



## Specification

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Title

# **Specification for the network side of the user-network interface: ADSL modem (ATU-R) ADSL/ADSL2/ADSL2plus**

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## 1. Scope

This specification describes the network side of ADSL access to the network of Telenor as prescribed in Article 4.2 of RTT&E-directive [16]. The requirements in Telenor Specification OA 100 [5] also apply.

This specification depicts requirements for an ADSL remote modem, ATU-R, interworking with an ATU-C installed in Telenor's DSLAM.

The objective is to ensure full interoperability between ADSL modems, ATU-C and ATU-R, from different vendors and with different hardware chip sets.

With a remote splitter the ATU-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 an ATU-R is made possible by the use of a non-overlapping frequency plan.

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

**NOTE:** *Presently the focus is to have ATU-R from different vendors working together with ISDN compatible line cards from:*

*Nokia D500 interface specification [1] or later releases                      and  
Alcatel interface specification [2] or later releases.*

In no event shall Telenor 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] Nokia *D500 DSLAM Public Interface Specification, Interface Specification D500 R. 3.2.x, R2.4 onwards, May 19. 2005 or updated/revised*
- [2] Alcatel 1000 ADSL (*Asymmetric Digital Subscriber Line*) and 7300 ASAM (*Advanced Services Access Manager*), *Network Compatibility Disclosure Document, ASAM Release 4.7/R4.7.05. (Dated December 23, 2004 or updated/revised)*
- [3] Alcatel Lucent 7302 ISAM compliance with xDSL modems (*Issue 1 - 2010*)
- [4] Telenor Specification OA 105, *Requirements for equipment to be connected to the local loop in the access network of Telenor. Equipment providing ADSL and PSTN or ISDN Basic Access services, full unbundled access (service type E<sub>AF</sub>)*

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<http://www.jara.no>

- [5] 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>
- [6] ITU-T Recommendation G.992.1 *Transmission Systems And Media – Asymmetrical Digital Subscriber Line (ADSL) Transceivers*
- [7] ITU-T Recommendation G.992.3, *Asymmetric digital subscriber line transceivers 2 (ADSL2)*
- [8] ITU-T Recommendation G.992.5: *Asymmetric Digital Subscriber Line (ADSL) transceivers – Extended bandwidth ADSL2 (ADSL2plus)*
- [9] ITU-T Recommendation G.994.1 *Handshake procedures for Digital Subscriber Line (DSL) transceivers*
- [10] ITU-T Recommendation I.610 *B-isdn operation and maintenance principles and functions abstract*
- [11] Telenor Specification A82: *Specification for the network side of the user-network interface: Remote splitter (PSTN/ISDN basic access)*
- [12] ETSI ES 202 913 *Access and Terminals (AT); POTS requirements applicable to ADSL modems when connected to an analogue presented PSTN line*
- [13] DSL Forum, Technical report TR-067, Issue 2, *ADSL interoperability test plan*, December 2004.
- [14] DSL Forum, Working text TR-100, *ADSL2/ADSL2plus Performance Test Plan*.
- [15] ITU-T Recommendation K.21 *Resistibility of telecommunication equipment installed in customer's premises to overvoltages and overcurrents*
- [16] Directive R&TTE 1999/05/EEC: (The Radio Equipment and Telecommunications Terminal Equipment)  
[http://ec.europa.eu/enterprise/sectors/rtte/documents/guidance/index\\_en.htm](http://ec.europa.eu/enterprise/sectors/rtte/documents/guidance/index_en.htm)
- [17] CENELEC EN 60603-7:1996, *Connectors for frequencies below 3 MHz for use with printed boards – Part 7: Detail specification for connectors, 8 way, including fixed and free connectors with common mating features (IEC 60603-7:1996)*
- [18] CENELEC EN 60950 *Safety of information technology equipment (IEC 60950)*

## 2.2 Informative references

- [19] 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*
- [20] 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*

- [21] 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 weatherprotected locations*
- [22] 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)
- [23] 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](http://ec.europa.eu/enterprise/policies/european-standards/documents/harmonised-standards-legislation/list-references/electromagnetic-compatibility/index_en.htm)
- [24] Norwegian regulations:  
<http://www.lovddata.no/for/sf/sd/sd-20000620-0628.html>

### 3. Definitions

- ETSI FB noise Line impairment type defined by ETSI. Details can be found in the ETSI TS 101 388 [22].
- Synctime “Synctime” 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.
- ADSL access Access line fitted with ADSL transmission equipment supporting ITU-T recommendations G.992.1, G.992.3, G.992.5 or other ADSL (pre-) standards.

