

# ETSI GS NIN 006 V1.1.1 (2024-07)



## Non-IP Networking (NIN); Scenario Definitions of Next Generation Protocols (NGP)

(<https://standards.iteh.ai>)

### Document Preview

[ETSI GS NIN 006 V1.1.1 \(2024-07\)](https://standards.iteh.ai/catalog/standards/etsi/fdae2b8f-07b1-4fa6-8c5f-1b0f965de480/etsi-gs-nin-006-v1-1-1-2024-07)

<https://standards.iteh.ai/catalog/standards/etsi/fdae2b8f-07b1-4fa6-8c5f-1b0f965de480/etsi-gs-nin-006-v1-1-1-2024-07>

#### *Disclaimer*

---

The present document has been produced and approved by the Non-IP Networking (NIN) ETSI Industry Specification Group (ISG) and represents the views of those members who participated in this ISG.  
It does not necessarily represent the views of the entire ETSI membership.

---

**Reference**DGS/NIN-06v111

---

**Keywords**

core network, cyber security, IoT, mobility,  
network, QoE, reliability, security, service, use  
case

**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.

# Contents

Intellectual Property Rights .....	7
Foreword.....	7
Modal verbs terminology.....	7
1 Scope .....	8
2 References .....	8
2.1 Normative references .....	8
2.2 Informative references.....	9
3 Definition of terms, symbols and abbreviations.....	11
3.1 Terms.....	11
3.2 Symbols.....	18
3.3 Abbreviations .....	18
4 Overview .....	21
5 Issues to be addressed by the Scenarios .....	23
6 Model References.....	25
6.0 Introduction .....	25
6.1 LTE Mobile Network Model.....	25
6.2 L2 and L3 VPN services .....	27
6.2.0 Introduction.....	27
6.2.1 MPLS/BGP Layer 3 Virtual Private Networks.....	28
6.2.2 VPLS, Virtual Private Line Services and Ethernet-VPN.....	29
6.3 All IP Core Network Model .....	31
6.4 NFV Reference Model .....	33
6.5 MEC Reference Model.....	34
7 Referenced Use Cases .....	34
8 Scenarios .....	35
8.1 Addressing.....	35
8.1.0 Introduction.....	35
8.1.1 Model Architecture .....	36
8.1.2 Scenario Description.....	37
8.1.2.0 Introduction.....	37
8.1.2.1 Scenarios for mobile communication.....	37
8.1.2.2 Scenarios for multi-homing and load balancing.....	38
8.1.3 Applicable Issues .....	39
8.1.4 Applicable Use Cases .....	39
8.1.4.1 Case 1: UE communicates with a fixed device; UE is moving within a same P-GW domain .....	39
8.1.4.2 Case 2: UE communicates with a fixed device; UE is moving across different P-GW domain .....	40
8.1.4.3 Case 3: UE communicates with a fixed device; UE is moving across heterogeneous access network .....	40
8.1.4.4 Case 4: UE communicates with another UE; UE is moving within a same P-GW domain .....	41
8.1.4.5 Case 5: UE communicates with another UE; UE is moving across different P-GW domain.....	41
8.1.4.6 Case 6: UE communicates with another UE; UE is moving across heterogeneous access network .....	42
8.1.4.7 Case 7: Multi-homing host connected to different ISP for link protection or load balance .....	42
8.1.4.8 Case 8: Customer network with multi-homing site connected to different ISP for link protection or load balancing .....	42
8.1.5 Scenario Targets .....	43
8.2 Security .....	44
8.2.1 Model Architecture/Protocol Stacks .....	44
8.2.2 Scenario Description.....	44
8.2.2.1 Scenario summary.....	44
8.2.2.2 Security approach.....	44
8.2.2.3 Description of new security challenges.....	45
8.2.3 Applicable Issues .....	45

