

**DOCSIS INTERFACE
SPECIFICATIONS
ON WYRE NETWORK**

Confidential

For Authorised Operators



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1. Introduction

The current document is provided to Wholesale Customers active on the Wyre HFC network following the BIPT Decision of 26 September 2023 regarding the identification of the network termination point for broadband services and TV services.

The current document only provides the interface specifications for the Wyre HFC network at the dedicated data RF interface. It is possible that following the services provided by the Wholesale Customers to the End Users additional specifications need to be added to the below specifications by the Wholesale Customers in order to comply with the obligations as mentioned in the BIPT Decision of 26 September 2023.

The BIPT Decision of 26 September 2023 is currently being appealed (Beroep van Orange Belgium tegen het besluit van de Raad van het BIPT van 26 september 2023 | BIPT). Should it appear that following the outcome of the appeal, the Decision of 26 September 2023 is annulled or needs to be amended, we preserve our rights to withdraw or amend the below specifications without prejudice.

1.1 Scope

This document describes the DOCSIS requirements for the Internet service over the Wyre HFC network at the dedicated data RF interface.

The interface specification does not apply under abnormal operating conditions such as:

- Operating conditions resulting from the use of services other than DOCSIS 3.1 over the dedicated data RF interface.
- Operating conditions arising from faults, maintenance, construction work, or efforts to minimize service interruptions.
- Operating conditions resulting from force majeure or third-party interference.
- Operating conditions during test signal injection governed by regulation.
- Instances of non-compliance with the relevant standards by a End User's installation, equipment, or technical requirements for connection, as established by this interface specification or public authorities, including the specified limits for electromagnetic compatibility.

The characteristics given in this interface specification are intended to be used to derive and specify requirements for equipment such as coaxial cables and cable modems to connect them to the dedicated data RF interface or Ethernet interface.

The values in this interface specification take precedence over requirements in equipment product standards and installation standards. The given characteristics are not intended to be used as electromagnetic compatibility levels or user emission limits in the Wyre network. This interface specification may be changed at any time and may break backward compatibility with previous versions.

1.2 Conventions

Throughout this document, the words that are used to define the significance of requirements are capitalized. These words are:

"MUST, SHALL": This word means that the item is an absolute requirement of this specification.

"MUST NOT": This phrase means that the item is an absolute prohibition of this specification.

"SHOULD": This word means that there MAY exist valid reasons in particular circumstances to ignore this item, but the full implications SHOULD be understood, and the case carefully weighed before choosing a different course.

"SHOULD NOT": This phrase means that there MAY exist valid reasons in particular circumstances. When the listed behavior is acceptable or even useful, but the full implications SHOULD be understood, and the case carefully weighed before implementing any behavior described with this label.

"MAY": This word means that this item is truly optional.

1.3 Definitions

Cable Modem (CM)	modulator-demodulator at subscriber locations intended for use in conveying data Communications on a cable television system.
Cable Modem Termination System (CMTS)	cable modem termination system, located at the cable television system headend or distribution hub, which provides complementary functionality to the cable modem to enable data connectivity to a wide-area network.
Cable Network	coaxial-based broadband access network in the form of either an all-coax or Hybrid Fiber/Coax (HFC) network.
Customer	human being or organization that accesses the network to communicate via the services provided by the network.
Downstream	in cable television, the direction of transmission from the headend to the subscriber.
Dynamic range	ratio between the greatest signal power that can be transmitted over a multichannel analogue transmission system without exceeding distortion or other performance limits, and the least signal power that can be utilized without exceeding noise, error rate or other performance limits.
Group delay	difference in transmission time between the highest and lowest of several frequencies through a device, circuit, or system.
Hybrid Fiber/Coax (HFC) system	broadband bidirectional shared-media transmission system using fiber trunks between the headend and the fiber nodes, and coaxial distribution from the fiber nodes to the customer locations.
Impulse noise	noise characterized by non-overlapping transient disturbances.
Layer	subdivision of the Open System Interconnection (OSI) architecture, constituted by subsystems of the same rank.
Mid split	frequency division scheme that allows bi-directional traffic on a single coaxial cable.
Orthogonal Frequency Division Multiplexing	method of efficiently encoding digital data on multiple carrier frequencies.
PHYsical (PHY) layer	layer 1 in the Open System Interconnection (OSI) architecture; the layer that provides services to transmit bits or groups of bits over a transmission link between open systems and which entails electrical, mechanical and handshaking procedures.
Quadrature Amplitude Modulation (QAM)	method of modulating digital signals onto a radiofrequency carrier signal involving both amplitude and phase coding.
Radio Frequency (RF)	in cable television systems, this refers to electromagnetic signals in the range 5 MHz to 1.794 GHz.
Return loss (RL)	parameter describing the attenuation of a guided wave signal (e.g. via a coaxial cable) returned to a source by a device or medium resulting from reflections of the signal generated by the source.
Terminal	equipment connected to a telecommunication network to provide access to one or more specific services

