



Specification

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Document owner Vidar Skovli	Telephone +47 8107 7000	e-mail vidar.skovli@telenor.com
Approved (sign) Torleif Bakken	Approved date 2010-10-15	

Title

Specification for the network side of the user-network interface: VDSL modem (VTU-R) VDSL2

Telenor Norway AS
N-1331 Fornebu
Norway
Telephone: +47 81077000
www.telenor.com

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1. Scope

This specification describes the network side of VDSL access to the network of Telenor as prescribed in Article 4.2 of RTT&E-directive [12]. The requirements in Telenor Specification OA 100 [3] also apply.

This specification depicts requirements for a VDSL remote modem, VTU-R, interworking with a VTU-O installed in Telenor's DSLAM.

The objective is to ensure full interoperability between VDSL modems, VTU-O and VTU-R, from different vendors and with different hardware chip sets.

With a remote splitter the VTU-R can coexist on the same access line as a connection to the PSTN or to the ISDN network. The operation of PSTN or ISDN basic access in combination with a VTU-R is made possible by the use of a non-overlapping frequency plan.

It is recommended that the vendor of VTU-R define a test regime to ensure compatibility between VTU-R and the network resources (VTU-O, DSLAM etc.).

NOTE: *Presently the focus is to have VTU-R from different vendors working together with ISDN compatible line cards of the ISAM family of Alcatel-Lucent DSLAMs (ISAM FD) [1] or later releases.*

In no event Telenor shall be liable to other parties for any direct, indirect, special, incidental, or consequential damages resulting from errors or defects in these specifications.

Functionality and performance regarding the local area network (LAN) or the data terminal equipment (DTE) on the customer site are out of the scope for this specification; e.g. functions as firewalls, DHCP, NAT etc. and interfaces like 10BaseT, USB, PCI, WLAN etc.

2. References

In case of any discrepancies between this specification and other specifications/standards referred to, this specification applies.

2.1 Normative references

This specification incorporates by dated or undated references, provisions from other publications/standards. These normative references are cited at the appropriate places in the text and the references are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this specification only when incorporated in it by amendment or revision. For undated references, including amendments, the last edition of the document referred to applies.

- [1] Information on the foundation for design of Alcatel-Lucent 7302 ISAM family DSLAMs (2010 Issue 1)
- [2] Telenor Specification OA 106, Requirements for equipment to be connected to the local loop in the access network of Telenor. Equipment providing VDSL and PSTN or ISDN Basic Access services, full unbundled access (service type E_{AF})
<http://www.jara.no>
- [3] Telenor Specification OA 100, General requirements for equipment to be connected to the local loop in the access network of Telenor and/or material and equipment to be installed and operated in Telelosji
<http://www.jara.no>
- [4] ITU-T Recommendation G.993.2, Transmission Systems And Media – Very high speed digital subscriber line transceivers 2 (VDSL2)
- [5] ETSI TS 101 271 V1.1.1 (2009-01), Access Terminals and Multiplexing (ATM); Access transmission system on metallic pairs; Very High Speed digital subscriber line system (VDSL2) [ITU-T G.993.2 modified].
- [6] ITU-T Recommendation G.994.1, Handshake procedures for Digital Subscriber Line (DSL) transceivers
- [7] ITU-T Recommendation G.996.1, Test procedures for Digital Subscriber Line (DSL) transceivers
- [8] Telenor Specification A82, Specification for the network side of the user-network interface: Remote splitter (PSTN/ISDN basic access)
- [9] ETSI ES 202913 V1.2.2 (2006-01), Access and Terminals (AT); POTS requirements applicable to ADSL modems when connected to an analogue presented PSTN line
- [10] Broadband Forum TR-114 VDSL2 Performance Test Plan
- [11] ITU-T Recommendation K.21 Resistibility of telecommunication equipment installed in customer's premises to overvoltage and overcurrent
- [12] Directive R&TTE 1999/05/EC: (The Radio Equipment and Telecommunications Terminal Equipment) http://europa.eu.int/comm/enterprise/rtte/index_en.htm
- [13] CENELEC EN 60603-7-2:2009 CLC/SR 48B Connectors for electronic equipment -- Part 7-2: Detail specification for 8-way, unshielded, free and fixed connectors, for data transmissions with frequencies up to 100 MHz

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[14] CENELEC EN 60950 Safety of information technology equipment (IEC 60950)