8.2.4	Applicable Use Cases .....	49
8.2.5	Scenario Targets .....	49
8.3	Mobility.....	51
8.3.1	Model Architecture .....	51
8.3.2	Scenario Description.....	53
8.3.3	Applicable Issues .....	54
8.3.4	Applicable Use Cases .....	56
8.3.4.0	Introduction.....	56
8.3.4.1	Case 1: Multi-Access, Session & Bearer connection, Same Macro.....	56
8.3.4.2	Case 2: Multi-Access, Session & Bearer connection, with Macro HO.....	56
8.3.4.3	Case 3: Single Access, Session & Bearer, Same Macro .....	56
8.3.4.4	Case 4: Single Access, Multi-Session, Multi-Bearer, Same Macro .....	56
8.3.4.5	Case 5: Fast, Single Access, Multi-Session, Multi-Bearer, with Macro HO.....	57
8.3.4.6	Case 6: Fast, Multi-Access, Session & Bearer connection, with Macro HO .....	57
8.3.4.7	Case 7: Fast, Multi-Access, Session & Bearer connection, with Macro HO .....	57
8.3.5	Scenario Targets .....	57
8.4	Multi-Access Support (including FMC).....	58
8.4.1	Model Architecture .....	58
8.4.2	Scenarios.....	58
8.4.3	Scenario Description.....	59
8.4.4	Applicable Issues .....	60
8.5	Context Awareness.....	60
8.5.1	Model Architecture/Protocol Stacks .....	60
8.5.2	Scenario Description.....	61
8.5.3	Applicable Issues .....	64
8.5.4	Applicable Use Cases (from Annex A).....	65
8.5.5	Scenario Targets .....	65
8.6	Performance Improvement & Content Enablement .....	66
8.6.1	Model Architecture .....	66
8.6.2	Scenario Descriptions .....	68
8.6.2.0	Introduction.....	68
8.6.2.1	Scenario #1 - Adaptive video streaming .....	69
8.6.2.2	Scenario #2 - 8K Video Streaming .....	69
8.6.2.3	Scenario #3 - Live Virtual Reality .....	70
8.6.2.4	Scenario #4 - URLLC For Time-Critical IoT .....	70
8.6.3	Issues with TCP Congestion Control.....	70
8.6.3.1	An appraisal of Congestion Management .....	70
8.6.3.2	An Introduction to Current TCP Congestion Mechanisms .....	71
8.6.4	Applicable Issues and Recommendations.....	72
8.6.5	Applicable Use Cases (from Annex A).....	74
8.6.5.0	Introduction.....	74
8.6.5.1	Case 1: New Transport Protocol .....	74
8.6.5.2	Case 2: Use Case for Flexible Application Traffic Routing.....	74
8.6.5.3	Case 3: In-Network Caching .....	74
8.6.5.4	Case 4: Deterministic Network Reporting/Profiling .....	74
8.6.6	Scenario Targets .....	74
8.7	Network Virtualisation .....	75
8.7.0	Introduction.....	75
8.7.1	Model Architecture .....	76
8.7.2	Scenario Description.....	80
8.7.2.1	Scenario #1: Network Virtualisation in EPS.....	80
8.7.2.2	Scenario #2: Virtualised RAN.....	81
8.7.3	Applicable Issues .....	82
8.7.4	Applicable Use Cases .....	84
8.7.4.1	Case 1: Network Slicing.....	84
8.7.4.2	Case 2: Network Slicing: With Simultaneous access to different instances of Virtualised core.....	86
8.7.4.3	Case 3: MEC and Network Virtualisation.....	86
8.7.4.4	Case 4: Cloud interconnect (Mobile/Fixed networks).....	86
8.7.4.5	Case 5: C-RAN Enhanced Computational Flexibility.....	87
8.7.4.6	Case 6: Heterogeneity of RAT .....	88
8.7.4.7	Case 7: Performance Enhancement of Low-power RRU.....	88
8.7.5	Scenario Targets .....	88

