

ETSI GS F5G 022 V1.1.1 (2025-01)



Fifth Generation Fixed Network (F5G); Specification for PON based Industrial Network

**(<https://standards.iteh.ai>)
Document Preview**

[ETSI GS F5G 022 V1.1.1 \(2025-01\)](https://standards.iteh.ai/catalog/standards/etsi/f2f739f3-59c2-4af8-9970-e759cbaefb15/etsi-gs-f5g-022-v1-1-1-2025-01)

<https://standards.iteh.ai/catalog/standards/etsi/f2f739f3-59c2-4af8-9970-e759cbaefb15/etsi-gs-f5g-022-v1-1-1-2025-01>

Disclaimer

The present document has been produced and approved by the Fifth Generation Fixed Network (F5G) 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/F5G-0022

Keywords

F5G, F5G Advanced, industrial, PON

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](#) repository.

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 2025.
All rights reserved.

Contents

Intellectual Property Rights	6
Foreword.....	6
Modal verbs terminology.....	6
1 Scope	7
2 References	7
2.1 Normative references	7
2.2 Informative references.....	8
3 Definition of terms, symbols and abbreviations.....	9
3.1 Terms.....	9
3.2 Symbols.....	10
3.3 Abbreviations	10
4 Overview	12
5 Industrial scenarios and requirements	12
5.1 Overview	12
5.2 Field Data Network	12
5.3 Office Network.....	13
5.4 Surveillance Network	13
6 Industrial PON system architecture.....	13
7 Key function specifications	15
7.1 Basic functions	15
7.1.1 MAC address learning & Layer 2 forwarding	15
7.1.2 Layer 2 isolation	15
7.1.3 Frame filtering	15
7.1.4 Loop detection	15
7.1.5 VLAN functions	16
7.1.6 OLT NNI link aggregation	16
7.1.7 Multi-service QoS mechanism.....	16
7.1.7.1 General requirement.....	16
7.1.7.2 Parameter configuration for Service-Level Agreement (SLA)	16
7.1.7.3 Priority tagging	16
7.1.7.4 Flow classification	16
7.2 Optional IP/Ethernet functions	16
7.2.1 IPv6 functions.....	16
7.2.2 VxLAN functions	17
7.3 Network slicing	18
7.3.1 General requirements.....	18
7.3.2 Ethernet related functions	18
7.3.3 VLAN functions	18
7.3.4 QoS functions	18
7.3.5 Network slicing management	18
7.4 Deterministic networking.....	19
7.4.1 General introduction	19
7.4.2 Cooperation between PON and industrial devices.....	19
7.4.3 Single-frame multi-burst.....	19
7.4.4 Quiet window opening management	20
7.4.4.1 Disabling of quiet window opening	20
7.4.4.2 Adaptive quiet window opening	20
7.4.4.3 Dedicated activation wavelength	21
7.4.5 Other deterministic networking functions.....	21
7.4.5.1 TSN Capability Support.....	21
7.4.5.2 Interoperability under Mixed Deployment.....	21
7.5 Network resilience.....	22