2.2 Informative references

- [15] ETSI EN 300 019-1-1: Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-1: Classification of environmental conditions; Storage
- [16] ETSI EN 300 019-1-2: Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-2: Classification of environmental conditions; Transportation
- [17] ETSI EN 300 019-1-3: Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weather protected locations
- [18] ETSI TS 101 388 Transmission and Multiplexing (TM); Access transmission systems on metallic access cables; Asymmetric Digital Subscriber Line (ADSL) – European specific requirements (ITU-T Recommendation G.992.1 modified)
- [19] Directive EMC 89/336/EEC etc.:
http://ec.europa.eu/enterprise/policies/european-standards/documents/harmonised-standards-legislation/list-references/electromagnetic-compatibility/index_en.htm
- [20] Norwegian regulations: <http://www.lovdato.no/for/sf/sd/sd-20000620-0628.html>

3. Definitions

Sync time	“Sync time” is the time interval from the moment when the modem starts training, until the moment the state “ShowTime” is achieved.
Showtime	“Showtime” is the state reached after training is completed and data can be transmitted.
VDSL access	Access line fitted with VDSL transmission equipment supporting ITU-T recommendations ITU-T G.993.2 and ETSI technical standard ETSI TS 101 271

3.1 Abbreviations

CPE	Customer Premises Equipment (usually an VTU-R and splitter)
DHCP	Dynamic host configuration protocol
DSLAM	Digital subscriber line access multiplexer (usually housing the VTU-O)
DTE	Data terminal equipment
ETSI	European Telecommunications Standards Institute
ISAM	IP subscriber access multiplexer
ISDN	Integrated services digital network
ITU-T	International Telecommunication Union – Telecommunication sector
NAT	Network address translation
OAM	Operation, administration and maintenance
PC	Personal computer
PCI	Peripheral component interconnect
PSTN	Public switched telephone network
PTM	Packet Transfer Mode
TE	Terminal equipment
USB	Universal serial bus
VDSL	Very high speed digital subscriber line
VCI	Virtual channel identifier?
VPI	Virtual path identifier?
VTU-R	VDSL2 Transceiver Unit at the remote site
VTU-O	VDSL2 Transceiver Unit at the ONU (or central office)
WLAN	Wireless local area network

4. Requirements

4.1 General

Requirements in order to obtain interoperability are considered to be mandatory. The equipment is compliant to this specification if all mandatory requirements are fully compliant.

Some statements may be considered optional or recommended if stated in the heading. Non-compliance to statements indicated as 'optional' or 'recommended' does not exclude compliance to this specification.

The VTU-R shall comply with the generic specification, Telenor Specification OA 100 [3].

This specification depicts functionality and performance regarding the VTU-R and its interaction with the VTU-O hosted in the DSLAM in figure 1. The VTU-O is the counterpart to the VTU-R.

In figure 1 the equipment located at the customer premises consists of a universal remote PSTN/ISDN splitter and a modem designated VTU-R. The VTU-R is in turn attached to data terminal equipment (DTE) or a local area network (LAN) domain.