1.4 Abbreviations

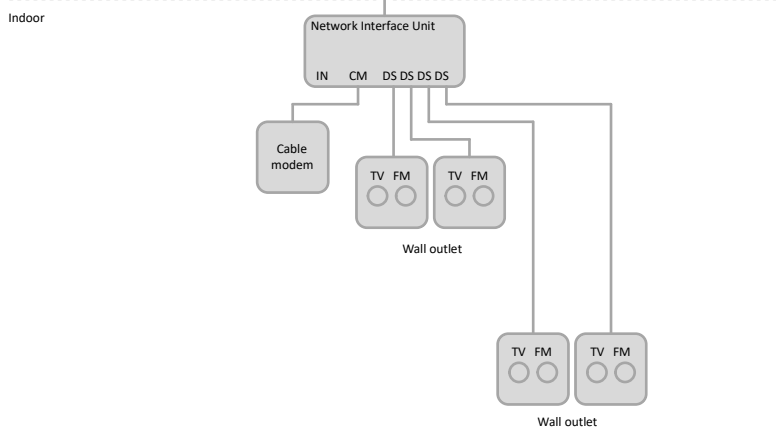
BER	Bit Error Rate
BPI+	Baseline Privacy Plus
CM	Cable Modem
CMCI	Cable Modem to CPE Interface
DHCP	Dynamic Host Configuration Protocol
DOCSIS	Data Over Cable Service Interface Specification
DS	Downstream
DS-Lite	Dual-Stack Lite
ERMI	European Retail Market Information
eRouter	embedded Router
FCC	Federal Communications Commission
FQDN	Fully Qualified Domain Name
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force/IP Internet Protocol
ITU	International Telecommunication Union
OSI	Open Systems Interconnection
MAC	Media Access Control
MER	Modulation Error Rate
MICE	Mechanical, Ingress, Climatic and Chemical, Electromagnetic
OFDM	Orthogonal Frequency-Division Multiplexing
QAM	Quadrature Amplitude Modulation
RCP	Receive Channel Profile
RF	Radio Frequency
SC	Single Carrier
SNMP	Simple Network Management Protocol
SNR	Signal to Noise Ratio
UGS	Unsolicited Grant Synchronization
US	Upstream
VAC	Volt Alternating Current
VDC	Volt Direct Current

2 Interface connectors

2.1 Demarcation point

The coax patch cable to connect the modem to the demarcation point, with either a clamp-type connector or a screw-type F-connector, needs to be certified and comply with the requirements stated in the document “Lastenkohier Wyre (Telenet-Interkabel)”. The demarcation point consists of an F connector, located on the NIU (Network Interface Unit).

Figure 1: Example of a typical installation



2.2 Modem interface description

The mechanical coaxial F connector on a modem device connected to the Wyre network must be according to the IEC 61169-24 standard as a “connector "F" type female socket (indoor)”.

3 DOCSIS 3.1 network RF characteristics

3.1 Downstream frequency range

The DOCSIS downstream frequency range according to CM-SP-PHYv3.1-I18-210125, B.6.3.2 shall be 108 to 1218MHz MHz (108 to 1794 MHz optional).

