.3	Permanent Equipment Identifier	190
5.9.4	5G Globally Unique Temporary Identifier	190
5.9.5	AMF Name	191
5.9.6	Data Network Name (DNN)	191
5.9.7	Internal-Group Identifier.....	191
5.9.8	Generic Public Subscription Identifier.....	192
5.9.9	AMF UE NGAP ID	192
5.9.10	UE Radio Capability ID.....	192
5.10	Security aspects.....	193
5.10.1	General.....	193
5.10.2	Security Model for non-3GPP access	193
5.10.2.1	Signalling Security.....	193
5.10.3	PDU Session User Plane Security.....	193

5.11	Support for Dual Connectivity, Multi-Connectivity	195
5.11.1	Support for Dual Connectivity	195
5.12	Charging	195
5.12.1	General	195
5.12.2	Usage Data Reporting for Secondary RAT	196
5.12.3	Secondary RAT Periodic Usage Data Reporting Procedure	196
5.13	Support for Edge Computing	196
5.14	Policy Control	197
5.15	Network slicing	197
5.15.1	General	197
5.15.2	Identification and selection of a Network Slice: the S-NSSAI and the NSSAI	198
5.15.2.1	General	198
5.15.2.2	Standardised SST values	199
5.15.3	Subscription aspects	199
5.15.4	UE NSSAI configuration and NSSAI storage aspects	200
5.15.4.1	General	200
5.15.4.1.1	UE Network Slice configuration	200
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	202
5.15.4.2	Update of UE Network Slice configuration	202
5.15.5	Detailed Operation Overview	203
5.15.5.1	General	203
5.15.5.2	Selection of a Serving AMF supporting the Network Slices	203
5.15.5.2.1	Registration to a set of Network Slices	203
5.15.5.2.2	Modification of the Set of Network Slice(s) for a UE	208
5.15.5.2.3	AMF Re-allocation due to Network Slice(s) Support	209
5.15.5.3	Establishing a PDU Session in a Network Slice	209
5.15.6	Network Slicing Support for Roaming	210
5.15.7	Network slicing and Interworking with EPS	211
5.15.7.1	General	211
5.15.7.2	Idle mode aspects	212
5.15.7.3	Connected mode aspects	212
5.15.8	Configuration of Network Slice availability in a PLMN	212
5.15.9	Operator-controlled inclusion of NSSAI in Access Stratum Connection Establishment	213
5.15.10	Network Slice-Specific Authentication and Authorization	214
5.16	Support for specific services	215
5.16.1	Public Warning System	215
5.16.2	SMS over NAS	215
5.16.2.1	General	215
5.16.2.2	SMS over NAS transport	215
5.16.3	IMS support	216
5.16.3.1	General	216
5.16.3.2	IMS voice over PS Session Supported Indication over 3GPP access	216
5.16.3.2a	IMS voice over PS Session Supported Indication over non-3GPP access	217
5.16.3.3	Homogeneous support for IMS voice over PS Session supported indication	217
5.16.3.4	P-CSCF address delivery	218
5.16.3.5	Domain selection for UE originating sessions / calls	218
5.16.3.6	Terminating domain selection for IMS voice	218
5.16.3.7	UE's usage setting	219
5.16.3.8	Domain and Access Selection for UE originating SMS	219
5.16.3.8.1	UE originating SMS for IMS Capable UEs supporting SMS over IP	219
5.16.3.8.2	Access Selection for SMS over NAS	219
5.16.3.9	SMF support for P-CSCF restoration procedure	219
5.16.3.10	IMS Voice Service via EPS Fallback or RAT fallback in 5GS	219
5.16.3.11	P-CSCF discovery and selection	220
5.16.3.12	HSS discovery and selection	220
5.16.4	Emergency Services	221
5.16.4.1	Introduction	221
5.16.4.2	Architecture Reference Model for Emergency Services	223
5.16.4.3	Mobility Restrictions and Access Restrictions for Emergency Services	223
5.16.4.4	Reachability Management	224