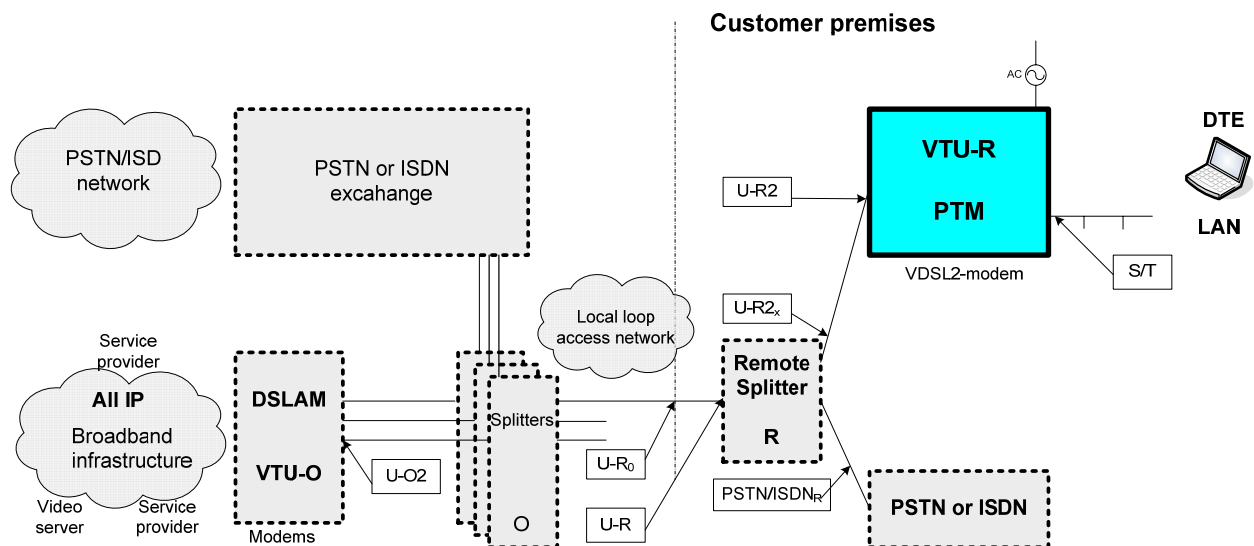


Figure 1 VDSL system functionality

The VTU-R may be a stand-alone unit or it may be an integrated part of a DTE. The DTE may be a PC or a router connected to LAN.

If PSTN or ISDN services are provided on the same pair the provision of a splitter is mandatory. Requirements for the splitter are given in the Telenor Specification A82 [8].

4.2 Transmission requirements

The support of VDSL2 (i.e. ITU-T Rec. G.993.2) [4] is mandatory.

4.2.1 Electrical and functional requirements

The VTU-R shall comply with Telenor Specification OA 106 [2] as well as OA 206/306/406.

ITU-T Rec. G.993.2 [4] Annex B defines the minimal set of requirements to provide satisfactory transmission between the network and the customer interface. The physical layer aspects required ensuring the compatibility between the network and the VTU-R at customer premises are specified.

According to OA regulations [2] the following transmit spectral masks are authorized:

PSDs up to 12 MHz

- B8-3 998-M1x-NUS0
- B8-6 998-M2x-B incl US0 (B8-2-M1x-B also accepted)

PSDs up to 17 Hz

- B8-10 998ADE17-M2x-NUS0-M
- B8-12 998ADE17-M2x-B inch US0

PSDs up to 30 MHz, NUS0

- B8-15 998ADE30-M2x-NUS0-M (not presently supported)

To support these PSDs the following VDSL2 profiles are supported 8c, 8d, 12a, 12b and 17a.

4.2.2 Upstream Power Back Off (UPBO) Requirements

UPBO shall be enabled and performed by the VTU-R to improve spectral compatibility between VDSL2 systems on loops of different lengths deployed in the same binder according to the Power back-off mechanism procedure defined in ITU-T G.993.2 **Feil! Fant ikke referansekil-**den., sub-clause 7.2.1.3.

4.2.3 PTM transport

The equipment shall transport PTM cells over VDSL based on IEEE 802.2ah 64/65 octet encapsulation according to ITU-T G.993.2 [4] Annex K - TPS-TC functional descriptions - Clause K.3. Packet transmission convergence function (PTM-TC).

4.2.4 Interworking with Telenor's VTU-O according to G.993.2

The bit transport using PTM over VDSL is presently supplied by one vendor of VTU-Os; Alcatel Lucent. The VTU-R shall comply with declaration made according to 4.2.4.1 and ITU-T G.993.2 [4].

4.2.4.1 Compatibility for Alcatel Lucent 7302 ISAM FD with ISDN compatible line cards

The VTU-R shall interwork with the VTU-O depicted in Alcatel Lucent interface specification [1] regarding ITU-T Rec. G.993.2.

4.2.5 Performance

The bit rate requirements shall apply with a remote splitter attached. The splitter shall conform to the requirements in the Telenor Specification A82, Specification for the network side of the user-network interface: Remote splitter (PSTN/ISDN basic access) [8].

4.2.5.1 Performance requirements for VDSL2 modems

The performance testing related to VDSL2 shall be performed according to TR-114 [10] Annex B Physical Layer Test Cases for G.993.2 Region B (Europe) with further references to ETSI TS 101 270-1 [5] and clause 4.2.4.1 to this document. **Feil! Fant ikke referansekilden. Feil! Fant ikke referansekilden..**

Requirements for downstream and upstream capacity related to VDSL-services defined by Telenor correspond to table 68 of TR-114 [10].

4.2.5.2 Downstream and upstream bit rate performance

The VTU-R shall at least support downstream transmission according to figure 2 and table 1 on a 0.4 mm copper wire pair. The line shall be impaired with crosstalk noise (FEXT and NEXT) based on ITU-T G.993.2 with coupling functions defined in ETSI TS 101 270 /TS 101 388.