3.2 Downstream RF performance

Metric At CPE

SNR ≥ 35 dB

Rx -15 dBmV < Rx < 15 dBmV Per 8MHz SC-QAM Channel

CER 0%

3.3 Upstream frequency range

The usable Frequency Range is 15MHz to 204MHz. Nominal minimum SC US channel count is 4.

The modem MUST support a frequency switchable split (upstream/downstream) at 65/85MHz and 204MHz (diplexer).

3.4 Upstream RF-performance

The reference channel bandwidth is 6.4MHz. Nominal values are valid for 99.5 % of the time.

Metric At CPE

Tx 25 dBmV < Tx < 51 dBmV Per Channel

CER 0%

4 DOCSIS 3.1 physical interface requirements

The following table describes the DOCSIS physical interface requirements at the coaxial termination point based on and in line with CM-SP-PHYv3.1-I18-210125 (CM-SP-PHYv3.1-I18-210125.pdf).



CM-SP-PHYv3.1-I18-210125.pdf

Index		Description	relevant for IF Spec	informative	mandatory	optional
1		SCOPE				
	1.1	Introduction and Purpose	x	x		
	1.2	Background	x	x		
	1.2.1	Broadband Access Network	x	x		
	1.2.2	Network and System Architecture	x	x		
	1.2.3	Service Goals	x	x		
	1.2.4	Statement of Compatibility	x	x		
	1.2.5	Reference Architecture	x	x		
	1.2.6	DOCSIS 3.1 Documents	x	x		
	1.3	Requirements	x		x	
	1.4	Conventions	x		x	
	1.5	Organization of Document	x	x		
2		REFERENCES				
	2.1	Normative References	x	x		
	2.2	Informative References	x	x		
	2.3	Reference Acquisition	x	x		
3		TERMS AND DEFINITIONS	x		x	
4		ABBREVIATIONS AND ACRONYMS	x		x	
5		OVERVIEW AND FUNCTIONAL ASSUMPTIONS				
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	5.2	Functional Assumptions		x		
	5.2.1	Equipment Assumptions		x		
	5.2.2	RF Channel Assumptions		x		
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	6.2.2	Signal Processing Requirements	x		x	

Index		Description	relevant for IF Spec	informative	mandatory	optional
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	6.2.4	R-S Encode	x		x	
	6.2.5	Upstream R-S Frame Structure (Multiple Transmit Channel Mode Enabled)	x		x	
	6.2.6	Upstream R-S Frame Structure (Multiple Transmit Channel Mode Disabled)	x		x	
	6.2.7	TDMA Byte Interleaver	x		x	
	6.2.8	Scrambler (randomizer)	x		x	
	6.2.9	TCM Encoder		x		
	6.2.10	Preamble Prepend	x		x	
	6.2.11	Modulation Rates	x		x	
	6.2.12	S-CDMA Framer and Interleaver		x		
	6.2.13	S-CDMA Framer		x		
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	6.2.15	S-CDMA Spreader		x		
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	6.2.17	Spectral Shaping	x		x	
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	6.3.1	Downstream Protocol		x		
	6.3.2	Spectrum Format		x		
	6.3.3	Scalable Interleaving to Support Video and High-Speed Data Services		x		
	6.3.4	Downstream Frequency Plan		x		
	6.3.5	DRFI Output Electrical		x		
	6.3.6	CMTS or EQAM Clock Generation		x		
	6.3.7	Downstream Symbol Clock Jitter for Synchronous Operation		x		
	6.3.8	Downstream Symbol Clock Drift for Synchronous Operation		x		
	6.3.9	Timestamp Jitter		x		
	6.4	Downstream Receive	x		x	
	6.4.1	Downstream Protocol and Interleaving Support	x		x	
	6.4.2	Downstream Electrical Input to the CM	x		x	

