



Vodafone Kabel Deutschland pNTP Interface Specification

Version: 1.0.3
26.04.2018

Schnittstellenkonform sind Endgeräte ausschließlich, wenn diese durch geeignete technische Maßnahmen so gesichert werden, dass diese weder durch Software- oder Hardware-Manipulationen in einer Weise verändert werden können, dass sie den Anforderungen dieser Schnittstellenbeschreibung nicht mehr entsprechen. Insbesondere ist das Einspielen veränderter Firmware wirksam zu unterbinden.

Mit der Veröffentlichung einer neuen Version dieser Schnittstellenbeschreibung verlieren vorherige Versionen ihre Gültigkeit.

Zur technischen Erprobung behält sich die Vodafone Kabel Deutschland vor, in räumlich begrenzten Regionen jederzeit abweichende Implementierungen vorzunehmen.

Vodafone Kabel Deutschland übernimmt keine Haftung für die Richtigkeit der im Dokument aufgeführten Referenzspezifikationen.

Hinweise:

Diese Schnittstellenbeschreibung für den passiven Netzabschlusspunkt (pNTP) setzt § 41c des Telekommunikationsgesetzes (TKG) vom 22. Juni 2004 (BGBl, I S. 1190), das zuletzt durch Artikel 10 Absatz 12 des Gesetzes vom 30. Oktober 2017 (BFBl, I S. 3618) geändert worden ist um und richtet sich an Hersteller. Für diese bestehen Testmöglichkeiten in den Laboren der Vodafone Kabel Deutschland zu FRAND Konditionen. Die Erklärung der Konformität mit den Inhalten dieser Schnittstellenbeschreibung erfolgt in Eigenverantwortung der Hersteller.

Contents

Contents	3
Conventions	4
Contact.....	5
1 Scope	6
2 References	7
2.1 Normative References	7
2.2 Informative References	7
2.3 Reference Acquisition	7
3 Definitions and Abbreviations.....	8
3.1 Definitions.....	8
3.2 Abbreviations.....	8
4 RF Interface connector	9
4.1 General.....	9
4.2 Environmental Profile and Safety.....	9
4.3 Mechanical interface description for a coaxial connector with socket centre contact (informative)	9
4.4 Electrical performance characteristics	9
5 Network RF characteristics	10
5.1 Downstream RF characteristics	10
5.2 Upstream RF characteristics.....	11
6 DOCSIS 3.0 Physical Interface Requirements.....	12
7 Upper Layer Requirements	13
7.1 MAC and Upper Layer	13
7.2 Security Layer	13
7.3 OSS Layer.....	13
7.4 Registration and Provisioning	13
8 IP-addresses for devices behind the cable modem (informative)	14
8.1 DHCPv4	14
8.2 DHCPv6	14
8.3 DS-Lite	14
8.4 Prefix delegation.....	14
Annex A Example RMCD (informative).....	15
Annex B Example cable modem Downstream frequency range (informative)	16
History.....	16

Conventions

Throughout this document, the words that are used to define the significance of particular 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.

Contact

Vodafone Kabel Deutschland GmbH
Beta-Strasse 6 - 8
85774 Unterföhring
Germany
Telefon: +49 (0)89 960 10 - 0
Fax: +49 (0)89 960 10 - 0
Website: www.vodafone.de

1 Scope

This document describes the DOCSIS protocol requirements for the Internet Service over the Vodafone Kabel Deutschland cable network at the dedicated data RF Interface and the main characteristics of the dedicated data RF interface in the Vodafone Kabel Deutschland cable network at the user's coaxial passive network termination point. This document describes the typical limits or values within which the RF characteristics can be expected to remain for networks that are built according to Vodafone Kabel Deutschland specifications at installation time.