#### 3.1 Abbreviations

ADSL	Asymmetric digital subscriber line
ASAM	ATM subscriber access multiplexer (DSLAM)
ATM	Asynchronous transfer mode
ATU	ADSL Transceiver Unit
ATU-C	ATU at the central office end (i.e network operator)
ATU-R	ATU at the remote terminal end (i.e Customer Premises)
CPE	Customer Premises Equipment (usually an ATU-R and splitter)
DHCP	Dynamic host configuration protocol
DSLAM	Digital subscriber line access multiplexer (usually housing the ATU-C)
DTE	Data terminal equipment
ETSI	European Telecommunications Standards Institute
ISDN	Integrated services digital network
ITU-T	International Telecommunication Union – Telecommunication sector
NAT	Network address translation
nrt-VBR	Non-real-time variable bit rate
OAM	Operation, administration and maintenance
PC	Personal computer
PCI	Peripheral component interconnect
PSTN	Public switched telephone network
PVC	Permanent virtual connection
TE	Terminal equipment
UBR	Unspecified bit rate
UBR+	UBR with minimum cell rate (MCR) specified
USB	Universal serial bus
VBR.3	Conformance definition according to ATM Forum TM4.0. (Cells above SCR but within PCR shall be tagged)

VCI	Virtual channel identifier
VPI	Virtual path identifier
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 ATU-R shall comply with the generic specification, Telenor Specification OA 100 [5].

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

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

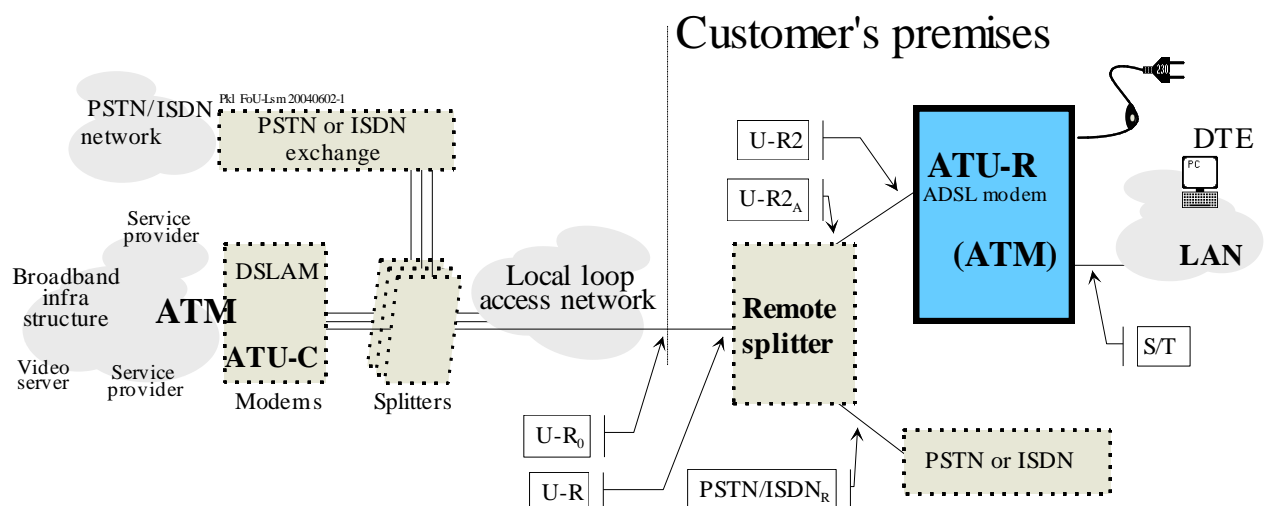


Figure 1 ADSL system functionality

The ATU-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: *Specification for the network side of the user-network interface: Remote splitter (PSTN/ISDN basic access)* [11].