Index		Description	relevant for IF Spec	informative	mandatory	optional
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	6.4.4	Downstream Multiple Receiver Capabilities	x		x	
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	7.2.2	Downstream CMTS Spectrum	x	x		
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	7.4	Upstream Transmit and Receive	x		x	
	7.4.1	Signal Processing Requirements	x		x	
	7.4.2	Time and Frequency Synchronization	x		x	
	7.4.3	Forward Error Correction	x		x	
	7.4.4	Data Randomization	x		x	
	7.4.5	Time and Frequency Interleaving and De-interleaving	x		x	
	7.4.6	Mapping of Bits to Cell Words	x		x	
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	7.4.8	REQ Messages	x		x	
	7.4.9	IDFT	x		x	
	7.4.10	Cyclic Prefix and Windowing	x		x	
	7.4.11	Burst Timing Convention	x		x	
	7.4.12	Fidelity Requirements	x		x	
	7.4.13	Cable Modem Transmitter Output Requirements	x		X	
	7.4.14	CMTS Receiver Capabilities	x	x		
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	7.5.12	Cable Modem Receiver Capabilities	x		x	
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	7.5.15	Downstream Pilot Patterns	x		x	
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Index		Description	relevant for IF Spec	informative	mandatory	optional
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	9.4.3	Upstream Impulse Noise Statistics	x	x		
	9.4.4	Upstream Equalizer Coefficients	x		x	
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	9.4.6	Upstream Histogram	x	x		
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5 DOCSIS 3.1 upper layer requirements

5.1 MAC and upper layer

Where the NVT-ASCII character set is referenced in the CableLabs DHCP Options Registry, ASCII graphics characters (hexadecimal 20 through 7E) **MUST** be used. For DOCSIS 3.1, RMVI Sub-Options **MUST** be present.

The following minimum requirements are applicable: at least 8 upstream service flows **MUST** be supported, 4 of which can be UGS-only.

The following table describes the DOCSIS MULPI interface requirements and in line with spec CM-SP-MULPIv3.1-I25-230419. (CM-SP-MULPIv3.1-I25-230419.pdf)



CM-SP-MULPIv3.1-I25-230419.pdf

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	1.2.1	Broadband Access Network	x	x		
	1.2.2	DOCSIS Network and System Architecture	x	x		
	1.2.3	Service Goals	x	x		
	1.2.4	Statement of Compatibility	x	x		
	1.2.5	Reference Architecture	x	x		
	1.2.6	DOCSIS 3.1 Documents	x	x		
	1.3	Requirements	x		x	
	1.4	Conventions	x		x	
	1.5	Organization of Document	x	x		
2		REFERENCES				
	2.1	Normative References	x		x	
	2.2	Informative References	x	x		
	2.3	Reference Acquisition	x	x		
3		TERMS AND DEFINITIONS	x		x	
4		ABBREVIATIONS AND ACRONYMS	x		x	
5		OVERVIEW AND THEORY OF OPERATIONS				
	5.1	MULPI Key Features	x	x		
	5.2	Technical Overview	x	x		
	5.2.1	CMTS and CM Models	x	x		
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Index		Description	relevant for IF Spec	informative	mandatory	optional
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	5.2.8	Enhanced Support for Timing Protocol mandatory or informative	x	x		
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	5.2.10	Relationship to the Physical HFC Plant Topology	x		x	
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6		MEDIA ACCESS CONTROL SPECIFICATION				
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	6.1.2	Definitions	x		x	
	6.1.3	Future Use	x	x		
	6.2	MAC Frame Formats	x		x	
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	6.2.3	MAC -Specific headers	x		x	
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	6.4	MAC Management Messages	x		x	
	6.4.1	MAC Management Message Header	x		x	
	6.4.2	Time Synchronization (SYNC)	x		x	
	6.4.3	Upstream Channel Descriptor (UCD)	x		x	
	6.4.4	Upstream Bandwidth Allocation Map (MAP)	x		x	
	6.4.5	Ranging Request Messages	x		x	
	6.4.6	Ranging Response (RNG-RSP)	x		x	
	6.4.7	Registration Request Messages	x		x	
	6.4.8	Registration Response Messages	x		x	
	6.4.9	Registration Acknowledge (REG-ACK)	x		x	
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	6.4.12	Dynamic Service Addition - Request (DSA-REQ)	x		x	
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Index		Description	relevant for IF Spec	informative	mandatory	optional
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		6.4.20 Dynamic Channel Change - Request (DCC-REQ)	x		x	
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		6.4.27 Downstream Channel Descriptor (DCD)	x		x	
		6.4.28 MAC Domain Descriptor (MDD)	x		x	
		6.4.29 Dynamic Bonding Change Request (DBC-REQ)	x		x	
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		6.4.31 Dynamic Bonding Change Acknowledge (DBC-ACK)	x		x	
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5.2 Security layer