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

- operating conditions arising as a result of operating services other than DOCSIS 3.0 over the dedicated data RF interface.
- operating conditions arising as a result of a fault, maintenance and construction work or to minimize the extend of interruption of service.
- operating conditions arising as a result of force majeure or third-party interference.
- operating conditions arising as a result of test signal injection governed by regulation.
- In case of non-compliance of a network user's installation or non-compliance of equipment with the relevant standards or non-compliance with the technical requirements for connection, established either by this interface specification or the public authorities including the relevant 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. 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 Vodafone Kabel Deutschland network.

This interface specification may be changed at any time. The user of this interface specification has to check for the newest version available from Vodafone Kabel Deutschland GmbH. This interface specification may be superseded in total or in part by the terms of a contract between the individual network user and Vodafone Kabel Deutschland GmbH.

2 References

In the case of a conflict between specific requirements in this document with requirements in any of the directly or indirectly referenced documents, the specific requirements of this document are applicable.

2.1 Normative References

CL-SP-CANN-DHCP-Reg-I13-160317	CableLabs' DHCP Options Registry
RFC6333	Dual-Stack Lite Broadband Deployments Following IPv4 Exhaustion
RFC6334	Dynamic Host Configuration Protocol for IPv6 (DHCPv6) Option for Dual-Stack Lite
RFC3633	IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6
ANGA 100 001	ANGA 100 001 v1.01: Specification for the passive Network Termination Point in DOCSIS 3.0 Environment Network and Provisioning requirements

2.2 Informative References

See ANGA 100 001

KDG 1 TR 8-8	Regelungen für Auftragnehmer der Kabel Deutschland zur Beurteilung bzw. Herstellung des Potenzialausgleichs im Zusammenhang mit der Einrichtung von Kabel Highspeed und Kabel Phone, Ausgabe 2005 ¹
--------------	--

¹ available under NDA

2.3 Reference Acquisition

- Internet Engineering Task Force (IETF) RFCs, <http://www.ietf.org>
- ITU Recommendations: <http://www.itu.int>
- CableLabs specification: <http://www.cablelabs.com>
- ANGA specification: <http://www.vodafone.de/hersteller-info>
- Excentis specification: https://www.excentis.com/system/files/resources/eurodocsis.bpireq_v7.pdf

3 Definitions and Abbreviations

3.1 Definitions

The definitions in ANGA 100 001, subclause 3.1 apply.

3.2 Abbreviations

The abbreviations in ANGA 100 001, subclause 3.2 apply.

AD	Frequency dependent Amplitude Distortion (Peak to Peak)
C/(N+IM)	Carrier (C) to Noise (N) and Intermodulation (IM) ratio
PD	Frequency dependent Phase Distortion (Peak to Peak)
RMCD	Ready Made Connecting Device
VF KD	Vodafone Kabel Deutschland GmbH

4 RF Interface connector

4.1 General

The location of the customer's pNTP within the hybrid fibre/coaxial network is shown in ANGA 100 001, subclause 4.1.

4.2 Environmental Profile and Safety

The technical specification of the present document applies under the environmental profiles classification in ANGA 100 001, subclause 4.2 and the environmental class E₀:

Table 1: E₀ environmental classification (MICE)

Electromagnetic Environment	E ₀
Radiated radio frequency, RF-AM	106 dB μ V/m at (30 to 470 MHz) 100 dB μ V/m at (470 to 862 MHz)
Conducted radio frequency	3 V at (150 kHz to 30 MHz)
Electrical fast transients (signal/data/control)	N/A
Surge (transient ground potential difference – signal, line to earth)	N/A
Magnetic Field (50 Hz)	3 A/m

Equipotential bonding of the pNTP according to KDG 1 TR 8-8 can be assumed for broadband cable networks under Vodafone Kabel Deutschland control.

Note: Equipotential bonding according to DIN VDE 0100-410 cannot be assumed for all installations. As a consequence, overvoltage protection cannot be assumed.

4.3 Mechanical interface description for a coaxial connector with socket centre contact (informative)

The mechanical coaxial connector and the connection requirements at the customer's pNTP in ANGA 100 001, subclause 4.3 apply.