7.5.1	Optical link protection switching requirements	22
7.5.1.1	General functional requirements for optical link protection switching	22
7.5.1.2	Optical link protection switching type	22
7.5.1.3	Switchback mechanisms	23
7.5.2	Device protection switching requirements	23
7.5.2.1	OLT core switch card 1+1 redundancy	23
7.5.2.2	OLT uplink port dual-homing protection	23
7.5.2.3	Configuration restoration	24
7.5.2.4	OLT power redundancy	24
7.6	Security functions	24
7.6.1	Access security	24
7.6.1.1	ONU access authentication	24
7.6.1.2	Authentication and authorization in management plane	24
7.6.2	Data security	25
7.6.2.1	Data encryption	25
7.6.2.2	Data isolation	25
7.7	Edge computing	25
7.7.1	OLT-side infrastructure capabilities to support edge computing	25
7.7.2	ONU-side integrated industrial data collection capability requirements	26
7.8	Interfaces and industrial protocol adaptations	26
7.8.1	Interfaces on the OLT side	26
7.8.2	Interfaces on the ONU side	26
7.8.3	Industrial protocol adaptations	26
7.9	Environmental adaption related functions	27
8	Performance specifications	27
8.1	PON and Ethernet related performance	27
8.1.1	Ethernet-related functions	27
8.1.2	Support on Jumbo Frames	27
8.1.3	Link Aggregation in the OLT uplink	27
8.1.4	VxLAN Functionality Requirements	28
8.2	Network slicing performance	28
8.2.1	General performance requirements	28
8.2.2	MAC Address Learning	28
8.2.3	Link Aggregation	28
8.3	Deterministic performance	29
8.3.1	Requirements for transmission latency	29
8.3.1.1	North-to-south latency	29
8.3.1.2	East-to-west latency	29
8.3.2	Requirements for transmission jitter	30
8.4	Network protection switch performance	30
8.5	Environmental adaption	30
8.5.1	Temperature	30
8.5.2	Water/dust resistance	31
8.5.3	Humidity	31
8.5.4	Electromagnetic Compatibility (EMC)	31
8.6	Edge computing	31
8.6.1	OLT side	31
8.6.2	ONU side	32
9	Management and provisioning specifications	32
9.1	Management protocols	32
9.2	Local management and provisioning	33
9.3	Remote management and provisioning	33
9.4	Configuration and delivery	33
9.4.1	General description	33
9.4.2	Field Data Network and surveillance network requirements	34
9.4.3	Office Network Requirements	34
10	Conclusion	34
Annex A (informative): Cooperation between PON and industrial devices		35

A.1	Introduction	35
A.2	Typical implementation details	35
Annex B (informative):	Calculating effective upstream throughput from single-frame multi-burst values.....	37
B.1	Introduction	37
B.2	GPON scenario.....	37
B.3	XGS-PON scenario	38
History	40

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 V S I . F 1 5 . G 1 (2 0 2 5 - 0 1)
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 IPR online database](#).

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™**, **LTE™** and **5G™** logo 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) Fifth Generation Fixed Network (F5G).

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 present document specifies the network architecture, functional requirements, performance requirements, management and provisioning specifications for PON based industrial networks deployed in typical industrial application scenarios, and satisfies the requirements from industrial services.

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 in the [ETSI docbox](#).

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] [ETSI GS F5G 013](#): "Fifth Generation Fixed Network (F5G); F5G Technology Landscape Release 2".
- [2] [ETSI GS F5G 024](#): "Fifth Generation Fixed Network (F5G); F5G Advanced Network Architecture Release 3".
- [3] [IEC 61158](#): "Industrial communication networks - Fieldbus specifications".
- [4] [IEEE 802.3asTM-2006](#): "IEEE Standard for Information technology -- Telecommunications and information exchange between systems -- Local and metropolitan area networks -- Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications".
- [5] [IEEE 802.1QTM-2018](#): "IEEE Standard for Local and Metropolitan Area Networks -- Bridges and Bridged Networks".
- [6] [IEEE 802.1adTM-2005](#): "IEEE Standard for Local and Metropolitan Area Networks -- Virtual Bridged Local Area Networks -- Amendment 4: Provider Bridges".
- [7] [Recommendation ITU-T Y.1291 \(2004\)](#): "An architectural framework for support of Quality of Service in packet networks".
- [8] [IEEE 802.1DTM-2004](#): "IEEE Standard for Local and metropolitan area networks: Media Access Control (MAC) Bridges".
- [9] [IETF RFC 7348](#): "Virtual eXtensible Local Area Network (VXLAN): A Framework for Overlaying Virtualized Layer 2 Networks over Layer 3 Networks".
- [10] [IEEE 802.3adTM-2000](#): "IEEE Standard for Information Technology -- Local and Metropolitan Area Networks -- Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications-Aggregation of Multiple Link Segments".
- [11] [Recommendation ITU-T G.9807.1 Amendment 2 \(2020\)](#): "10-Gigabit-capable symmetric passive optical network (XGS-PON)".
- [12] [Recommendation ITU-T G.987.1 \(2016\)](#): "10-Gigabit-capable passive optical networks (XG-PON): General requirements".

