



Vodafone Kabel Deutschland pNTP Interface Specification

Version: 1.0.4
13.12.2018

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 passive Netzabschlusspunkte (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	8
2.3 Reference Acquisition	8
3 Definitions and Abbreviations.....	9
3.1 Definitions.....	9
3.2 Abbreviations.....	9
4 Interface connectors.....	11
4.1 General.....	11
4.2 Environmental Profile and Safety.....	11
4.3 Mechanical Interface Description (informative).....	11
4.4 Electrical performance characteristics	11
5 DOCSIS 3.x Network RF characteristics.....	12
5.1 Downstream RF characteristics	12
5.2 Upstream RF characteristics.....	14
6 DOCSIS 3.x Physical Interface Requirements.....	14
7 DOCSIS 3.x Upper Layer Requirements	15
7.1 MAC and Upper Layer	15
7.2 Security Layer	15
7.3 OSS Layer.....	15
7.4 Registration and Provisioning	15
8 IP-addresses for devices behind the cable modem (informative).....	16
8.1 DHCPv4	16
8.2 DHCPv6	16
8.3 DS-Lite	16
8.4 Prefix delegation.....	16
Annex A Example pRMCD for type A pNTP (informative).....	17
Annex B Example cable modem Downstream frequency range (informative)	18
Annex C Security Recommendations.....	19
History.....	19

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 as well as the Ethernet based 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.x 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 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 Vodafone Kabel Deutschland network.

This interface specification may be changed at any time and may break backward compatibility with previous versions. Manufacturers are therefore asked to provide regular software updates. 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

See ANGA 100 001, ANGA 100 002

ANSI/TIA/EIA 568-B	Commercial Buildings Telecommunications Cabling Standard
BSI	Testkonzept für Breitband-Router, (DSL-, Kabel-, SOHO-, CE-, CPE-Router, IADs); May/2016
CFR Pt. 68	FCC CFR Pt. 68; 1999
CL-SP-CANN-DHCP	CableLabs' DHCP Options Registry (newest version)
DIN VDE 0100-410	DIN VDE 0100-410 VDE 0100-410:2007-06: Errichten von Niederspannungsanlagen Teil 4-41: Schutzmaßnahmen - Schutz gegen elektrischen Schlag (IEC 60364-4-41:2005, modifiziert); Deutsche Übernahme HD 60364-4-41:2007
DIN ISO 8601	DIN ISO 8601:2006-09: Datenelemente und Austauschformate - Informationsaustausch - Darstellung von Datum und Uhrzeit (ISO 8601:2004)
ETSI EN 302 878-1	Access, Terminals, Transmission and Multiplexing (ATTM); Third Generation Transmission Systems for Interactive Cable Television Services – IP Cable Modems; Part 1: General; DOCSIS 3.0
IEC 61196-2	Radio-frequency cables - Specifications - Part 2: Semi-rigid radio-frequency and coaxial cables with polytetrafluoroethylene (PTFE) insulation - Sectional specification
IEEE 802.3	802.3-2015 - IEEE Standard for Ethernet, ISBN 978-1-5044-0078-7
RFC3663	IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6
RFC6333	Dual-Stack Lite Broadband Deployments Following IPv4 Exhaustion
RFC6334	Dynamic Host Configuration Protocol for IPv6 (DHCPv6) Option for Dual-Stack Lite
VDE 0627-603-7	Steckverbinder für elektronische Einrichtungen - Teil 7: Bauartspezifikation für ungeschirmte freie und feste Steckverbinder, 8polig (IEC 60603-7:2008 + A1:2011); Deutsche Fassung EN 60603-7:2009 + A1:2011
VDE 0855-1	VDE 0855-1:2017-10: Kabelnetze für Fernsehsignale, Tonsignale und interaktive Dienste, Teil 11: Sicherheitsanforderungen (IEC 60728-11:2016 + COR1:2016); Deutsche Fassung EN 60728-11:2017
ANGA 100 001	ANGA 100 001 v1.01: Specification for the passive Network Termination Point in DOCSIS 3.0 Environment Network and Provisioning requirements
ANGA 100 002	ANGA 100 002 v1.0: Specification for a passive Network Termination Point In DOCSIS 3.1 Environments Network and Provisioning requirements

2.2 Informative References

See ANGA 100 002

CL-SP-sRouter-I02-170111 Standalone Router Specification

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 2005¹

¹ available under NDA

2.3 Reference Acquisition

- ANGA specifications: <http://www.vodafone.de/hersteller-info>
- BSI Router Testkonzept: <https://www.bsi.bund.de/SharedDocs/Downloads/DE/BSI/Cyber-Sicherheit/Themen/Testkonzept-Breitbandrouter.html>
- CableLabs specifications: <http://www.cablelabs.com>
- DIN standards: <https://www.beuth.de/de>
- FCC: <https://www.fcc.gov>
- IEEE: <http://www.ieee.org>
- IETF RFCs: <http://www.ietf.org>
- ITU recommendations: <http://www.itu.int>
- Telecommunications Industry Association: <https://www.tiaonline.org/>
- VDE standards: <https://www.vde-verlag.de>

3 Definitions and Abbreviations

3.1 Definitions

The definitions in ANGA 100 001, subclause 3.1 apply.

3.2 Abbreviations

The abbreviations in ANGA 100 002, subclause 3.2 apply.