8.8	IoT Scenario .....	90
8.8.1	Model Architecture/Protocol Stacks .....	90
8.8.2	Scenario Descriptions .....	90
8.8.2.0	Introduction .....	90
8.8.2.1	Active Assisted Living (AAL) .....	91
8.8.2.2	Cooperation between factories and remote applications .....	91
8.8.2.3	Smart glasses in industrial applications.....	91
8.8.3	Applicable Issues .....	91
8.8.4	Applicable Use Cases (from Annex A).....	93
8.9	Energy Efficiency .....	93
8.10	eCommerce.....	94
8.11	Mobile Edge Computing (MEC).....	94
8.11.0	Introduction.....	94
8.11.1	Model Architecture .....	95
8.11.2	Applicable Issues and Recommendations.....	96
8.11.3	Applicable Use Cases .....	97
8.11.3.0	Introduction .....	97
8.11.3.1	Case 1: Video Stream Analysis service.....	97
8.11.3.2	Case 2: Augmented and Virtual Reality service.....	98
8.11.3.3	Case 3: Assistance for intensive computation service.....	98
8.11.3.4	Case 4: IoT Gateway service.....	98
8.11.3.5	Use Case 5: Connected Vehicles service scenario .....	99
8.11.4	Scenario Targets .....	100
8.12	Mission Critical Services: PSC and PUC .....	100
8.12.0	Introduction.....	100
8.13	Drones, Autonomous and Connected Vehicles .....	100
8.13.0	Introduction.....	100
8.13.1	Model.....	100
8.13.2	Scenarios.....	101
8.13.3	Applicable Issues and Recommendations .....	102
8.13.4	Applicable Use Cases .....	104
8.13.4.0	Introduction .....	104
8.13.4.1	Hazardous operations .....	104
8.13.4.2	Driverless vehicles .....	105
8.13.4.3	Automated Convoys ('platooning').....	105
8.13.4.4	Connected vehicles.....	105
8.14	URLLC: Ultra-Reliable and Low Latency Communications .....	105
8.14.0	Introduction.....	105
8.14.1	Model architecture .....	106
8.14.2	Scenario description.....	107
8.14.2.0	Scenarios Introduction .....	107
8.14.2.1	Handover interruption caused by UE's mobility .....	107
8.14.2.2	Interruption Latency caused by mobility of application.....	108
8.14.2.3	E2E latency enlarged by Indeterminate processing delay in network nodes.....	108
8.14.2.4	Conflict between high reliability and low latency under wireless packet loss .....	109
8.14.3	Applicable Issues and Recommendations.....	109
8.14.4	Use cases.....	109
8.14.4.1	Case 1: Local UAV Collaboration .....	109
8.14.4.2	Case 2: Industrial Factory Automation .....	110
8.14.4.3	Case 3: V2X .....	110
8.14.4.4	Scenario Targets.....	110
<b>Annex A (informative): Use Cases &amp; Parameterization .....</b>		<b>111</b>
<b>Annex B (informative): 5G mobile network model .....</b>		<b>126</b>
B.0	Introduction .....	126
B.1	References .....	126
B.2	Reading the scenarios in the context of 5G.....	126
B.3	Key differences from LTE mobile Network Model.....	126

B.4	Service Based Architecture .....	126
B.5	5G Protocol stacks.....	127
B.5.0	Introduction .....	127
B.5.1	User plane protocols.....	127
B.5.2	5G Control Plane Protocols.....	128
B.6	Networking issues carried over from LTE architecture .....	129
<b>Annex C (informative):</b>	<b>Void .....</b>	<b>130</b>
History .....		131

i T h S t a n d a r d s  
( h t t p s : / / s t a n d a r d s . i t  
D o c u m e n t i e P w r

E T S I G S I . N I N . N ( 0 0 2 4 - 0 7 )  
h t t p s : / / s t a n d a r d s . i t e h . a i / c a t a l o g / s t a n

---

# 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.

---

# Foreword

This Group Specification (GS) has been produced by ETSI Industry Specification Group (ISG) Non-IP Networking (NIN).