4.4 Electrical performance characteristics

The values given in ANGA 100 001, subclause 4.4 apply. The nominal rated values conditions are 24 VAC (max. 65 VAC) or 34 VDC (max. 120 VDC) at the pNTP (Note: see VDE 0855-1:2017-10, 8.2).

5 Network RF characteristics

5.1 Downstream RF characteristics

5.1.1 Downstream frequency range

The Downstream Frequency Range specification at the customer's pNTP in ANGA 100 001, subclause 5.1.1 applies.

Note: CM configured for different fixed DS frequency ranges (fixed duplex filter) MAY NOT be used (frequency band selection is mutual exclusive).

Nominal minimum DS channel count for DOCSIS 3.0 services are given in the table below:

Table 2: Minimum DS channel count

Network type	Nominal minimum DS channel count	Maximum DS channel count
1	16	32
2	20	32
> 3	16	N/A

5.1.2 Downstream RF performance

If not listed otherwise in this subclause the Downstream RF performance characteristics at the customer's pNTP in ANGA 100 001 subclause 5.1.2 apply.

The following tables define specific values different from in ANGA 100 001 subclause 5.1.2:

Table 3: Specific Downstream Performance characteristics at the pNTP (Type 1 networks)

Parameter	Nominal ratings and characteristics	Absolute maximum ratings and characteristics during normal operation
frequency deviation	≤ 20 kHz	N/A
ingress ¹	present	N/A
total input power	N/A	≤ 94 dB(μV)
signal tilt (full range)	N/A	≤ 16 dB
channel signal tilt	N/A	N/A
carrier level backoff between adjacent SC-QAM channels	≤ 6 dB	N/A
carrier level backoff between adjacent channels	≤ 10 dB	N/A
64 QAM signal level	50 to 67 dB(μV)	≤ 76 dB(μV)
64 QAM BER	< 1 x 10 ⁻⁶	≤ 1 x 10 ⁻⁴
64 QAM MER	≥ 27.1 dB	≥ 23 dB
256 QAM signal level	56 to 73 dB(μV)	≤ 76 dB(μV)
256 QAM BER	< 1 x 10 ⁻⁶	≤ 1 x 10 ⁻⁴
256 QAM MER	≥ 32.7 dB	≥ 29 dB

¹see [2] in ANGA 100 001 v1.01

Table 4: Specific Downstream Performance characteristics at the pNTP (other network types)

Parameter	Nominal ratings and characteristics	Absolute maximum ratings and characteristics during normal operation
frequency deviation	≤ 20 kHz	N/A
ingress ¹	present	N/A
total input power	N/A	N/A
signal tilt (122/826 MHz)	N/A	≤ 10 dB
channel signal tilt	N/A	N/A
carrier level backoff between adjacent SC-QAM channels	≤ 6 dB	N/A
64 QAM signal level	50 to 67 dB(μV)	≤ 76 dB(μV)
64 QAM BER	< 1 x 10 ⁻⁶	≤ 1 x 10 ⁻⁴
64 QAM MER	≥ 27.1 dB	≥ 23 dB
256 QAM signal level	56 to 73 dB(μV)	≤ 76 dB(μV)
256 QAM BER	< 1 x 10 ⁻⁶	≤ 1 x 10 ⁻⁴
256 QAM MER	≥ 33.1 dB	≥ 29 dB

¹ see [2] in ANGA 100 001 v1.01

Table 4 in ANGA 100 001 is augmented by the table below.

Table 5: Micro reflections at the pNTP

time	nominal value
≤ 35 ns	-12 dBc
35 ns to 0.3 μs	-12 to -42 dBc
0.3 μs to 0.5 μs	-42 dBc

5.2 Upstream RF characteristics

5.2.1 Upstream Frequency Range

If not listed otherwise in this subclause the upstream frequency range at the customer's pNTP in ANGA 100 001, subclause 5.2.1 applies. The usable Frequency Range is 15 MHz to 65 MHz. Nominal minimum US channel count is 4.