5.16.4.5	SMF and UPF selection function for Emergency Services	224

5.16.4.6	QoS for Emergency Services	224
5.16.4.7	PCC for Emergency Services	224
5.16.4.8	IP Address Allocation	224
5.16.4.9	Handling of PDU Sessions for Emergency Services	224
5.16.4.9a	Handling of PDU Sessions for normal services for Emergency Registered UEs	225
5.16.4.10	Support of eCall Only Mode	225
5.16.4.11	Emergency Services Fallback	225
5.16.5	Multimedia Priority Services	226
5.16.6	Mission Critical Services	227
5.17	Interworking and Migration	228
5.17.1	Support for Migration from EPC to 5GC	228
5.17.1.1	General	228
5.17.1.2	User Plane management to support interworking with EPS	230
5.17.2	Interworking with EPC	230
5.17.2.1	General	230
5.17.2.2	Interworking Procedures with N26 interface	233
5.17.2.2.1	General	233
5.17.2.2.2	Mobility for UEs in single-registration mode	234
5.17.2.3	Interworking Procedures without N26 interface	235
5.17.2.3.1	General	235
5.17.2.3.2	Mobility for UEs in single-registration mode	236
5.17.2.3.3	Mobility for UEs in dual-registration mode	237
5.17.2.3.4	Redirection for UEs in connected state	238
5.17.2.4	Mobility between 5GS and GERAN/UTRAN	238
5.17.3	Interworking with EPC in presence of Non-3GPP PDU Sessions	239
5.17.4	Network sharing support and interworking between EPS and 5GS	239
5.17.5	Service Exposure in Interworking Scenarios	239
5.17.5.1	General	239
5.17.5.2	Support of interworking for Monitoring Events	240
5.17.5.2.1	Interworking with N26 interface	240
5.17.5.2.2	Interworking without N26 interface	240
5.17.5.3	Availability or expected level of a service API	240
5.17.6	Void	241
5.17.7	Configuration Transfer Procedure between NG-RAN and E-UTRAN	241
5.17.7.1	Architecture Principles for Configuration Transfer between NG-RAN and E-UTRAN	241
5.17.7.2	Addressing, routing and relaying	242
5.17.7.2.1	Addressing	242
5.17.7.2.2	Routing	242
5.17.7.2.3	Relaying	243
5.18	Network Sharing	243
5.18.1	General concepts	243
5.18.2	Broadcast system information for network sharing	244
5.18.2a	PLMN list handling for network sharing	244
5.18.3	Network selection by the UE	244
5.18.4	Network selection by the network	245
5.18.5	Network Sharing and Network Slicing	245
5.19	Control Plane Load Control, Congestion and Overload Control	245
5.19.1	General	245
5.19.2	TNLA Load Balancing and TNLA Load Re-Balancing	246
5.19.3	AMF Load Balancing	246
5.19.4	AMF Load Re-Balancing	246
5.19.5	AMF Control Of Overload	247
5.19.5.1	General	247
5.19.5.2	AMF Overload Control	247
5.19.6	SMF Overload Control	248
5.19.7	NAS level congestion control	248
5.19.7.1	General	248
5.19.7.2	General NAS level congestion control	248
5.19.7.3	DNN based congestion control	249
5.19.7.4	S-NSSAI based congestion control	251
5.19.7.5	Group specific NAS level congestion control	252
5.19.7.6	Control Plane data specific NAS level congestion control	252

5.20	External Exposure of Network Capability.....	253
5.20a	Data Collection from an AF	254
5.21	Architectural support for virtualized deployments	254
5.21.0	General.....	254
5.21.1	Architectural support for N2.....	254
5.21.1.1	TNL associations.....	254
5.21.1.2	NGAP UE-TNLA-binding.....	255
5.21.1.3	N2 TNL association selection	255
5.21.2	AMF Management.....	255
5.21.2.1	AMF Addition/Update	255
5.21.2.2	AMF planned removal procedure	256
5.21.2.2.1	AMF planned removal procedure with UDSF deployed	256