NOTE: This Group Specification (GS) has been initially produced by ETSI Industry Specification Group (ISG) Next Generation Protocols (NGP) as ETSI GS NGP 001, and revised by ETSI Industry Specification Group (ISG) Non-IP Protocols (NIN) .

---

# 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.

---

# 1 Scope

The scope of the present document is to specify the minimum set of key scenarios for the Next Generation Protocols (NGP), Industry Specific Group (ISG).

---

## 2 References

### 2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <https://docbox.etsi.org/Reference/>.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

- [1] NGMN: "[5G Whitepaper](#)".
- [2] [Recommendation ITU-T Y.2091](#): "Terms and definitions for next generation networks".
- [3] [Recommendation ITU-T Y.2720](#): "NGN identity management framework".
- [4] [IETF RFC 8113](#): "Locator/ID Separation Protocol (LISP): Shared Extension Message & IANA Registry for Packet Type Allocations".
- [5] [IETF RFC 760](#): "DoD standard Internet Protocol".
- [6] [ISO/IEC 7498-1](#):1994: "Information technology - Open Systems Interconnection -- Basic Reference Model: The Basic Model".
- [7] [Department of Defense World Geodetic System 1984 TR 8350.2](#).
- [8] [ETSI GS NFV 002](#): "Network Functions Virtualisation (NFV); Architectural Framework".
- [9] [ETSI GS NFV 003](#): "Network Functions Virtualisation (NFV); Terminology for Main Concepts in NFV".
- [10] [IETF RFC 4364](#): "BGP/MPLS IP Virtual Private Networks (VPNs)".
- [11] [IETF RFC 4761](#): "Virtual Private LAN Service (VPLS) Using BGP for Auto-Discovery and Signaling".
- [12] [IETF RFC 3753](#): "Mobility Related Terminology".
- [13] [IETF RFC 7333](#): "Requirements for Distributed Mobility Management".
- [14] [IETF draft-ietf-lisp-lcaf-14 \(LISP\)](#): "LISP Canonical Address Format (LCAF)".
- [15] [IETF draft-farinacci-lisp-eid-anonymity-00 \(LISP\)](#): "LISP EID Anonymity".
- [16] [ETSI GS NFV 001 \(V1.1.1\)](#): "Network Functions Virtualisation (NFV); Use Cases".
- [17] Void.
- [18] [ETSI GS NFV-SEC 003 \(V1.1.1\)](#): "Network Functions Virtualisation (NFV); NFV Security; Security and Trust Guidance".

- [19] [ETSI GS MEC 001 \(V1.1.1\)](#): "Mobile Edge Computing (MEC) Terminology".
- [20] [ETSI GS MEC 003 \(V1.1.1\)](#): "Mobile Edge Computing (MEC); Framework and Reference Architecture".
- [21] [ETSI GS MEC-IEG 004 \(V1.1.1\)](#): "Mobile-Edge Computing (MEC); Service Scenarios".
- [22] [ETSI TS 103 307](#): "CYBER; Security Aspects for LI and RD Interfaces".
- [23] [ETSI GS NFV-SEC 009 \(V1.1.1\)](#): "Network Functions Virtualisation (NFV); NFV Security; Report on use cases and technical approaches for multi-layer host administration".
- [24] [ETSI TS 132 500](#): "Universal Mobile Telecommunications System (UMTS); LTE; Telecommunication management; Self-Organizing Networks (SON); Concepts and requirements (3GPP TS 32.500)".
- [25] MEC White-paper: "[Mobile Edge Computing: A key technology towards 5G](#)", 2015.
- [26] [IEEE 802.1Q™-2011](#): "IEEE Standard for Local and metropolitan area networks--Media Access Control (MAC) Bridges and Virtual Bridged Local Area Networks".
- [27] [ETSI TS 123 401](#): "LTE; General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access (3GPP TS 23.401 Release 13)".
- [28] [ETSI TS 122 261](#): "5G; Service requirements for next generation new services and markets (3GPP TS 22.261 Release 15)".
- [29] [ETSI TS 122 280](#): "LTE; Mission Critical Services Common Requirements (3GPP TS 22.280 Release 14)".
- [30] [Society of Automotive Engineers, J3016](#): "Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems".
- [31] [IETF RFC 3246](#): "An Expedited Forwarding PHB (Per-Hop Behavior)".
- [32] [ETSI TS 123 501](#): "5G; System Architecture for the 5G System (3GPP TS 23.501 Release 15)".
- [33] [3GPP TR 29.891](#): "3rd Generation Partnership Project; Technical Specification Group Core Network and Terminals; 5G System - Phase 1; CT WG4 Aspects (Release 15)".
- [34] [ETSI TS 138 300](#): "5G; NR; Overall description; Stage-2 (3GPP TS 38.300)".
- [35] [ETSI TS 129 281](#): "Universal Mobile Telecommunications System (UMTS); LTE; General Packet Radio System (GPRS) Tunnelling Protocol User Plane (GTPv1-U) (3GPP TS 29.281)".

