MSO specific interface description

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Date	Version	Author	Description
22.3.2016	0.1	AM	initial document structure
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11.9.2017	1.2	TB	company name changed
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1.   Base specifications

1.1   DOCSIS (ANGA Template)

The interface specification for the passive network termination point, the access to the DOCSIS network and the generic network and provisioning requirements are covered in the document in **Appendix A**, referred as **base specification** throughout this document.

The base specification was discussed and created in a forum under participation of several cable network operator, external consultants and cable industry experts and moderated by ANGA.

The base specification in its current form references the industry standard DOCSIS 3.0 and incorporates the relevant parts of the PHY, MULPI, OSSI and SEC specifications.

Any additions or MSO specific changes or amendments are covered in this document.

2.   Scope

This document contains MSO specific information and specifications, beyond the definitions made in the base specification, for customer owned network termination devices which can be connected and operated on the MSO network.

Any information provided in this document must be taken into account, evaluated and any technical specifications and requirements must be fulfilled to claim full compatibility of the device to the MSO network. Definitions in this document supersede definitions and assumptions made in the base specification.

The equipment vendor is liable for damages and defects and must ensure proper operation, there is no obligation by the MSO to evaluate any customer owned network termination to proof compatibility or detect malfunctions.

The MSO operates the service in Germany, so any specifications and all certificates must follow the European version or subsections in the specification documents. This especially applies to:

- DOCSIS   → Euro DOCSIS Specifications, MIBS and X.509 certificate chain
- PacketCable   → EuroPacketCable Specifications, MIBS and X.509 certificate chain

3.   MSO Name and relevant specification parts

MSO	Specification Part		Supported by MSO
Synvia	1.	Base specifications	X
Synvia	1.1	DOCSIS (ANGA Template)	X
Synvia	2.	Scope	X
Synvia	3.	MSO Name and relevant specification parts	X
Synvia	4.	Definitions, symbols and abbreviations	X
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Synvia	5.	Basic Service Definition	X
Synvia	6.	L1 Network Access	X
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Synvia	8.	IP (Internet) Services	X
Synvia	8.1	IPv4 operations	X
Synvia	8.1.1	DHCP IPv4 Operation	X
Synvia	8.1.2	PPPoE IPv4 Operation	
Synvia	8.2	IPv6 operations	X
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Synvia	12.	Safeguard clause	X

4. Definitions, symbols and abbreviations

4.1 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-Fibre/Coax (HFC) network

Carrier Hum Modulation: peak-to-peak magnitude of the amplitude distortion relative to the RF carrier signal level due to the fundamental and low-order harmonics of the power-supply frequency

Composite Second Order beat (CSO): peak of the average level of distortion products due to second-order non-linearity's in cable system equipment

Composite Triple Beat (CTB): peak of the average level of distortion components due to third-order non-linearity's in cable system equipment

customer: human being or organization that accesses the network in order 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

High Frequency (HF): Used in the present document to refer to the entire subsplit (5 MHz to 30 MHz) and extended subsplit (5 MHz to 65 MHz) band used in return channel communications over the cable television network

hum modulation: undesired modulation of the television visual carrier by the fundamental or low-order harmonics of the power supply frequency, or other low-frequency disturbances

Hybrid Fibre/Coax (HFC) system: broadband bidirectional shared-media transmission system using fibre trunks between the headend and the fibre nodes, and coaxial distribution from the fibre 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

micro-reflections: echoes in the forward transmission path due to departures from ideal amplitude and phase characteristics

mid split: frequency division scheme that allows bi-directional traffic on a single coaxial cable

passive network termination point (pNTP): customer terminal with minimum optical/electrical spacing to the CMTS

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 radio-frequency 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 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

4.2 Abbreviations

BER	Bit Error Rate
C/N or CNR	Carrier-to-Noise Ratio
CENELEC	European Commitee for Electrotechnical Standardization
CM	Cable Modem
CPE	Customer Premise Equipment
CoNT	Customer Owned Network Termination Device
CSO	Composite Second Order beat
CTB	Composite Triple Beat
DIN	Deutsches Institut für Normung
DOCSIS	Data Over Cable Service Interface Specifications
ETSI	European Telecommunications Standards Institute
FM	Frequency Modulation
HF	High Frequency
HFC	Hybrid-Fibre/Coax
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
MER	Modulation Error Ratio
MGCP	Media Gateway Control Protocol
NCS	Network Control Signalling
PER	Packet Error Rate
POTS	Plain old telephony service
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase-Shift Keying
RF	Radio Frequency
pNTP	passive Network Termination Point
SIP	Session Initiation Protocol
TI	Terminal Input
SNR	Signal to Noise Ratio
MIB	Management Information Base
RFC	Request for Comment
MSO	Multiple Service Operator
L[1-7]	OSI Layer [1-7]

5. Basic Service Definition

The MSO grants network access to compatible devices which are following the MSO Interface specification. The customer will be able to use the following services, which are referenced as basic services throughout this document:

- L1 Network Access

- L2 Network Access

- IP (Internet) Service

- Voice Service

6. L1 Network Access

The CoNT must be capable of bonding a minimum number of downstream and upstream channels. Those minimum requirements are

Bandwidth	0 – 200 Mbit/s	8 SC QAM	Downstream
Bandwidth	200 – 400 Mbit/s	16 SC QAM	Downstream
Bandwidth	0 – 20 Mbit/s	4 Channels	Upstream

Minimum channel requirements for bandwidths beyond the previously shown limits are calculated with the following formula :

# of SC QAM x 50 Mbit/s = achievable bandwidth downstream

Vendors may offer CoNT with higher bonding capabilities in downstream and upstream direction.

