ETSI GS F5G 023 V1.1.1 (2024-09)

Fifth Generation Fixed Network (F5G); F5G Advanced Technology Requirements and Gap Analyses; Release 3

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Foreword

This Group Specification (GS) has been produced by ETSI Industry Specification Group (ISG) Fifth Generation Fixed Network (F5G).

Modal verbs terminology

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1 Scope

The present document specifies the technology requirements for F5G-A use cases release 3 and explores existing technologies from related SDOs. The present document performs gap analyses between the technologies required by the use cases and those that are available. The identification of the relevant SDOs is based on their existing projects.

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.

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

[1] Recommendation ITU-T G.709/Y.1331: "Interfaces for the optical transport network".

[2] Recommendation ITU-T G.709.20: "Overview of fine grain OTN".

[3] ETSI GS F5G 014: "Fifth Generation Fixed Network (F5G); F5G Network Architecture Release 2".

[4] IEEE 802.11k™: "IEEE Standard for Information technology -- Local and metropolitan area networks-- Specific requirements-- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 1: Radio Resource Measurement of Wireless LANs".

[5] IEEE 802.11v™: "IEEE Standard for Information technology -- Local and metropolitan area networks-- Specific requirements-- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 8: IEEE 802.11 Wireless Network Management".

[6] IEEE 802.11r™: "IEEE Standard for Information technology -- Local and metropolitan area networks-- Specific requirements-- Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 2: Fast Basic Service Set (BSS) Transition".

[7] Recommendation ITU-T G.9940 (2023): "High speed fibre-based in-premises transceivers - system architecture".

[8] Recommendation ITU-T G.9941 (2024): "High speed fibre-based in-premises transceivers - physical layer specification".

[9] Recommendation ITU-T G.9942 (2024): "High speed fibre-based in-premises transceivers - Data link layer".

[10] Recommendation ITU-T G.988 (2022): "ONU management and control interface (OMCI) specification".

[11] ETSI GS F5G 013: "Fifth Generation Fixed Network (F5G); F5G Technology Landscape Release 2".

[12] Recommendation ITU-T G.709.1: "Flexible OTN common elements", consented in the ITU-T SG15 Plenary Meeting, 20 November - 1 December, 2023.

[13] Recommendation ITU-T G.709.3: "Flexible OTN B100G long-reach interfaces".

[14] Recommendation ITU-T G.709.5: "Flexible OTN short-reach interfaces".

[15] Recommendation ITU-T G.709.6: "Flexible OTN B400G long-reach interfaces".

[16] Recommendation ITU-T G.872: "Architecture of the optical transport network".

[17] IEEE P2893™-2023: "IEEE Approved Draft Standard for Flexible Optical Service Unit (OSUFlex) of Optical Transport Network (OTN) in Power Systems", published, 14 July, 2023.

[18] Recommendation ITU-T G.823: "The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy.

[19] Recommendation ITU-T G.825: "The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH).

[20] Recommendation ITU-T G.874 (2020.10): "Management aspects of optical transport network elements".

[21] ETSI GS F5G 015 (V1.2.1): "Fifth Generation Fixed Network (F5G); F5G Residential Services Quality Evaluation and Classification Release 2".

[22] ETSI GS F5G 017 (V1.1.1): "Fifth Generation Fixed Network (F5G); F5G Measurement Specification for Residential Services Quality Evaluation".

[23] ETSI GS F5G 026 (V1.1.1): "Fifth Generation Fixed Network (F5G); Architecture and data models for residential service quality monitoring".

[24] ISO/IEC 14496-10:2022: "Information technology -- Coding of audio-visual objects -- Part 10: Advanced video coding".

[25] Recommendation ITU-T G.698.2: "Amplified multichannel dense wavelength division multiplexing applications with single channel optical interfaces".

[26] IEEE 802.3™-2022: "IEEE standards for Ethernet".

[27] OIF-400ZR-01.0 March 10th 2020: "Implementation Agreement 400ZR".

[28] IEEE 802.3ct™-2021: "IEEE Standard for Ethernet Amendment 13: Physical Layers and Management Parameters for 100 Gb/s Operation over DWDM Systems".