5.2.2 Upstream RF Performance

If not listed otherwise in this subclause the Upstream RF Performance characteristics at the customers pNTP in ANGA 100 001, subclause 5.2.2 applies. The reference channel bandwidth is 3.2 MHz. Nominal values are valid for 99.5 % of the time.

Table 3: 862 MHz Network Upstream Characteristics at the pNTP

Parameter	Nominal ratings and characteristics at installation time	Absolute maximum ratings and characteristics
single upstream level range	98.1 to 110 dB(μV)	≤ 114 dB(μV)
C/(N+IM)	≥ 64.5 dB	≥ 62.5 dB
MER ¹	≥ 32 dB	≥ 30 dB
AD	≤ 1.1 dB _{PP}	≤ 2.0 dB _{PP}
PD	≤ 1.1 ° _{PP}	≤ 2.4 ° _{PP}

¹: for 16 QAM

Table 4: Spurious Emissions in a 5.12 MHz upstream channel

Parameter	During Burst transmission	Between Bursts
Inband	-43 dBc	-72 dBc

6 DOCSIS 3.0 Physical Interface Requirements

The Network RF interface requirements at the customers pNTP in ANGA 100 001, clause 6 applies.

7 Upper Layer Requirements

7.1 MAC and Upper Layer

The MULPI interface requirements at the customer's pNTP in ANGA 100 001, clause 7 applies, except:

Where the NVT-ASCII character set is referenced in the CableLabs' DHCP Options Registry, ASCII graphics characters (hexadecimal 20 through 7E) MUST be used.

The following minimum requirements are applicable

- At least 8 upstream service flows MUST be supported, 4 of which can be UGS-only.

7.2 Security Layer

- Compliance with CM-SP-SECv3.0-I15-130808 with the exception of the requirements defined in EuroDOCSIS BPI+ requirements MUST be accomplished.
- Certificate requirements are defined in EuroDOCSIS BPI+, requirements specified in this document take precedence over requirements in CM-SP-SECv3.0-I15-130808.

7.3 OSS Layer

Compliance with CM-SP-OSSv3.0-I28-151210 MUST be accomplished.

Note: SNMP MAY be used.

7.4 Registration and Provisioning

During registration cable modems will receive a generic configuration file with maximum sustained traffic rates for raw internet access in bit/s (gross IP service data rate) considering SI decimal prefixes. All network provided channels MUST be supported to achieve the maximum configurable traffic rate per network segment.

Note: For minimum and maximum channel counts see subclauses 5.1.1 and 5.2.1.

8 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.

8.1 DHCPv4

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

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

8.2 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 section 8.3 below)
- Delegated prefix

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

8.3 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.

8.4 Prefix delegation

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

Annex A Example RMCD (informative)

The screening effectiveness requirements for RMCD in the VF KD network depend on the capabilities of the demodulator within the cable modem and the physical parameters like return loss and the length of the RMCD itself.

Calculated example values for the minimum required screening effectiveness of RMCD within the VF KD network are given in the table below for an external disturbance field strength of 120 dB(μ V/m) (EN 61000-4-3).

Table 6: Calculated screening effectiveness of RMCD

Frequency [MHz]	Value [dB]
30 to 80	75
698 (MER _{CM} =27 @ 64 QAM)	74
546 (MER _{CM} =32 @ 256 QAM)	76

Annex B Example cable modem Downstream frequency range (informative)

A successful implementation of subclause 5.1.1 requires RCP CLAB-8M-016 (16 downstream channels, extended up to 1 GHz) or CLAB-8M-024 (24 DS channels, extended to 1 GHz).

Note: A 16 DS-channel CM MAY bond to 8 channels if no 16 channel bonding group is available.

History

Document history		
V1.0	21.07.2016	Ready for publishing
V1.01	22.07.2016	Version to be published
V1.02	02.08.2016	Editorial changes
V1.03	26.04.2018	Major changes: AC/DC and RF performance characteristics, clause 9 and subclauses 4.2, 4.4, 7.1