7. L2 network access

The L2 network access is entirely covered in the base specification

8. IP (Internet) Services

The following section provides information regarding the IP and Internet Services which will be provided by the MSO. The following definition is set:

- IPv4 support is mandatory

- IPv6 support is mandatory

- DS-lite support is mandatory

The specification only references RFC's which must be supported in addition to the base RFC's which are mandatory to provide basic IPv4, IPv6 and DS-lite protocol operations.

8.1 IPv4 operations

Internet Protocol Version 4 is a widely used protocol in data communication over different types of networks. The logical connection between participating devices is set up by providing identification to each device.

In order to use the internet service, a compatible device must retrieve identification data (IP address) from the MSO backend systems. IPv4 addresses will only be assigned dynamically and may change on any network connect or device restart.

8.1.1 DHCP IPv4 Operation

The following RFC's must be supported for an address assignment performed via DHCP:

- RFC951, updated by 1395, 1497, 1532, 1542, 5494

- RFC2131, updated by 3396, 4361, 5494, 6842

- RFC2132

Any static or stateless configuration approach of IP address information, DNS services or routes on the WAN connection is incompatible with the MSO requirements and specifications.

8.1.2   PPPoE IPv4 Operation

The following RFC's must be supported for an address assignment performed via PPPoE:

- RFC 1661, updated by 2153

- RFC 1662, RFC 2516

Any static configuration of IP address information, DNS services or routes on the WAN connection is incompatible with the MSO requirements and specifications.

8.2   IPv6 operations

Internet Protocol Version 6 is the successor of IPv4 and supports a much larger number of nodes due to an increased address space. The logical connection between participating devices is set up by providing identification to each device.

In order to use the internet service, a compatible device must retrieve identification data (IP address / Ipv6 prefix) from the MSO backend systems. IPv6 addresses and IPv6 prefixes will only be assigned dynamically and are subject to change on any network connect or device restart.

IPv6 addresses on the WAN side are exclusively provided through DHCPv6, SLAAC is not supported and must remain disabled.

The following RFC's must be supported:

- RFC2131 (IPv4)

- RFC2132 (IPv4 and IPv6)

- RFC3315, updated by 4361, 5494, 6221, 6422, 6644, 7083, 7227, 7283, 7550

- RFC6221, RFC6422, RFC6644, RFC6842

Any static or stateless configuration approach of IP address information, DNS services or routes on the WAN connection is incompatible with the MSO requirements and specifications.

8.3   DS-lite operations

DS-lite is a very important IPv4 – IPv6 transition technology and must be supported by any router which connects to the MSO network. The MSO may drop single stack or dual stack operation at any time and move to an IPv6 only network where the customer owned network termination devices will operate as a B4 element.

The following RFC's must be supported for DS-Lite operation:

- RFC6233, updated by RFC 7335

9. Voice Services

9.1 PacketCable 1.x based Voice Services

Telephony services are provided leveraging the PacketCable Standard in Version 1.x. The following section describes the relevant PacketCable specifications for the voice service.

The PacketCable based voice services do not use any credentials due to the principle of centralized call logic and sophisticated device identification through certificates and provisioning.

The following PacketCable Specifications are relevant:

Specification	Title	IF spec relevant
PKT-SP-ASP1.5-I02-070412	Audio Server Protocol	
PKT-SP-ATPBX1.5-I01-060419	Analog Trunking for PBX Specification	
PKT-SP-BV16-Codec1.5-I01-031030	BroadVoice 16 Speech Codec Specification	x
PKT-SP-CMSPROV1.5-I02-070412	CMS Subscriber Provisioning	
PKT-SP-CMSS1.5-I07-120412	CMS to CMS Signaling	
PKT-SP-CODEC1.5-I04-120412	Audio/Video Codecs	x
PKT-SP-DQOS1.5-I04-090624	Dynamic Quality-of-Service	x
PKT-SP-EM1.5-I03-070412	Event Messages	x
PKT-SP-ESP1.5-I02-070412	Electronic Surveillance	x
PKT-SP-EVEMIB1.5-I02-050812	Management Event MIB Specification	x
PKT-SP-MEM1.5-I05-100527	Management Event Mechanism	x
PKT-SP-MIB-EXMTA1.5-I01-050128	MTA Extension MIB	x
PKT-SP-MIB-EXSIG1.5-I05-121030	Signaling Extension MIB	x
PKT-SP-MIB-MTA1.5-I01-050128	MTA MIB	x
PKT-SP-MIBS1.5-I03-090624	MIBs Framework Specification	x
PKT-SP-NCS1.5-I04-120412	Network-Based Call Signaling Protocol	x
PKT-SP-PROV1.5-I04-090624	MTA Device Provisioning	x
PKT-SP-SEC1.5-I03-090624	Security	x
PKT-SP-TGCP1.5-I04-120412	PSTN Gateway Call Signaling Protocol Specification	