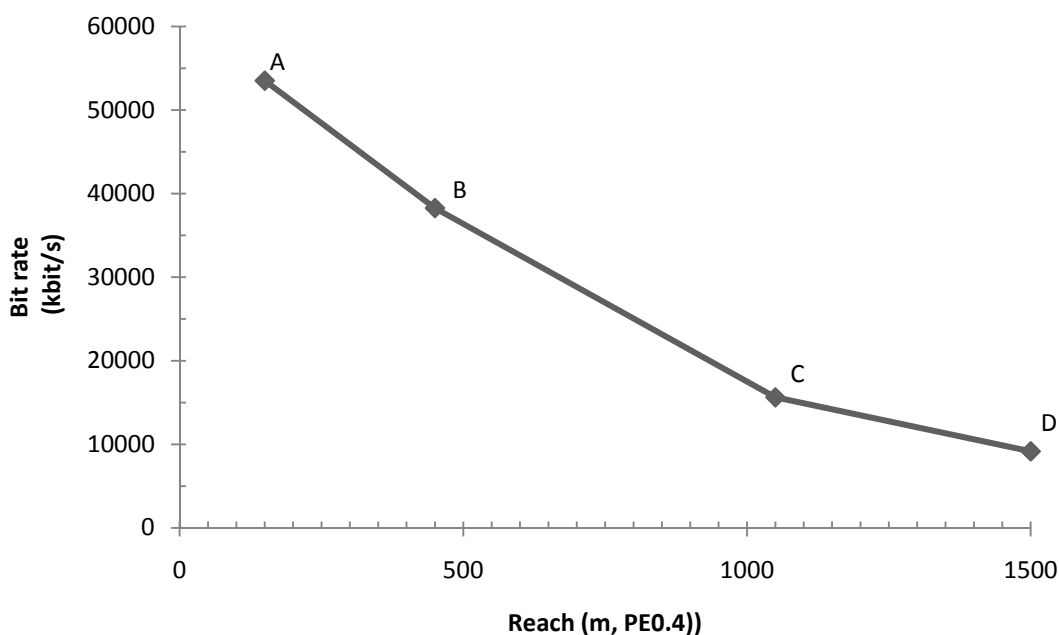


Figure 2 Rate-reach mask

Point	Reach (m, PE0.4mm loop)	Downstream Sync Rate (kbit/s)	Upstream Sync Rate (kbit/s)
A	150	53520	21392
B	450	38276	14228
C	1050	15628	2536
D	1500	9164	684

Table 1 Down-/upstream bit rate

4.2.5.3 Sync time

The sync time is expected to be less than 1 minute.

4.2.6 Requirements for limitation of impact on PSTN/ISDN

The requirements in this clause are based on ETSI ES 202913 [9].

Scenario 1 in ES 202913 [9] clause 4 is most likely to be used.

4.2.6.1 Polarity

Requirements in ES 202913 [9] clause 4.1 shall apply.

4.2.6.2 DC resistance

Requirements in ES 202913 [9] clause 4.2 shall apply.

4.2.6.3 Ringing impedance

Requirements in ES 202913 [9] clause 4.3 shall apply.

4.2.6.4 Transient response

Requirements in ES 202913 [9] clause 4.4 shall apply.

4.2.6.5 DC ringing current

Requirements in ES 202913 [9] clause 4.5 shall apply.

4.2.6.6 Impedance unbalance about earth

Requirements in ES 202913 [9] clause 4.6 shall apply.

4.2.6.7 DC resistance to earth

Requirements in ES 202913 [9] clause 4.7 shall apply.

4.2.6.8 Impedance for PSTN voice band (200 Hz – 4 000 Hz)

Requirements in ES 202913 [9] clause 4.8.1 shall apply.

4.2.6.9 Impedance for metering pulses (12 kHz and 16 kHz)

Requirements in ES 202913 [9] clause 4.8.2 shall apply.

4.3 Management and configuration

4.3.1 Vendor ID

The VTU-O should be able to identify the vendor of the remote VTU-R. The data in the vendor ID information block should be available as specified in ITU-T Rec. G.994.1 [6].

4.3.2 Dying gasp (Loss of power)

The VTU-R should be able to detect when the electrical power has been shut off according to ITU-T G.993.2 [4] Clause 11 - Operation and maintenance (OAM).

4.3.3 Fast channel

The VTU-R shall have a channel for fast transmission of data in both directions.

4.3.4 Interleaved channel down

The VTU-R shall have an interleaved channel in direction towards the customer that supports transmission of interleaved data with an interleaved depth of (9) or more.

4.3.5 Interleaved channel up

The VTU-R shall in direction towards the network have an interleaved channel that supports transmission of interleaved data with an interleaved depth of (9) or more.