[29] Recommendation ITU-T G.672: "Characteristics of multi-degree reconfigurable optical add/drop multiplexers".

[30] Recommendation ITU-T G.7044/Y.1347: "Hitless adjustment of ODUflex (GFP)".

[31] Recommendation ITU-T G.698.4 (2023): "Multichannel bi-directional DWDM applications with port agnostic single-channel optical interfaces".

[32] ETSI GS F5G 006: "Fifth Generation Fixed Network (F5G); End-to-End Management and Control; Release #1".

[33] IEEE 802.3df™-2024: "IEEE Standard for Ethernet Amendment 9: Media Access Control Parameters for 800 Gb/s and Physical Layers and Management Parameters for 400 Gb/s and 800 Gb/s Operation".

[34] Recommendation ITU-T G.9804.3: "50-Gigabit-capable passive optical networks (50G-PON): Physical media dependent (PMD) layer specification".

[35] Recommendation ITU-T G.987 series: "10-Gigabit-capable passive optical networks (XG-PON)".

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] ETSI GR F5G 020 (V1.1.1): "Fifth Generation Fixed Network (F5G); F5G Advanced Use Cases; Release 3".

[i.2] IETF RFC 3945: "Generalized Multi-Protocol Label Switching (GMPLS) Architecture".

[i.3] IETF RFC 7138: "Traffic Engineering Extensions to OSPF for GMPLS Control of Evolving G.709 Optical Transport Networks".

[i.4] IETF RFC 7139: "GMPLS Signalling Extensions for Control of Evolving G.709 Optical Transport Networks".

[i.5] IETF RFC 9376: "Applicability of GMPLS for beyond 100 Gbit/s Optical Transport Network".

[i.6] draft-ietf-ccamp-otn-topo-yang: "A YANG Data Model for Optical Transport Network Topology".

[i.7] draft-ietf-ccamp-otn-tunnel-model: "OTN Tunnel YANG Model".

[i.8] draft-ietf-ccamp-otn-path-computation-yang: "A YANG Data Model for requesting Path Computation in an Optical Transport Network (OTN)".

[i.9] draft-ietf-ccamp-l1csm-yang: "A YANG Data Model for L1 Connectivity Service Model (L1CSM)".

[i.10] draft-ietf-ccamp-client-signal-yang: "A YANG Data Model for Transport Network Client Signals.

[i.11] ITU-T draft G.9943: "High speed fibre-based in-premises transceivers - management".

[i.12] ITU-T draft G.wmci: "WLAN management control interface (WMCI) for in-premises network".

[i.13] IEEE 802.11bn™: "IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks--Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment: Enhancements for Ultra High Reliability".

[i.14] BBF oneM2M TR-069: "CPE WAN Management Protocol (CWMP)".

[i.15] BBF oneM2M TR-369: "User Services Platform (USP)".

[i.16] ITU-T draft G.dfos: "Distributed fibre optic sensing".

[i.17] ITU-T draft G.Sup.CMAFP: "Coordinated management of access and fibre on premises networks".

[i.18] ETSI DGS/F5G-0025: "Fifth Generation Fixed Network (F5G); Architecture of computing collaboration in PON network".

[i.19] IETF draft-gstk-ccamp-actn-optical-transport-mgmt: "Integrating YANG Configuration and Management into an Abstraction and Control of TE Networks (ACTN) System for Optical Networks".

[i.20] BBF oneM2M TR-383: "Common YANG Modules for Access Networks".

[i.21] BBF oneM2M TR-385: "ITU-T PON YANG Modules".

[i.22] WT-411i2: "Definition of interfaces between Cloud CO Functional Modules".

[i.23] WT-454i2: "YANG Modules for Network Map & Equipment Inventory".

[i.24] ETSI GR F5G 021 (V1.1.1): "Fifth Generation Fixed Network (F5G); F5G Advanced Generation Definition".

[i.25] IEEE 802.11ad™: "Telecommunications and Information Exchange between Systems Local and metropolitan area networks--Specific requirements-Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 3: Enhancements for Very High Throughput in the 60 GHz Band".

[i.26] IEEE 802.11aj™: "Telecommunications and Information Exchange between Systems Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 3: Enhancements for Very High Throughput to Support Chinese Millimetre Wave Frequency Bands (60 GHz and 45 GHz)".