5.21.2.2.2	AMF planned removal procedure without UDSF.....	257
5.21.2.3	Procedure for AMF Auto-recovery	259
5.21.3	Network Reliability support with Sets.....	260
5.21.3.1	General.....	260
5.21.3.2	NF Set and NF Service Set.....	261
5.21.3.3	Reliability of NF instances within the same NF Set.....	261
5.21.3.4	Reliability of NF Services	261
5.21.4	Network Function/NF Service Context Transfer	262
5.21.4.1	General	262
5.22	System Enablers for priority mechanism.....	262
5.22.1	General.....	262
5.22.2	Subscription-related Priority Mechanisms	262
5.22.3	Invocation-related Priority Mechanisms	263
5.22.4	QoS Mechanisms applied to established QoS Flows	264
5.23	Supporting for Asynchronous Type Communication.....	264
5.24	3GPP PS Data Off	265
5.25	Support of OAM Features	265
5.25.1	Support of Tracing: Signalling Based Activation/Deactivation of Tracing	265
5.25.2	Support of OAM-based 5G VN group management.....	266
5.26	Configuration Transfer Procedure.....	266
5.26.1	Architecture Principles for Configuration Transfer	266
5.26.2	Addressing, routing and relaying.....	267
5.26.2.1	Addressing	267
5.26.2.2	Routing.....	267
5.26.2.3	Relaying	267
5.27	Time Sensitive Communications.....	268
5.27.0	General.....	268
5.27.1	TSN Time Synchronization	268
5.27.1.1	General	268
5.27.1.2	Distribution of timing information.....	269
5.27.1.2.1	Distribution of 5G internal system clock.....	269
5.27.1.2.2	Distribution of TSN grandmaster clock and time-stamping	269
5.27.1.3	Support for multiple TSN working domains	270
5.27.1a	Periodic deterministic QoS	271
5.27.2	TSC Assistance Information (TSCAI).....	271
5.27.3	Support for TSC QoS Flows	272
5.27.4	Hold and Forward Buffering mechanism.....	273
5.27.5	5G System Bridge delay	273
5.28	Support of integration with TSN	274
5.28.1	5GS TSN bridge management	274
5.28.2	5GS Bridge configuration.....	276
5.28.3	Port and bridge management information exchange in 5GS.....	277
5.28.3.1	General	277
5.28.3.2	Transfer of port or bridge management information.....	284
5.28.3.3	VLAN Configuration Information	285
5.28.4	QoS mapping tables.....	285
5.29	Support for 5G LAN-type service	287
5.29.1	General.....	287
5.29.2	5G VN group management	287
5.29.3	PDU Session management.....	288

5.29.4	User Plane handling	289
5.30	Support for non-public networks.....	290
5.30.1	General.....	290
5.30.2	Stand-alone non-public networks	290
5.30.2.0	General	290
5.30.2.1	Identifiers	290
5.30.2.2	Broadcast system information.....	291
5.30.2.3	UE configuration and subscription aspects	291
5.30.2.4	Network selection in SNPN access mode	292
5.30.2.5	Network access control	292
5.30.2.6	Cell (re-)selection in SNPN access mode.....	292
5.30.2.7	Access to PLMN services via stand-alone non-public networks.....	292
5.30.2.8	Access to stand-alone non-public network services via PLMN	293
5.30.3	Public Network Integrated NPN	293
5.30.3.1	General	293
5.30.3.2	Identifiers	294
5.30.3.3	UE configuration, subscription aspects and storage.....	294
5.30.3.4	Network and cell (re-)selection, and access control.....	295
5.30.3.5	Support of emergency services in CAG cells.....	296
5.31	Support for Cellular IoT	296
5.31.1	General.....	296
5.31.2	Preferred and Supported Network Behaviour	297
5.31.3	Selection, steering and redirection between EPS and 5GS	298
5.31.4	Control Plane CIoT 5GS Optimisation	298