- [13] [IEEE 802.1QciTM-2017](#): "IEEE Standard for Local and metropolitan area networks -- Bridges and Bridged Networks -- Amendment 28: Per-Stream Filtering and Policing".
- [14] [Recommendation ITU-T G.983.5](#): "A broadband optical access system with enhanced survivability".
- [15] [IEEE 802.3afTM-2003](#): "IEEE Standard for Information Technology -- Local and Metropolitan Area Networks -- Specific Requirements -- Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications -- Data Terminal Equipment (DTE) Power Via Media Dependent Interface (MDI)".
- [16] [IEEE 802.3afTM-2009](#): "IEEE Standard for Information technology -- Local and metropolitan area networks -- Specific requirements -- Part 3: CSMA/CD Access Method and Physical Layer Specifications Amendment 3: Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) Enhancements".
- [17] [IEEE 802.3btTM-2018 IEEE](#): "Standard for Ethernet Amendment 2: Physical Layer and Management Parameters for Power over Ethernet over 4 pairs".
- [18] [IEC 60529](#): "Degrees of protection provided by enclosures (IP Code)".
- [19] [IEC 61000-4-2:2008](#): "Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test".
- [20] [Recommendation ITU-T G.988](#): "ONU management and control interface (OMCI) specification".
- [21] [IETF RFC 6241](#): "Network Configuration Protocol (NETCONF)".
- [22] [ISO/IEC 20922:2016](#): "Information technology — Message Queuing Telemetry Transport (MQTT) v3.1.1".
- [23] [IEEE 802.3TM-2018](#): "IEEE Standard for Ethernet".
- [24] [IETF RFC 4789 \(2006\)](#): "Simple network management protocol (SNMP) over IEEE 802 networks".
- [25] [IEEE 802.1XTM-2020](#): "IEEE Standard for Local and Metropolitan Area Networks -- Port-Based Network Access Control".

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 001: "Fifth Generation Fixed Network (F5G); F5G Generation Definition Release #1".
- [i.2] ETSI GR F5G 007 (V1.1.1): "Fifth Generation Fixed Network (F5G); F5G Industrial PON".
- [i.3] ETSI GR F5G 008 (V1.1.1): "Fifth Generation Fixed Network (F5G); F5G Use Cases Release #2".
- [i.4] IETF RFC 8040: "RESTCONF Protocol".
- [i.5] Recommendation ITU-T G.Sup51 (06/17): "Passive optical network protection considerations".
- [i.6] ETSI GR F5G 021: "Fifth Generation Fixed Network (F5G); F5G Advanced Generation Definition".

- [i.7] IETF RFC 4241: "A Model of IPv6/IPv4 Dual Stack Internet Access Service".
- [i.8] IETF RFC 4213: "Basic Transition Mechanisms for IPv6 Hosts and Routers".
- [i.9] IETF RFC 8305: "Happy Eyeballs Version 2: Better Connectivity Using Concurrency".
- [i.10] IETF RFC 8200: "Internet Protocol, Version 6 (IPv6) Specification".
- [i.11] IETF RFC 2474: "Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers".
- [i.12] IETF RFC 9099: "Operational Security Considerations for IPv6 Networks".
- [i.13] Recommendation ITU-T G.987.3 (2020): "10-Gigabit-capable passive optical networks (XG-PON): Transmission convergence (TC) layer specification".
- [i.14] Recommendation ITU-T G.9804.2 (2021): "Higher speed passive optical networks - Common transmission convergence layer specification".
- [i.15] Recommendation ITU-T G.Sup71: "Optical line termination capabilities for supporting cooperative dynamic bandwidth assignment".
- [i.16] Recommendation ITU-T G.984.3 (2014): "Gigabit-capable passive optical networks (G-PON): Transmission convergence layer specification".
- [i.17] Recommendation ITU-T G.984.1 (2008): "Gigabit-capable passive optical networks (GPON): General characteristics".
- [i.18] Recommendation ITU-T G.9804.1 (2019): "Higher speed passive optical networks – Requirements".
- [i.19] IEEE 802.1QbvTM-2015: "IEEE Standard for Local and metropolitan area networks -- Bridges and Bridged Networks -- Amendment 25: Enhancements for Scheduled Traffic".
- [i.20] IEEE 802.1QbuTM-2016: "IEEE Standard for Local and metropolitan area networks -- Bridges and Bridged Networks -- Amendment 26: Frame Preemption".
- [i.21] Recommendation ITU-T E.419 (2006): "Business oriented Key Performance Indicators for management of networks and services".
- [i.22] ETSI EN 300 019-1-4: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-4: Classification of environmental conditions; Stationary use at non-weather protected locations".
- [i.23] ETSI EN 300 019-2-4: "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 2-4: Specification of environmental tests; Stationary use at non-weather protected locations".