AD	Frequency dependent Amplitude Distortion (Peak to Peak)
AFTR	Address Family Transition Router
ANGA	Arbeitsgemeinschaft für Betrieb und Nutzung von Gemeinschaftsantennen- und -verteileranlagen
ASCII	American Standard Code for Information Interchange
BER	Bit Error Rate
BPI+	Baseline Privacy Plus
BSI	Bundesamt für Sicherheit in der Informationstechnik
C/(N+IM)	Carrier (C) to Noise (N) and Intermodulation (IM) ratio
CableLabs	Cable Television Laboratories, Inc.
CM	Cable Modem
CMCI	Cable Modem to CPE Interface
DHCP	Dynamic Host Configuration Protocol
DIN	Deutsches Institut für Normung
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
KDG	Kabel Deutschland GmbH
MAC	Media Access Control
MER	Modulation Error Rate
MICE	Mechanical, Ingress, Climatic and Chemical, Electromagnetic
OFDM	Orthogonal Frequency-Division Multiplexing

PD	Frequency dependent Phase Distortion (Peak to Peak)
pNTP	passive network termination point
pRMCD	passive Ready Made Connecting Device (cable assembly)
QAM	Quadrature Amplitude Modulation
RCP	Receive Channel Profile
RF	Radio Frequency
SC	Single Carrier
SI	Système international d'unités
SNMP	Simple Network Management Protocol
UGS	Unsolicited Grant Synchronization
US	Upstream
VAC	Volt Alternating Current
VDC	Volt Direct Current
VDE	Verband der Elektrotechnik Elektronik Informationstechnik e. V.
VF KD	Vodafone Kabel Deutschland GmbH

4 Interface connectors

4.1 General

The location of the customer's pNTP within the hybrid fibre/coaxial network for DOCSIS is shown in ANGA 100 001, subclause 4.1 for type A and B pNTP (coaxial pNTP). See CFR Pt. 68 for type C pNTP according to subscription contractual details (see also location of CMCI in ETSI EN 302 878-1, V1.1.1, subclause 1.2.5).

4.2 Environmental Profile and Safety

The technical specification of the present document applies under the environmental profiles and MICE classification in ANGA 100 002, subclause 4.2. 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 (informative)

The requirements for the mechanical coaxial connector with socket centre contact and the connection requirements at a customer's pNTP in ANGA 100 001, subclause 4.3 for a type A pNTP, IEC 61169-2 for type B pNTP and VDE 0627-603-7 (jack) in combination with ANSI/TIA/EIA 568-B-2 for a type C pNTP apply.

4.4 Electrical performance characteristics

The values given in ANGA 100 002, subclause 4.4 for coaxial pNTP apply. In this case the nominal rated values conditions are 24 VAC (max. 65 VAC) or 34 VDC (max. 120 VDC) (Note: see VDE 0855-1:2017-10, 8.2). For type C pNTP, see IEEE 802.3 (e.g. 1000Base-T).

5 DOCSIS 3.x Network RF characteristics

5.1 Downstream RF characteristics

5.1.1 Downstream frequency range

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

Note: CM configured for different fixed DS frequency ranges (fixed diplex 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 1: Minimum DS 3.0 channel count

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

Nominal minimum DS channel count for DOCSIS 3.1 services are given in the table below:

Table 2: Minimum DS 3.1 channel count

Network type	Nominal minimum DS channel count	Maximum DS channel count
1	0	0
2	> 0	2
> 3	0	2

5.1.2 Downstream RF performance

If not listed otherwise in this subclause the Downstream RF performance characteristics at the customer's coaxial 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 for coaxial 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

¹ see [2] in ANGA 100 001 v1.01

Table 4: Specific Downstream Performance characteristics for coaxial 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
OFDM MER ²	≥ 27 dB	≥ 24,5 dB (TBD)

¹ see [2] in ANGA 100 001 v1.01
² 256 QAM

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

Table 5: Micro reflections at the coaxial 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 coaxial pNTP in ANGA 100 001, subclause 5.2.1 applies. The usable Frequency Range is 15 MHz to 65 MHz. Nominal minimum SC 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 coaxial 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 6: 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(μ V)	≤ 114 dB(μ V)
OFDM level range	N/A	≤ 125 dB(μ V)
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 7: Spurious Emissions in a 5.12 MHz upstream channel

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

6 DOCSIS 3.x Physical Interface Requirements

The Network RF interface requirements at the customers coaxial pNTP in ANGA 100 001 and ANGA 100 002, clause 6 applies (see also subclause 4.4).

7 DOCSIS 3.x Upper Layer Requirements

7.1 MAC and Upper Layer

The MULPI interface requirements at the customer's pNTP in ANGA 100 001 and ANGA 100 002, 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. For DOCSIS 3.1, RMVI Sub-Options MUST be present¹.

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.
- For DOCSIS 3.1 services, ANGA 100 002, clause 8 applies.

7.3 OSS Layer

Compliance with CM-SP-OSSv3.0-I28-151210 MUST be accomplished. For DOCSIS 3.1 services ANGA 100 002, clause 7 applies.

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.

¹ contact Volker of CL-RMVI-WP for more information.

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 pRMCD for type A pNTP (informative)

pRMCD with IEC 61169-24 screw type F connectors SHOULD not be used and MAY be accompanied by a plastic torque handle to achieve the nominal tightening torque at type A pNTP for technically correct installation (see ANGA 100 001, subclause 4.3).

The screening effectiveness requirements for pRMCD 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 pRMCD itself.

Calculated example values for the minimum required screening effectiveness of pRMCD within the VF KD network are given in the table below for an external disturbance field strength of 120 dB(μ V/m) (EN 55035).

Table 8: Calculated screening effectiveness of pRMCD

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.

Annex C Security Recommendations

Security relevant exclusion requirements can be found in BSI "Testkonzept für Breitbandrouter" (e.g. table 33). Vodafone Kabel Deutschland accepts security measures according to CL-SP-sRouter-I02-170111, subclause 13.3 through 13.5.

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
V1.04	13.12.2018	Additional requirements for DS 3.1 and CMCI Interface (clause 4). New security recommendations in Annex C.