4.4 PTM requirements

4.4.1 Functionality

4.4.1.1 Ethernet Parameters

Ethernet is used as transport medium to provide connections on layer 2 at the U-RV2 according to ch 4.2.3

4.4.1.2 Ethernet Structure

Ethernet frames shall be supported according to IEEE802.3 (CSMA/CD)

4.4.2 OAM loop back functions (recommendations)

EFM OAM according to IEEE 802.3ah and 802.1ag to support OAM capability discovery mechanism, remote Loopback and link monitoring, link performance monitoring for frames etc is recommended.

4.4.3 CPE WAN management (recommendation)

CPE WAN management should be according to TR-69.

4.5 Auxiliary requirements

4.5.1 No configuration needed

Before customer installation and start up, no configuration of the VTU-R defining parameters specified by mandatory requirements in this technical specification shall be necessary.

4.6 Physical interface and indicators

4.6.1 Customer premise's interface, U-R₀

The cord connecting the CPE to the access network shall be CAT3 or CAT5 and equipped with a plug mating a socket according to EN 60603-7 [13] (RJ45 also described as an 8P8C connector).

The wall socket (or equivalent female connector) complies with EN 60603-7 [13] (RJ45). Signals are present on pins 4 and 5.

4.6.2 VDSL port, U-R2 (recommandations)

Vendor's preference.

If the splitter functions are integrated within the VDSL modem (in VTU-R) the interfaces U-R2 and U-R2_A may not be present as external interfaces.

With RJ45 connectors on all or most of the interfaces (U-R, U-R2_A, U-R0 and PSTN/ISDN_R), it is more convenient to adapt different lengths of relevant interconnecting cords. In this case pins 4 and 5 should be used.

See also Telenor Specification A82, Specification for the network side of the user-network interface: Remote splitter (PSTN/ISDN basic access) [8].

4.6.3 Application interface, S/T (recommandations)

Connecting hardware may be selected to suite the relevant applications as indicated in clause 4.1, General.

4.6.4 Indication, power status

The VTU-R shall indicate presence of power.

4.6.5 Indication, link status

The VTU-R shall indicate the following status:

- VDSL link not available
- VDSL link available

4.6.6 Indication, link initialisation state (recommandations)

The VTU-R should indicate presence of link initialisation state (training).

4.6.7 Indication, traffic status (recommandations)

The VTU-R should indicate presence of VDSL link traffic.

4.7 Environmental requirements

4.7.1 CE-marking

Equipment shall comply with requirements specified in order to obtain the CE marking.

4.7.2 EMC

The EU directives concerning EMC are in force and conformance to these EU directives is mandatory. The EU directives are made legal also in Norway (1989/366/EØF, 1991/263/EØF, 1993/97/EØF, 1992/31/EØF, 1993/68/EØF, R&TTE Directive 1999/5/EC).

For requirements in Norwegian regulations, see the relevant EEC directives:

http://europa.eu.int/comm/enterprise/electr_equipment/emc/directiv/text.htm **Feil! Fant ikke referansekilden.** and http://europa.eu.int/comm/enterprise/rtte/index_en.htm [12]

4.7.3 Resistibility

4.7.3.1 Gas discharge tubes

The *provision* of gas discharge tubes is not mandatory. If gas discharge tubes are provided, the requirements in Telenor Specification OA 100 [3] shall apply.

4.7.3.2 Protection (recommendations)

The major power distribution system in Norway is the IT-system, which is more susceptible for electromagnetic disturbances. It is recommended that equipment connected to both telecommunication lines and to mains shall resist lightning pulses of 10 kV (enhanced test levels in K.21 [10]).

4.7.4 Climatic and mechanical recommendations

The modems (VTU-R) will typically be ordered in large quantities and distributed by one and one unit by public transportation.

4.7.4.1 Storage (recommendations)

Requirements in EN 300019-1-1 class 1.2 [15] apply for storage. Humidity is normally not controlled.

4.7.4.2 Transportation (recommendations)

Requirements in EN 300019-1-2 class 2.3 **Feil! Fant ikke referansekilden.** apply for public transportation.

4.7.4.3 Operational (recommendations)

Requirements in EN 300019-1-3 class 3.2 **Feil! Fant ikke referansekilden.** apply for stationary use at weather-protected locations. Equipment may be exposed to direct sunshine and humidity is normally not controlled. It is recommended that the equipment may operate over the temperature range of +5°C to +55°C.

4.8 Electrical safety

Requirements in CENELEC EN 60950 [14] apply in general.

Requirements in Norwegian regulations **Feil! Fant ikke referansekilden.:**

http://www.npt.no/pt_internet/venstremeny/regelverk/forskrifter.html
(Nr 0636 Forskrift om elsikkerhet i telenett)

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