[i.27] IEEE 802.11ay™: "Telecommunications and Information Exchange between Systems Local and Metropolitan Area Networks--Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment 2: Enhanced Throughput for Operation in License-exempt Bands above 45 GHz".

[i.28] ITU-T draft G.vhsp: "Very High Speed PON".

[i.29] IEEE 802.3bq™-2024: "IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks--Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications Amendment: Enhancements for Integrated mmWave (IMMW) WLAN".

[i.30] IEEE 802.3cw™-2021: "IEEE standards for 400Gbps over DWDM System". Editor's Note: this is reference is to the IEEE task force.

[i.31] IEEE 802.3dj™-2021: "IEEE standards for 200Gbps, 400Gbps, 800Gbps, 1.6Gbps Ethernet.

[i.32] ROS: "Robot Operating System".

[i.33] Object Management Group (OMG): "Data Distribution Service (DDS) Version 1.4", April 2014.

[i.34] The Linux® Foundation Projects CAMARA website.

NOTE: Linux® is the registered trademark of Linus Torvalds in the U.S. and other countries.

[i.35] ETSI GS F5G 011 (V1.1.1): "Fifth Generation Fixed Network (F5G); Telemetry Framework and Requirements for Access Networks".

[i.36] Recommendation ITU-T G.808.4: "Linear protection for fine grain Metro Transport Network (fgMTN) and fine grain Optical Transport Network (fgOTN)".

[i.37] ITU-T Recommendation G.798 Amendment 1: "Characteristics of optical transport network hierarchy equipment functional blocks".

[i.38] ITU-T Recommendation G.8251 Amendment 1: "The control of jitter and wander within the optical transport network (OTN)".

3 Definition of terms, symbols and abbreviations

3.1 Terms

Void.

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ACTN	Abstraction and Control of Traffic Engineering Networks
AFC	Automatic Fare Collection
AGGN	Aggregation Network
AI	Artificial Intelligence
AP	Access Point
API	Application Programming Interface
BBF	BroadBand Forum
BE	Best Effort
BK	Background
BSS	Basic Service Set
BSSID	Basic Service Set ID
CBR	Constant Bit Rate
CCSA	China Communications Standards Association
CPE	Customer Premise Equipment
CPN	Customer Premise Network
CPU	Central Processing Unit
DBA	Dynamic Bandwidth Allocation
DC	Data Centre
DCI	Data Centre Interconnect
DCPS	Data-Centric Publish-Subscribe
DDS	Data Distribution Service
DFOS	Distributed Fibre Optic Sensing
DL	Data Link
DLL	Data Link Layer
DR	Disaster Recovery
DWDM	Dense Wavelength Division Multiplexing
E2E	End To End
EMF	Equipment Management Function
EML	Element Management Layer
E-ONU	Edge ONU
FCAPS	Fault, Configuration, Accounting, Performance and Security
fgODU	fine grain Optical Data Unit
fgOTN	fine grain Optical Transport Network
FMCI	Fibre Management & Control Interface
FOADM	Fixed Optical Add/Drop Multiplexer
FTTR	Fibre to the Room
FTTx	Fibre To The (x = Room, Home, Machine, Office
GE	Gigabit Ethernet
GIS	Geographic Information System
GMP	Generic Mapping Procedure
GMPLS	Generalized Multi-Protocol Label Switching
GPON	Gigabit Passive Optical Network
GPU	Graphics Processing Unit
HDMI	High-Definition Multimedia Interface
ID	Identification
IMMW	Integrate mmWave
IMP	Idle Mapping Procedure
IoT	Internet of Things
IP	Internet Protocol
IPTV	Internet Protocol Television
KQI	Key Quality Indicators
L2	Layer 2
LAN	Local Area Network