### 4.2 Transmission requirements

The support of ADSL (i.e. ITU-T Rec. G.992.1) is mandatory.

The support of ADSL2 is optional.

The support of ADSL2plus is optional.

#### 4.2.1 Electrical and functional requirements

The ATU-R shall comply with Telenor Specification OA 105 [2].

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ITU-T Rec. G.992.1 [6] 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 ATU-R at customer premises are specified.

#### 4.2.1.1 ADSL2 and ADSL2plus (optional)

ITU-T Rec. G.992.3 [7] Annex B defines the minimal set of requirements to provide satisfactory transmission between the network and the customer interface.

ADSL2: Requirements in both Alcatel interface specification [2] or [3] and in Nokia D500 interface specification [1] regarding ITU-T Rec. G.992.3 Annex B [7] shall apply.

ADSL2plus: Requirements in both Alcatel interface specification [2] or [3] and in Nokia D500 interface specification [1] regarding ITU-T Rec. G.992.5 Annex B [8] shall apply.

#### 4.2.2 Frequency division multiplexing

ATU-R shall use frequency division multiplexing (FDM). See appropriate recommendations (i.e. according to ITU-T Rec. G.992.1 [6], G.992.3 [7]).

#### 4.2.3 ATM transport

The equipment shall transport ATM cells over ADSL. See appropriate recommendations (i.e. according to ITU-T Rec. G.992.1 [6], G.992.3 [7]). For cell transport, the ATM-specific parts shall apply.

#### 4.2.3.1 ADSL2 and ADSL2plus (optional)

ADSL2/ADSL2plus: Requirements in both Alcatel interface specification [2] and in Nokia D500 interface specification [1] regarding ITU-T Rec. G.992.3 [7] (or ITU-T Rec. G.992.5 [8]) shall apply.

#### 4.2.4 Interworking with Telenor's ATU-C according to G.992.1 annex B

The bit transport using ATM over ADSL is presently supplied by two vendors of ATU-C; Alcatel or Nokia. The ATU-R shall comply with both vendors, according to 4.2.4.1, 4.2.4.2 **Feil! Fant ikke referansekinden.** and 4.2.4.3.

#### 4.2.4.1 Compatibility for Alcatel 1000 and 7300 with ISDN compatible line cards

The ATU-R shall interwork with the ATU-C depicted in Alcatel interface specification [2] regarding ITU-T Recommendations.

#### 4.2.4.2 Compatibility for Alcatel Lucent ISAM 7302 ISDN compatible line cards

The ATU-R shall interwork with the ATU-C as defined in *Alcatel Lucent 7302 ISAM compliance with xDSL modems* [3] regarding ITU-T Recommendations.

#### 4.2.4.3 Compatibility for Nokia D500 ISDN compatible line cards

The ATU-R shall interwork with the ATU-C depicted in Nokia D500 interface specification [1].

#### 4.2.5 Interworking with Telenor's ATU-C with ADSL2 or ADSL2plus functionality (Optional)

When ADSL2 or ADSL2plus functionality is provided, the requirements in both 4.2.5.1 and in 4.2.5.2 shall apply.



#### 4.2.5.1 Compatibility for Alcatel 7300 with ISDN compatible line cards

ADSL2/ADSL2plus: The ATU-R shall interwork with the ATU-C depicted in Alcatel interface specification [2] regarding respectively ITU-T Rec. G.992.3 Annex B [7] or ITU-T Rec. G.992.5 Annex B [8].

#### 4.2.5.2 Compatibility for Nokia D500 with ISDN compatible line cards

The ATU-R shall interwork with the ATU-C depicted in Nokia D500 interface specification [1] regarding respectively ITU-T Rec. G.992.3 Annex B [7] or ITU-T Rec. G.992.5 Annex B [8].

#### 4.2.6 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) [11].

The conformance testing related to ADSL (i.e. ITU Rec. G.992.1) shall be performed respecting conditions in TR-067 [13] and clauses 4.2.4.1, **Feil! Fant ikke referansekilden.** and 4.2.4.3.

The conformance testing related to ADSL2 and ADSL2plus shall be performed respecting conditions in WT-100 [14] and clauses 4.2.5.1 and 4.2.5.2.