9.2   SIP based voice services

SIP based voice service are provided based on the IETF RFC 3261 standard and its extensions. SIP services, opposite to PacketCable based voice services, are not auto provisioned, the customer must enter and apply the data manually. The SIP credentials follow the schema shown below, equipment vendors should provide a compatible input interface for data entry into the device:

SIP username:	(^0|^0049)([2-9])(\d{5,}).{10,20}
SIP authname:	(^0|^0049)([2-9])(\d{5,}).{10,20}
SIP password:	(?=.*\d)(?=.*[a-z])(?=.*[A-Z]).{6,10}
SIP registrar:	<host>.<domain>.tld
SIP proxy:	<host>.<domain>.tld

10.   Other services

There are no other services supported by the MSO.

11.   Management, service and support

The management, service and support responsibility for the network termination device will shift from the MSO to the customer and respectively to the equipment supplier. Nevertheless, the MSO may require access to the CoNT under some circumstances. The customer must actively permit this support access and may open it to the MSO personnel on a case by case or permanent basis. Any use of this support access and any data retrieval should be controllable and auditable by the customer.

It is therefore recommended that equipment vendors implement certain control mechanisms which enable the customer to limit management and support access.

The following Management OID's shall be accessible by the MSO if the customer permits the remote management operation. Any other MIB access is not required and should be blocked on the CoNT.

RF Parameter Modem

Index OID	1.3.6.1.2.1.2.2.1.1
Sequence	2
MIB Name	RFC1213-MIB
is Table	Y
TableName	ifTable

RF Parameter Modem DS 1

Index OID	1.3.6.1.2.1.2.2.1.1
Sequence	3
MIB Name	RFC1213-MIB
is Table	Y
TableName	ifTable

RF Parameter Modem US 1

Index OID	1.3.6.1.2.1.2.2.1.1
Sequence	4
MIB Name	RFC1213-MIB
is Table	Y
TableName	ifTable

RF Parameter Modem DS n (bonding)

Index OID	1.3.6.1.2.1.2.2.1.1
Sequence	[48-79]
MIB Name	RFC1213-MIB
is Table	Y
TableName	ifTable

RF Parameter Modem US n (bonding)

Index OID	1.3.6.1.2.1.2.2.1.1
Sequence	[80-87]
MIB Name	RFC1213-MIB
is Table	Y
TableName	ifTable

Modem Serial Number

Index OID	1.3.6.1.2.1.69.1.1.4
Sequence	0
MIB Name	DOCS-CABLE-DEVICE-MIB
is Table	N
TableName	N/A

Time and Date

Index OID	1.3.6.1.2.1.69.1.1.2
Sequence	0
MIB Name	DOCS-CABLE-DEVICE-MIB
is Table	N
TableName	N/A

Current SW Version

Index OID	1.3.6.1.2.1.69.1.3.5
Sequence	0
MIB Name	DOCS-CABLE-DEVICE-MIB
is Table	N
TableName	N/A

System Description

Index OID	1.3.6.1.2.1.1.1
Sequence	0
MIB Name	RFC1213-MIB
is Table	N
TableName	N/A

DOCSIS HF Downstream Parameters

Index OID	1.3.6.1.2.1.2.2.1.1
Sequence	any
MIB Name	DOCS-IF-MIB
is Table	Y
TableName	docsIfDownstreamChannelTable

DOCSIS HF Upstream Parameters	
Index OID	1.3.6.1.2.1.2.2.1.1
Sequence	any
MIB Name	DOCS-IF-MIB
is Table	Y
TableName	docsIfUpstreamChannelTable

DOCSIS HF Quality Parameters	
Index OID	1.3.6.1.2.1.2.2.1.1
Sequence	any
MIB Name	DOCS-IF-MIB
is Table	Y
TableName	docsIfSignalQualityTable

DOCSIS HF TX Power	
Index OID	1.3.6.1.2.1.10.127.1.2.2.1.3
Sequence	0
MIB Name	DOCS-IF-MIB
is Table	N
TableName	N/A

12.   Safeguard clause

If any of the information provided in this document are invalid or otherwise, then to the extent and within the jurisdiction which that information is illegal, invalid or unenforceable, it shall be severed and deleted from this clause and the remaining information shall survive, remain in full force and effect and continue to be binding and enforceable.

Appendix A