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

deterministic networking: network feature primarily in a best-effort packet network, in which the deterministic quality of service is applied to flows designated as being critical to a real-time application

field data network: network transporting factory intra-plant industrial data

NOTE: The industrial PON-based network serves as a connection and convergence network for the machines within the factory because the product line data is carried over the industrial PON-based network.

industrial environment adaptation: capability of a device to adapt to the industrial environments while maintaining an acceptable level of service

industrial protocol adaptation: capability of a device to adapt to the industrial scenarios to interpreting and/or converting a range of industrial communication protocols

network resilience: capability of a network to protect against and maintain an acceptable level of service in the presence of network failure(s)

PON slice: resource allocation and isolation mechanism in Passive Optical Networks (PON), which divides the physical PON network into multiple logically independent networks

NOTE: Each slice is configured to support the specific Service Level Agreements (SLAs), ensuring that various types of traffic are appropriately handled and isolated on a shared physical infrastructure, guaranteeing that the quality of critical applications and services is not affected.

3.2 Symbols

Void.

3.3 Abbreviations

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

10GE	10 Gbit/s Ethernet
10G-EPON	10 Gbit/s Ethernet Passive Optical Network
40GE	40 Gbit/s Ethernet
50G-PON	50 Gbit/s Passive Optical Network
100GE	100 Gbit/s Ethernet
ACL	Access Control List
AI	Artificial Intelligence
AN	Access Network
ARP	Address Resolution Protocol
BNG	Broadband Network Gateway
CAN	Controller Area Network
CLI	Command-Line Interface
CO DBA	Cooperative Dynamic Bandwidth Allocation
CPU	Central Processing Unit
CPN	Customer Premises Network
CVBS	Composite Video Baseband Signal
DA	Destination Address
DBA	Dynamic Bandwidth Allocation
DHCP	Dynamic Host Configuration Protocol
DHCPv6	Dynamic Host Configuration Protocol for IPv6
DoS	Denial of Service
DSCP	Differentiated Services Code Point
EMC	Electromagnetic Compatibility
ERP	Enterprise Resource Planning
EMS	Element Management System
EPON	Ethernet Passive Optical Network
FE	Fast Ethernet
FEC	Forward Error Correction
FP16	16-bit Floating Point
FP32	32-bit Floating Point
GE	Gigabit Ethernet
GEM	GPON Encapsulation Method
GFLOPS	Giga Floating Point Operations Per Second
GPON	Gigabit Passive Optical Network
GPU	Graphics Processing Unit
GTC	GPON Transmission Convergence
HART	Highway Addressable Remote Transducer Protocol