5.31.4.1	General	298
5.31.4.2	Establishment of N3 data transfer during Data Transport in Control Plane CIoT 5GS Optimisation.....	299
5.31.4.3	Control Plane Relocation Indication procedure	300
5.31.5	Non-IP Data Delivery (NIDD).....	300
5.31.6	Reliable Data Service.....	300
5.31.7	Power Saving Enhancements.....	301
5.31.7.1	General	301
5.31.7.2	Extended Discontinuous Reception (DRX) for CM-IDLE and CM-CONNECTED with RRC-INACTIVE.....	301
5.31.7.2.1	Overview	301
5.31.7.2.2	Paging for extended idle mode DRX in E-UTRA connected to 5GC.....	303
5.31.7.2.3	Paging for a UE registered in a tracking area with heterogeneous support of extended idle mode DRX.....	304
5.31.7.3	MICO mode with Extended Connected Time	304
5.31.7.4	MICO mode with Active Time	304
5.31.7.5	MICO mode and Periodic Registration Timer Control	304
5.31.8	High latency communication	305
5.31.9	Support for Monitoring Events	306
5.31.10	NB-IoT UE Radio Capability Handling.....	306
5.31.11	Inter-RAT idle mode mobility to and from NB-IoT	306
5.31.12	Restriction of use of Enhanced Coverage	307
5.31.13	Paging for Enhanced Coverage.....	308
5.31.14	Support of rate control of user data.....	308
5.31.14.1	General	308
5.31.14.2	Serving PLMN Rate Control.....	308
5.31.14.3	Small Data Rate Control	309
5.31.15	Control Plane Data Transfer Congestion Control	310
5.31.16	Service Gap Control.....	310
5.31.17	Inter-UE QoS for NB-IoT.....	312
5.31.18	User Plane CIoT 5GS Optimisation.....	312
5.31.19	QoS model for NB-IoT	313
5.31.20	Category M UEs differentiation.....	313
5.32	Support for ATSSS.....	314
5.32.1	General.....	314
5.32.2	Multi Access PDU Sessions	314
5.32.3	Policy for ATSSS Control	317
5.32.4	QoS Support.....	317

5.32.5	Access Network Performance Measurements.....	319
5.32.5.1	General principles	319
5.32.5.2	Round Trip Time Measurements.....	319
5.32.5.3	Access Availability/Unavailability Report.....	320
5.32.5.4	Protocol stack for user plane measurements and measurement reports.....	321
5.32.6	Support of Steering Functionalities	322
5.32.6.1	General	322
5.32.6.2	High-Layer Steering Functionalities	323
5.32.6.2.1	MPTCP Functionality.....	323
5.32.6.3	Low-Layer Steering Functionalities.....	324
5.32.6.3.1	ATSSS-LL Functionality.....	324
5.32.7	Interworking with EPS.....	325
5.32.7.1	General	325
5.32.7.2	Interworking with N26 Interface.....	325
5.32.7.3	Interworking without N26 Interface.....	326
5.32.8	ATSSS Rules	326
5.33	Support for Ultra Reliable Low Latency Communication.....	328
5.33.1	General.....	328
5.33.2	Redundant transmission for high reliability communication	328
5.33.2.1	Dual Connectivity based end to end Redundant User Plane Paths.....	328
5.33.2.2	Support of redundant transmission on N3/N9 interfaces	330
5.33.2.3	Support for redundant transmission at transport layer	331
5.33.3	QoS Monitoring to Assist URLLC Service	332
5.33.3.1	General	332
5.33.3.2	Per QoS Flow per UE QoS Monitoring.....	332
5.33.3.3	GTP-U Path Monitoring.....	333
5.34	Support of deployments topologies with specific SMF Service Areas.....	334
5.34.1	General.....	334
5.34.2	Architecture	335
5.34.2.1	SBA architecture	335
5.34.2.2	Non-roaming architecture	335
5.34.2.3	Roaming architecture	336
5.34.3	I-SMF selection, V-SMF reselection	336
5.34.4	Usage of an UL Classifier for a PDU Session controlled by I-SMF.....	337