## 2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] [3GPP TR 22.891](#): "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Feasibility Study on New Services and Markets Technology Enablers; Stage 1".
- [i.2] [3GPP TR 23.799](#): "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Study on Architecture for Next Generation System (NexGen)".

- [i.3] ETSI TR 121 905: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); LTE; Vocabulary for 3GPP Specifications (3GPP TR 21.905)".
- [i.4] 5GPPP Whitepaper on Automotive Vertical Sector.
- [i.5] 5GPPP Whitepaper on Energy Vertical Sector.
- [i.6] 5GPPP Whitepaper on Factories of the Future.
- [i.7] 5GPPP Whitepaper on E-Health.
- [i.8] Elements of Mathematics: "General Topology", Berlin, Springer- Verlag, 1990, Bourbaki, N. 1971.
- [i.9] "Elements of the Topology of Plane Sets of Points", Newman, M, 1964.
- [i.10] Stallings, William: "High-Speed Networks and Internets", Prentice-Hall™, 2002.
- [i.11] Risk Nexus: "[Overcome by cyber risks? Economic benefits and costs of alternate cyber futures](#)".
- [i.12] "[A Binary Feedback Scheme for Congestion Avoidance in Computer Networks with Connectionless Network Layer](#)", ACM Transactions on Computer Systems, Vol. 8, No. 2, May 1990, pp. 158-181, K. Ramakrishnan and Raj Jain.
- [i.13] Digital Equipment Corporation Technical Report No. DEC-TR-510: "Congestion Avoidance in Computer Networks with A Connectionless Network Layer: Part IV: A Selective Binary Feedback Scheme for General Topologies", August 1987, 43 pp., K. Ramakrishnan and Raj Jain.
- [i.14] Void.
- [i.15] IETF RFC 4762: "Virtual Private LAN Service (VPLS) Using Label Distribution Protocol (LDP) Signaling".
- [i.16] IETF RFC 4984: "Report from the IAB Workshop on Routing and Addressing".
- [i.17] 3GPP TR 23.863: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Support of Short Message Service (SMS) in IP Multimedia Subsystem (IMS) without Mobile Station International ISDN Number (MSISDN); Stage 2".
- [i.18] 3GPP TR 22.864: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Feasibility Study on New Services and Markets Technology Enablers - Network Operation; Stage 1".
- [i.19] IETF RFC 6582: "The NewReno Modification to TCP's Fast Recovery Algorithm".
- [i.20] IETF RFC 2018: "TCP Selective Acknowledgment Options".
- [i.21] ETSI GS MEC 002: "Mobile Edge Computing (MEC); Technical Requirements".
- [i.22] ETSI GS MEC-IEG 005: "Mobile-Edge Computing (MEC); Proof of Concept Framework".
- [i.23] IETF RFC 7041: "Extensions to the Virtual Private LAN Service (VPLS) Provider Edge (PE) Model for Provider Backbone Bridging".
- [i.24] 5G Manifesto for timely deployment of 5G.
- [i.25] ETSI TR 138 913: "5G; Study on Scenarios and Requirements for Next Generation Access Technologies (3GPP TR 38.913)".
- [i.26] [IETF Charter of IETF DMM documents](#).
- [i.27] Broadband Forum TR-069: "CPE WAN Management Protocol".
- [i.28] 3GPP TR 38.801: "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Study on new radio access technology: Radio access architecture and interfaces".