ID	Identifier
IGMP	Internet Group Management Protocol
IPv6	Internet Protocol version 6
IP	Internet Protocol
IPG	Inter-Packet Gap
ITU-T	International Telecommunication Union - Telecommunication Standardization Sector
LAND	Local Area Network Denial Attack
MAC	Media Access Control
MB	Megabyte
MES	Manufacturing Execution System
MLQ	Multicast Listener Query
MQTT	Message Queuing Telemetry Transport
NPU	Neural Processing Unit
NETCONF	Network Configuration Protocol
NNI	Network-to-Network Interface
OLT	Optical Line Terminal
OMCI	Optical Network Terminal Management and Control Interface
ME	Managed Entity
ONU	Optical Network Unit
ONU-ID	Optical Network Unit Identifier
OSI	Open Systems Interconnection
PLOAM	Physical Layer Operations, Administration, and Maintenance
PLC	Power Line Communication
PoE	Power over Ethernet
PPPoE	Point-to-Point Protocol over Ethernet
PRI	Primary Rate Interface
QoS	Quality of Service
RA	Router Advertisement
RESTCONF	RESTful Configuration Protocol
SA	Source Address
SAP	Service Access Point
SLA	Service-Level Agreement
SDN	Software-Defined Networking
SNI	Server Name Indication
SNMP	Simple Network Management Protocol
SPP	Service Processing Point
SSD	Solid State Drive
SYN	Synchronization
TCP	Transmission Control Protocol
T-CONT	Transmission Container
TFLOPS	Tera Floating Point Operations Per Second
TOS	Type of Service
TSN	Time-Sensitive Networking
UDP	User Datagram Protocol
UCL	User Control List
UNI	User-Network Interface
VLAN	Virtual Local Area Network
VNI	VxLAN Network Identifier
VTEP	VxLAN Tunnel End Point
VxLAN	Virtual eXtensible LAN
Wi-Fi™	Wireless Fidelity
XGEM	10 Gigabit GPON Encapsulation Method
XG-PON	10-Gigabit-capable Passive Optical Network
XGS-PON	10-Gigabit-capable Symmetric Passive Optical Network
XGTC	10 Gigabit GPON Transmission Convergence

4 Overview

Industrial networks are designed to connect and control devices, systems, machines, and other assets within the industrial environment. With digital transformation, remote control machinery and sensors are deployed to automate production, monitoring, and management. Industrial networks are incorporate facilities related to the Industrial business including R&D centres, warehouses, administrative offices and customer service branches.

Industrial PON, is inheriting a mature PON technology from the residential access network, and enhancing it to include functions required by the industrial customers. Industrial PON shall support high quality connectivity for communication between sensors, devices, machines, and people within the industrial parks.

NOTE: For more detailed description of PON based industrial network see ETSI GR F5G 001 [i.1], ETSI GS F5G 013 [1], ETSI GR F5G 007 [i.2] and ETSI GR F5G 021 [i.6].

The present document describes the typical industrial PON deployment scenarios, encompassing the architecture, the key industrial functions and the interfaces of the industrial PON system. The PON based industrial network architecture includes the management system, the OLTs, and ONUs used in industrial scenarios. PON based industrial network shall comply with the industrial environmental recommendations.

In the present document, the network architecture, the functional requirements, the performance requirements, the management and provisioning specifications for PON based industrial networks are specified.

5 Industrial scenarios and requirements

5.1 Overview

There are three deployment scenarios for PON based industrial networks, as described in ETSI GR F5G 007 [i.2] (Industrial PON) and in ETSI GR F5G 008 [i.3] (Use Cases Release #2), namely:

- 1) The field data network which is primarily in the industrial environment.
- 2) The office network including sales, marketing, finance and managerial staff areas.
- 3) The surveillance network including internal and external video surveillance and sensors.

PON based industrial networks shall support the above three sub-networks within a single network infrastructure. Network slicing is essential for the isolation of these sub-networks.

Smart network monitoring and management functions based on NETCONF/YANG and telemetry technology are needed for smart operation and rapid service configuration in the PON based industrial networks.

5.2 Field Data Network

The primary application in PON based industrial networks is transport factory intra-plant industrial services. PON serves as a connection and convergence network for the machines within the factory.

There are several industrial field level interfaces and protocols defined in the IEC 61158 series [3]. Therefore, the ONUs in the industrial network need to be equipped with the corresponding physical interfaces and the built-in protocol-related functions, or provide connectivity to existing industrial gateways, to support the communications between the Power Line Communication (PLC), other industrial gateways, and production management systems. Deterministic network transmission and high service availability are required for these field data network scenarios. The PON based industrial network integrated with deterministic networking functions, shall support the configuration of bounded transmission times, and various network protection schemes for the differential network resilience scenarios.