The requirements defined in EuroDOCSIS BPI+ requirements MUST be accomplished in compliance with CM-SP-SECv3.1-I11-230419. Certificate requirements are defined in EuroDOCSIS BPI+. Requirements specified in this document take precedence over requirements in CM-SP-SECv3.1-I11-230419. The following table describes the DOCSIS SEC interface requirements in line with CM-SP-SECv3.1-I11-230419. (CM-SP-SECv3.1-I11-230419.pdf)



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5.3 OSS layer

Compliance with CM-SP-CM-OSSIV3.1-I25-231012 MUST be accomplished. The following table describes the DOCSIS OSSI interface requirements and in line with CM-SP-CM-OSSIV3.1-I25-231012 (CM-SP-CM-OSSIV3.1-I25-231012.pdf).



CM-SP-CM-OSSIV3.1-I25-231012.pdf

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5.4 Registration and provisioning

During registration cable modems will receive a generic configuration file. All network provided channels **MUST** be supported to achieve the maximum configurable traffic rate per network segment.

Vendor and model fields of the system descriptor (sysDescr) **MUST NOT** change during the lifetime of the product.

6 IP-addresses for devices behind the cable modem (informative)

IP-capable devices/interfaces behind the cable modem can be assigned with IP configuration in one of the three possible scenarios:

1. IPv4-only configuration – each allowed device/interface will receive a native IPv4 address and other corresponding configuration to use for inbound/outbound IPv4-based traffic
2. Dual-Stack – each allowed device/interface will receive a native IPv4 address and a global IPv6 address as well as a delegated prefix in the range of /56 to /64 to use for inbound/outbound IPv4- and IPv6-based traffic respectively.
3. Dual-Stack Lite – each allowed device/interface will receive a global IPv6 address as well as a delegated prefix in the range of /56 to /64 to use for inbound/outbound IPv6-based traffic. Also, DS-Lite configuration will be assigned to the device/interface for IPv4-based traffic.

6.1 DHCPv4

The following information **MUST** be requested by the DHCP client and will then be provided by DHCP server:

- IP-address
- Subnet mask
- Gateway address (router option)
- DNS-server

6.2 DHCPv6

The following information **MUST** be requested by the DHCP client and thus will be provided by DHCPv6

- IPv6-address
- DNS-server
- DS-Lite option (if requested see 10.3 below)
- Delegated prefix

To avoid a configuration conflict, the configuration of the router device WAN behind/in the cable modem **MUST** be done via respective DHCP and other procedures such as static configuration **MUST NOT** be used.

6.3 DS-Lite

Dual-Stack Lite is implemented according to RFC6333. The FQDN of the AFTR device is provided to the client-router according to RFC6334. DS-Lite **MUST NOT** be activated if an IPv4 public lease is obtained.

6.4 Prefix delegation

IPv6 Prefix delegation according to RFC3633 **MUST** be supported.

6.5 Multicast

If the modem contains an eRouter, IGMP/MLD proxy and IPv4/IPV6 multicast forwarding SHOULD be supported as described by CM-SP-eRouter-I21-220200.

7 L2VPN

This section provides requirements for wholesale operators using L2VPN service/technology.

The following document describes the L2VPN requirement in line with spec CM-SP-L2VPN-I16-220328 (CM-SP-L2VPN-I16-220328.pdf).



CM-SP-L2VPN-I16-2
20328.pdf

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	1.3	Conventions	x	x		
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