LR/ZR	Long Range / Data Rate optic series
M&C	Management and Control
MAC	Medium Access Control
MD-ROADM	Multi-Dimensional Reconfigurable Optical Add/Drop Multiplexer
ME	Management Entities
M-FTR	G.fin transceiver in the Main Fibre Unit
MFU	Main FTTR Unit
MGWS	Multiple Gigabit Wireless System
MIMO	Multiple Input Multiple Output
MMW	mmWave
MOS	Mean Opinion Score
MPEG	Moving Pictures Experts Group
MSOTN	Multi-Service OTN
MSTP	Multi-Service Transport Platform
NaaS	Network as a Service
NAS	Network Attached Storage
NE	Network Element
NPU	Network Processing Unit
NTP	Network Time Protocol
O&M	Operation and Maintenance
OADM	Optical Add/Drop Multiplexer
OAM	Operation Administration and Maintenance
ODN	Optical Distribution Network
ODUk	Optical Data Unit k =0, 1, 2, 3, 4, flex
OFDM	Orthogonal Frequency Division Multiplexing
OIF	Optical Internetworking Forum
OLT	Optical Line Termination
OMCI	Optical Management and Control Interface
ONU	Optical Network Unit
ONU/AP	Optical Network Unit / Access Point
OPEX	Operational expense
OPGW	Optical Ground Wire
OS	Operating System
OSNR	Optical Signal to Noise Ratio
OSPF	Open Short Path First
OSU	Optical Service Unit
OSUFlex	Flexible Optical Service Unit
OTN	Optical Transport Network
OXC	Optical Cross Connect
P2MP	Point to MultiPoint
P2P	Peer-to-Peer
PCM	Pulse Code Modulation
PCS	Physical Coding Sublayer
PDH	Plesiochronous Digital Hierarchy
PHY	PHYsical (as in physical layer of a protocol)
PIS	Passenger Information System
PKT	Packet
PLOAM	Physical Layer Operation Administration and Maintenance
PMA	Physical Medium Attachment sublayer
PMD	Physical Medium Dependent sublayer
PON	Passive Optical Network
P-ONU	Primary ONU
QAM	Quadrature Amplitude Modulation
QoD	Quality on Demand
QoE	Quality of Experience
QoS	Quality of Service
RaaS	Robotics as a Service
RF	Radio Frequency
ROADM	Reconfigurable Optical Add/Drop Multiplexer
ROS	Robotics Operating System
RTT	Round Trip Time
RUC	Requirement Use csae

SA	Standards Association
SDH	Synchronous Digital Hierarchy
SDN	Software Defined Networking
SDO	Standards Development Organisation
S-FTR	G.fin transceiver in an Sub Fibre Unit
SFU	Sub FTTR Unit
SG	Study Group
SINR	Signal to Interference and Noise Ratio
SLA	Service Level Agreement
SME	Small Medium Enterprise
SNR	Signal to Noise Ratio
SOP	State Of Polarization
SR/DR	Short Range / Data Rate optic series
STA	Station
STM	Synchronous Transport Module
SU	Single User
TDM	Tine Division Multiplexing
TE	Traffic Engineering
TV	TeleVision
UC	Use Case
UHD	Ultra-High Definition
UHV	Ultra-High Voltage
VBR	Variable Bit Rate
VC	Virtual Container
VI	Video
VO	Voice
VoIP	Voice over Internet Protocol
VR	Virtual Reality
WDM	Wavelength Division Multiplexing
WFA	Wi-Fi® Alliance
WLAN	Wireless Local Area Network
WMCI	WLAN Management & Control Interface
WP3	Working party 3 (ITU-T - Study Group 15)
WT	Working Text
XGS	10 G Symmetric
XGSPON	10 Gigabit Symmetric Passive Optical Network
YANG	Yet Another Next Generation data modelling language

4 Technology requirements and landscape

4.1 Overview

4.1.1 Introduction

This clause is reliant on the use cases as defined in ETSI GR F5G 020 [i.1] and specifies per use case the technology requirements, describes the gaps in technology to implement those use cases and the current available related standards.

NOTE: Some clauses define requirements, standards, and gaps for several similar use cases together.

The following use cases are included in the present document, refer to ETSI GR F5G 020 [i.1] for a detailed description of the use cases. In the following, only use case titles are given for reference:

- UC#1: Premium private line service automation: clause 4.2.
- UC#2: Stable & reliable Wi-Fi® connection over on-premises networking: clause 4.3.
- UC#3: Computing collaboration in PON network: clause 4.4.
- UC#4: Intelligent power grid: clause 4.5.