5.34.5	Usage of IPv6 multi-homing for a PDU Session controlled by I-SMF.....	338
5.34.6	Interaction between I-SMF and SMF for the support of traffic offload by UPF controlled by the I-SMF	339
5.34.6.1	General	339
5.34.6.2	N4 information sent from SMF to I-SMF for local traffic offload.....	339
5.34.7	Event Management	340
5.34.7.1	UE's Mobility Event Management	340
5.34.7.2	SMF event exposure service	340
5.34.7.3	AMF implicit subscription about events related with the PDU Session	341
5.34.8	Support for Cellular IoT	341
5.34.9	Support of the Deployment Topologies with specific SMF Service Areas feature within and between PLMN(s).....	341
5.34.10	Support for 5G LAN-type service.....	341
5.35	Support for Integrated access and backhaul (IAB).....	341
5.35.1	IAB architecture and functional entities	341
5.35.2	5G System enhancements to support IAB	343
5.35.3	Data handling and QoS support with IAB	343
5.35.4	Mobility support with IAB	344
5.35.5	Charging support with IAB.....	344
5.35.6	IAB operation involving EPC.....	344
5.36	RIM Information Transfer.....	344
6	Network Functions	344
6.1	General	344
6.2	Network Function Functional description	344
6.2.1	AMF.....	344
6.2.2	SMF	346
6.2.3	UPF	347

6.2.4	PCF	348
6.2.5	NEF	348
6.2.5.0	NEF functionality	348
6.2.5.1	Support for CAPIF	349
6.2.5a	Void	349
6.2.6	NRF	349
6.2.6.1	General	349
6.2.6.2	NF profile	350
6.2.6.3	SCP profile	351
6.2.7	UDM	352
6.2.8	AUSF	352
6.2.9	N3IWF	352
6.2.9A	TNGF	353
6.2.10	AF	353
6.2.11	UDR	353
6.2.12	UDSF	354
6.2.13	SMSF	354
6.2.14	NSSF	354
6.2.15	5G-EIR	354
6.2.16	LMF	355
6.2.16A	GMLC	355
6.2.17	SEPP	355
6.2.18	Network Data Analytics Function (NWDAF)	355
6.2.19	SCP	355
6.2.20	W-AGF	356
6.2.21	UE radio Capability Management Function (UCMF)	356
6.2.22	TWIF	356
6.2.23	NSSAAF	357
6.3	Principles for Network Function and Network Function Service discovery and selection	357
6.3.1	General	357
6.3.1.0	Principles for Binding, Selection and Reselection	358
6.3.1.1	NF Discovery and Selection aspects relevant with indirect communication	360
6.3.1.2	Location information	361
6.3.2	SMF discovery and selection	361
6.3.3	User Plane Function Selection	363
6.3.3.1	Overview	363
6.3.3.2	SMF Provisioning of available UPF(s)	363
6.3.3.3	Selection of an UPF for a particular PDU Session	364
6.3.4	AUSF discovery and selection	365
6.3.5	AMF discovery and selection	366
6.3.6	N3IWF selection	368
6.3.6.1	General	368
6.3.6.2	Stand-alone N3IWF selection	368
6.3.6.2a	SNPN N3IWF selection	369
6.3.6.3	Combined N3IWF/ePDG Selection	370
6.3.6.4	PLMN Selection for emergency services	372
6.3.7	PCF discovery and selection	373
6.3.7.0	General principles	373
6.3.7.1	PCF discovery and selection for a UE or a PDU Session	373
6.3.7.2	Providing policy requirements that apply to multiple UE and hence to multiple PCF	375
6.3.7.3	Binding an AF request targeting a UE address to the relevant PCF	375
6.3.8	UDM discovery and selection	376
6.3.9	UDR discovery and selection	376
6.3.10	SMSF discovery and selection	377
6.3.11	CHF discovery and selection	377
6.3.12	Trusted Non-3GPP Access Network selection	378
6.3.12.1	General	378
6.3.12.2	Access Network Selection Procedure	380
6.3.12a	Access Network selection for devices that do not support 5GC NAS over WLAN	382
6.3.12a.1	General	382
6.3.12a.2	Access Network Selection Procedure	382
6.3.13	NWDAF discovery and selection	383