- [i.29] 3GPP TR 36.881: "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Study on latency reduction techniques for LTE".
- [i.30] Ericsson Research AB: "Service Mobility in Mobile Networks", 2015 IEEE 8th International Conference on Cloud Computing .
- [i.31] Nokia: "W01-Third Workshop on 5G Architecture (5GArch 2016)", Mobility Management Enhancements for 5G Low Latency Services.
- [i.32] IETF draft-briscoe-tsvwg-ecn-l4s-id-00 K. De Schepper, I. Tsang, Bell Labs, B. Briscoe, Ed Simula Research Lab: "Identifying Modified Explicit Congestion Notification (ECN) Semantics for Ultra-Low Queuing Delay".
- [i.33] Void.
- [i.34] 3GPP TR 22.862: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Feasibility Study on New Services and Markets Technology Enablers for Critical Communications; Stage 1" (Release 14).
- [i.35] National Highway Traffic Safety Administration: "[Preliminary statement of policy concerning automated vehicles](#)" (2013).
- [i.36] 5GPPP white paper: "5G Automotive Vision".
- [i.37] 3GPP TR 22.886: "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Study on enhancement of 3GPP Support for 5G V2X Services (Release 15)".
- [i.38] [Society of Automotive Engineers Mobulus: "Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems"](#).
- [i.39] [Driverless Future](#).
- [i.40] ETSI GS NFV 006 (V4.4.1) : "Network Functions Virtualisation (NFV) Release 4; Management and Orchestration; Architectural Framework Specification".

---

## 3 Definition of terms, symbols and abbreviations

### 3.1 Terms

For the purposes of the present document, the terms applying to scenarios that include mobile network architectures given in ETSI TR 121 905 [i.3] and 3GPP TR 23.799 [i.2] and the following apply:

**access point:** point of access to a network, which in this generic NGP context may be a traditional Wi-Fi access point, 3GPP cellular network base station, RRU supporting a cell or sector or part thereof if the cell is configured as a multi-point access cell

**address:** identifier for a specific termination point and is used for routing to this termination point

NOTE: See Recommendation ITU-T Y.2091 [2].

**application process:** instantiation of a program executing in a processing system intended to accomplish some purpose

NOTE: An application contains one or more application protocol machines.

**application process name:** name of an application process

**application protocol:** protocol characterized by modifying state external to the protocol by performing remote operations on an object model

NOTE: The minimal set of operations are create/delete, start/stop and read/write.

**application protocol name:** name of an application protocol

**asymmetric link:** link with transmission characteristics which are different depending upon the relative position or design characteristics of the transmitter and the receiver of data on the link

NOTE: For instance, the range of one transmitter may be much higher than the range of another transmitter on the same medium see IETF RFC 3753 [12].

**autonomous:** entity capable of piloting itself based on sensory input and pre-defined behaviours, including collision avoidance, speed limits and geographical constraints

NOTE 1: Used in the context of communications pertaining to an autonomous drone or vehicle in the present document.

NOTE 2: However, a remote piloting capability may be provided via a network to which the vehicle is able to communicate with.

**autonomous drone:** autonomous vehicle with no human operator on-board

NOTE: The distinction between a 'drone' and an 'autonomous drone' is that in the case of an 'autonomous drone', the vehicle is piloted through on-board sensor processing, and optionally, and less frequently remote control 'managed by' a human operator. Where: the term 'managed by' indicates that the human operator may be actively monitoring the vehicle's progress, and taking control manually on an event triggered basis, as necessary; or delegating the remote control to a computing process.