Requirements for downstream capacity are contained in table 4.1 and requirements for upstream capacity are contained in table 4.2.

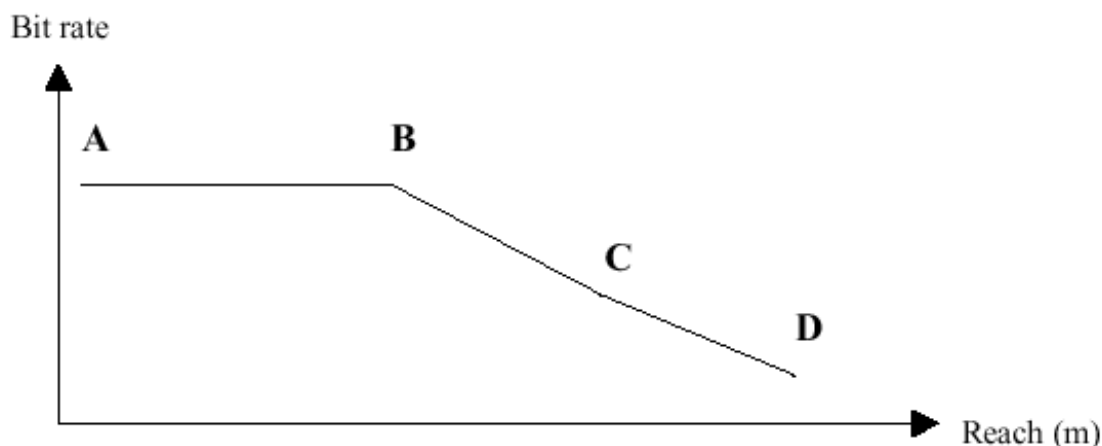


Figure 2 Rate-reach mask

##### 4.2.6.1 Downstream bit rate

Point (Figure 2)	Reach (m)	ADSL (G.992.1) (kbit/s)	ADSL2 (kbit/s)	ADSL2plus (kbit/s)
A	100	5 024	5 230	16 256
B	1000	6 720	7 296	13 024
C	2000	3 520	4 160	5 152
D	2750	128	224	224
Test conditions		TR-067 [13] See clauses 4.2.4.1, <b>Feil! Fant ikke referansekilden.</b>	TR-100 [14] See clauses 4.2.5.1 and 4.2.5.2	TR-100 [14] See clauses 4.2.5.1 and 4.2.5.2

	and 4.2.4.3		
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**Table 4.1 Downstream bit rate**

#### 4.2.6.2 Upstream bit rate

Point (Figure 2)	Reach (m)	ADSL (G.992.1) (kbit/s)	ADSL2 (kbit/s)	ADSL2plus (kbit/s)
A	100	768	768	768
B	1000	768	768	768
C	2000	480	480	480
D	2750	128	128	128
Test conditions		TR-067 [13] See clauses 4.2.4.1, <b>Feil! Fant ikke referansekinden.</b> and 4.2.4.3	TR-100 [14] See clauses 4.2.5.1 and 4.2.5.2	TR-100 [14] See clauses 4.2.5.1 and 4.2.5.2

**Table 4.2 Upstream bit rate**

#### 4.2.6.3 Syncntime

The syncntime shall be less than 1 minute. The syncntime shall be measured at the points given in according to 4.2.6.1 and 4.2.6.2.

#### 4.2.7 Requirements for limitation of impact on PSTN/ISDN

The requirements in this clause are based on ETSI ES 202913 [12].

Scenario 1 in ES 202913 [12] clause 4 is most likely to be used.

##### 4.2.7.1 Polarity

Requirements in ES 202913 [12] clause 4.1 shall apply.

##### 4.2.7.2 DC resistans

Requirements in ES 202913 [12] clause 4.2 shall apply.

##### 4.2.7.3 Ringing impedance

Requirements in ES 202913 [12] clause 4.3 shall apply.

##### 4.2.7.4 Transient response

Requirements in ES 202913 [12] clause 4.4 shall apply.

##### 4.2.7.5 DC ringing current

Requirements in ES 202913 [12] clause 4.5 shall apply.