**autonomous vehicle:** vehicle capable of piloting itself, that also has a human operator on-board

NOTE 1: The distinction between an 'autonomous vehicle' and an 'autonomous drone' is the presence of a human operator in the vehicle.

NOTE 2: The 'autonomous vehicle' is piloted through a combination of on-vehicle sensor readings, which are processed to determine action, and optional interjection from a human operator. An example of this kind of situation is when there is a 'self-driving car' with a human passenger on-board who is capable of piloting the car.

**backhaul:** transmission system between a base station entity and the cellular core network or Non-Access Stratum

**binding a name to an object:** function,  $F_n(M_{NS})$ , that defines the mapping of elements of  $NS$ (namespace) to elements of  $M$ (object)

NOTE 1: The result of this function is called a *binding*. e.g. In LISP, the binding operation is called mapping.

NOTE 2: For example,  $\langle ID1, RLOC1 \rangle$  is the mapping of  $ID1="identity1"$  to  $RLOC1="an\ ip\ address\ or\ any\ other\ form\ of\ addressing"$ .

**care-of-address:** IP address associated with a mobile node while visiting a foreign link; the subnet prefix of this IP address is a foreign subnet prefix

NOTE: A packet addressed to the mobile node which arrives at the mobile node's home network when the mobile node is away from home and has registered a Care-of Address will be forwarded to that address by the Home Agent in the home network see IETF RFC 3753 [12].

**centralized mobility management:** makes use of centrally deployed mobility anchors

NOTE: Please see IETF RFC 7333 [13].

**compound connection:** connection that includes logical connectivity to more than one access network at a time

**congestion avoidance:** mechanism that operates the network at the knee of the congestion or response time (or delay) curve to optimize the trade-off between response time and throughput

**congestion 'cliff':** congestion point of the response time (or delay) curve at which a session collapses

**congestion control:** control scheme that manages packet congestion, by constantly testing the congestion level that causes the network communications to collapse and responds by introducing packet loss to reduce the load during periods of congestion so that the network can recover to an uncongested state

NOTE 1: The congestion level that causes the network to collapse is often referred to as the 'congestion cliff' because the curve of throughput versus load, becomes very steep beyond this congestion level.

NOTE 2: Addresses the "social" problem of having various logical links in a network cooperate in order to avoid and/ or recover from congestion of the intermediate nodes that they share.

**congestion 'knee':** congestion point of the response time (or delay) curve at which as session begins to notably deteriorate

**connected vehicle:** vehicle connected to one or more communications networks and piloted by a human operator

NOTE 1: The network will allow the vehicle to share data with other connected vehicles and remote servers.

NOTE 2: A Connected vehicle does not need to be autonomous, but is network connected for purposes of assisted navigation, environmental updates, vehicle analysis, infotainment etc.

**connection:** shared state between EFCPM-instances

NOTE: See ISO/IEC 7498-1 [6].

**C-RAN:** Cloud RAN where the physical radio part of a base station termed the RRU has been remoted from its base band equipment termed the BBU via 'fronthaul' transmission and the BBU part connects the composite RAN equipment to the cellular core via 'backhaul'

NOTE: Often multiple RRU communicate with a single BBU to effect RAN optimization at the BBU level across a number of Cells provided by the RRH.

**data transfer protocol, machine dtp(m):** half of the EFCP that performs tightly bound mechanisms, such as ordering, and fragmentation/reassembly

NOTE: One instantiation is created for each flow allocated, see ISO/IEC 7498-1 [6].

**Data Transfer Control Protocol, Machine DTCP(M):** half of the EFCP that performs loosely bound (feedback) mechanisms, such as retransmission and flow control

NOTE: This protocol maintains state, which is discarded after long periods of no traffic (2MPL). One instantiation is created for each flow requiring either flow control or retransmission control. See ISO/IEC 7498-1 [6].

**distance vector:** characteristic of some routing protocols in which, for each desired destination, a node maintains information about the distance to that destination, and a vector (next hop) towards that destination

NOTE: See IETF RFC 3753 [12].

**distributed application:** collection of cooperating APs that exchange information using IPC and maintain shared state

**distributed mobility management:** not centralized, so that traffic does not need to traverse centrally deployed mobility anchors far from the optimal route

NOTE: See IETF RFC 7333 [13].

**drone:** powered vehicle remotely controlled by a human operator

NOTE: To distinguish these entities from radio-controlled planes or cars used by hobbyists, the drone should be a client and/or server of data towards a network: for example, it may send video or sensor readings, or be sent images of objects it will aim to detect in its environment.

**D-RAN:** traditional RAN where the physical radio part of a base station and its base band equipment are co-located at the base station cell site and connected to the rest of the cellular network with 'backhaul' transmission

**dual connectivity:** mechanism whereby a device can access multiple cells/access points at the same time to bond multiple single cell/access point capabilities together to increase available throughput

**Endpoint ID (EID):** in LISP binding operation and is called a mapping

NOTE: For example <ID1, RLOC1> is the mapping of ID1="identity1" to RLOC1="an IP address or any other form of addressing", see IETF RFC 6830 [4], [14] and [15].

**Error and Flow Control Protocol (EFCP):** data transfer protocol required to maintain an instance of IPC within a layer characterized by modifying state internal to the protocol

NOTE: The functions of this protocol may ensure reliability, order, and flow control as required.

**Error and Flow Control Protocol Machine (EFCPM):** task that instantiates an instance of the EFCP for a single flow or connection

NOTE: An EFCPM consists of two state machines loosely coupled through a single state vector: one that performs the tightly bound mechanisms, referred to as the Data Transfer PM; and the other that performs the loosely coupled mechanisms, referred to as the Data Transfer Control PM, see ISO/IEC 7498-1 [6].

**flooding:** process of delivering data or control messages to every node within the network under consideration

NOTE: See IETF RFC 3753 [12].

**flow control:** often referred to as ETE Flow control, see definition in ETSI TR 121 905 [i.3]

**front-haul:** transmission between separated component parts of a traditional base station when it has been functionally split into at least 2 parts and those parts are remote from each other

**function chaining:** virtual inter-connection of VNFs to form a NS

**graph:** ordered pair  $G = (V, E)$  comprising a set  $V$  of vertices or nodes or points together with a set  $E$  of edges or arcs or lines, which are 2-element subsets of  $V$

NOTE: I.e. an edge is related with two vertices, and the relation is represented as an unordered pair of the vertices with respect to the particular edge).

**grouping service slice:** service chain built to render support for a virtual service offering according to a defined subscriber grouping

NOTE: See 3GPP TR 23.799 [i.2] for further information on the 3GPP ongoing definition of Network Slicing.

**handover:** process by which an active Mobile Node (in the Active State) changes its point of attachment to the network, or when such a change is attempted

NOTE: The access network may provide features to minimize the interruption to sessions in progress. This procedure is also called hand-off. See IETF RFC 3753 [12].

**home address:** IP address assigned to a mobile node, used as the permanent address of the mobile node

NOTE: This address is within the mobile node's home link. Standard IP routing mechanisms will deliver packets destined for a mobile node's home address to its home link. See IETF RFC 3753 [12].

**Hybrid RAN (H-RAN):** optimized form of RAN using concepts from both C-RAN and D-RAN

**identifier:** series of digits, characters and symbols or any other form of data used to identify subscriber(s), user(s), network element(s), function(s), network entity(ies) providing services/applications, or other entities (e.g. physical or logical objects)

NOTE: See Recommendation ITU-T Y.2720 [3].

**identity:** information about an entity that is sufficient to identify that entity in a particular context

NOTE: See Recommendation ITU-T Y.2720 [3].

**Instance Identifier (IID):** used to define extended forms of EID as a multi-tuple value

NOTE: Where (IID, EID) is one example of an extended EID, see IETF RFC 6830 [4].

**IoT(mobileS):** mobile capable IoT device with one or more sensors