##### 4.2.7.6 Impedance unbalance about earth

Requirements in ES 202913 [12] clause 4.6 shall apply.

##### 4.2.7.7 DC resistance to earth

Requirements in ES 202913 [12] clause 4.7 shall apply.

#### **4.2.7.8 Impedance for PSTN voice band (200 Hz – 4 000 Hz)**

Requirements in ES 202913 [12] clause 4.8.1 shall apply.

#### **4.2.7.9 Impedance for metering pulses (12 kHz and 16 kHz)**

Requirements in ES 202913 [12] clause 4.8.2 shall apply.

### **4.3 Management and configuration**

#### **4.3.1 Vendor ID**

The ATU-C should be able to identify the vendor of the remote ATU-R. The data in the vendor ID information block should be available as specified in ITU-T Rec. G.994.1 [9].

#### **4.3.2 Dying gasp (Loss of power)**

The ATU-R should be able to detect when the electrical power has been shut off according to ITU-T Rec. G.992.1 [6] or ITU-T Rec. G.992.3 [7].

#### **4.3.3 Fast channel**

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

#### **4.3.4 Interleaved channel down**

The ATU-R shall in direction towards the customer have an interleaved channel that supports transmission of interleaved data with an interleaved depth of 8 or more.

#### **4.3.5 Interleaved channel up**

The ATU-R shall in direction towards the network have an interleaved channel that supports transmission of interleaved data with an interleaved depth of 4 or more.

### **4.4 ATM requirements**

#### **4.4.1 Functionality**

The present ATM service categories supported by Telenor are UBR.1, UBR+ and nrt-VBR with conformance VBR.3.

#### **4.4.2 F5 loop back**

The ATM OAM F5 end-to-end or segment loop-back functionality at virtual channel level according to ITU-T Rec. I.610 [10] shall be supported.

#### **4.4.3 VPI/VCI**

At least one PVC shall be preconfigured:  
VPI/VCI = 8/35.

### **4.5 Auxiliary requirements**

#### **4.5.1 No configuration needed**

Before customer installation and start up, no configuration of the ATU-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-R<sub>0</sub>**

The cord connecting the CPE to the access network shall be equipped with a plug mating a socket according to EN 60603-7 [17] (RJ45).

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The wall socket (or equivalent female connector) complies with EN 60603-7 [17] (RJ45). Signals are present on pins 4 and 5.

#### **4.6.2 ADSL port, U-R2 (recommendations)**

Vendor's preference.

If the splitter functions are integrated within the ADSL modem (in ATU-R) the interfaces U-R2 and U-R2<sub>A</sub> may not be present as external interfaces.

With RJ45 connectors on all or most of the interfaces (U-R, U-R2<sub>A</sub>, U-R0 and PSTN/ISDN<sub>R</sub>), 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)* [11].

#### **4.6.3 Application interface, S/T (recommendations)**

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

#### **4.6.4 Indication, power status**

The ATU-R shall indicate presence of power.

#### **4.6.5 Indication, link status**

The ATU-R shall indicate the following status:

- ADSL link not available
- ADSL link available

#### **4.6.6 Indication, link initialisation state (recommendations)**

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

#### **4.6.7 Indication, traffic status (recommendations)**

The ATU-R should indicate presence of ADSL 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, 1999/05/EØF).

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

[http://ec.europa.eu/enterprise/policies/european-standards/documents/harmonised-standards-legislation/list-references/rtte/index\\_en.htm](http://ec.europa.eu/enterprise/policies/european-standards/documents/harmonised-standards-legislation/list-references/rtte/index_en.htm)

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## 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 [5] clause 6.3 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 (instead of 4/6 kV as stated in K.21 [15]).

## 4.7.4 Climatic and mechanical recommendations

The modems (ATU-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 [19] apply for storage. Humidity is normally not controlled.

### 4.7.4.2 Transportation (recommendations)

Requirements in EN 300019-1-2 class 2.3 [20] apply for public transportation.

### 4.7.4.3 Operational (recommendations)

Requirements in EN 300019-1-3 class 3.2 [21] 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 [18] apply in general.

Requirements in Norwegian regulations [24]: <http://www.lovdatab.no/cgi-wift/ldles?doc=/sf/sf/sf-20000620-0628.html>