

**Public Switched Telephone Network (PSTN);
Network Termination Point (NTP) analogue interface;
Specification of physical and electrical characteristics
at a 2-wire analogue presented NTP
for short to medium length loop applications**



Reference

REG/ATA-006003

Keywords

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Foreword

This ETSI Guide (EG) has been produced by ETSI Project Analogue Terminals and Access (ATA).

Introduction

The present process of harmonization of the 2-wire analogue voice band switched interface (traditionally PSTN) has focussed on harmonization of the terminal equipment. Now that the terminal harmonization process is nearing completion, it becomes feasible to move towards harmonization of the network interface itself. This is particularly true for new local access delivery systems which tend to provide service via short local loops.

It is not suggested that installed networks be upgraded to meet the proposed specification since this would clearly be uneconomic. Existing operators may, however, consider that there are benefits in evolving their network interfaces towards a common specification as network elements are replaced.

1 Scope

The present document is applicable to an analogue presented Network Termination Point (NTP) intended to deliver 3,1 kHz voiceband services which terminates a Public Switched Telephone Network (PSTN) with short to medium length 2-wire local loops, independently of the technologies used in the access part of the network itself.

NOTE: The local loop might use Fixed Wireless Access, xDSL or other technologies. The network itself might also be of different types. There may be a need for filtering in case of non-desirable connections (signal transfer) between these technologies and the NTP specified in the present document. For the purpose of the present document, a "short to medium length 2-wire local loop" has a loop resistance not greater than 750 Ω .

The objective of the present document is to specify the physical and electrical characteristics at an analogue NTP particularly suitable for use by new network operators, or by operators operating in several European countries; operators of existing PSTNs are not expected to modify their network to align with the present document. The present document specifies characteristics of the NTP to enable it to operate with most existing national PSTN Terminal Equipment (TE), and especially with PSTN TE designed according to the European standards for analogue presented TEs.

The electrical conditions specified at the NTP are sufficient to ensure satisfactory operation of the following functions of TE:

- a) call control;
- b) transmission;
- c) dialling;
- d) ringing.

The present document also aims to identify the parameters that may be included in a declaration of the technical characteristics of a network interface as required by Article 11 of Directive 98/10/EC [21] on the application of Open Network Provision (ONP) to voice telephony and on universal service for telecommunications in a competitive environment. The values of the parameters in such a declaration are outside the scope of the present document.

The present document does not specify the design characteristics of an equipment delivering the NTP.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] TBR 21: "Terminal Equipment (TE); Attachment requirements for pan-European approval for connection to analogue Public Switched Telephone Networks (PSTNs) of TE (excluding TE supporting the voice telephony service) in which network addressing, if provided, is by means of Dual Tone Multi Frequency (DTMF) signalling".

[2] Void.

- [3] TBR 38: "Public Switched Telephone Network (PSTN); Attachment requirements for a terminal equipment incorporating an analogue handset function capable of supporting the justified case service when connected to the analogue interface of the PSTN in Europe".
 - [4] ETS 300 659: "Public Switched Telephone Network (PSTN); Subscriber line protocol over the local loop for display (and related) services".
 - [5] ETS 300 778: "Public Switched Telephone Network (PSTN); Protocol over the local loop for display and related services; Terminal Equipment requirements".
 - [6] ITU-T Recommendation G.711 (1988): "Pulse code modulation (PCM) of voice frequencies".
 - [7] TR 101 183: "Public Switched Telephone Network (PSTN); Analogue ringing signals".
 - [8] Void.
 - [9] ETR 206: "Public Switched Telephone Network (PSTN); Multifrequency signalling system to be used for push-button telephones [CEPT Recommendation T/CS 46-02 E (1985)]".
 - [10] Miniature 6-position plug as described in FCC 47, CFR 68.500: "Code of Federal Regulations (USA); Title 47 Telecommunication; Chapter 1 Federal Communications Commission, Part 68 Connection of Terminal Equipment to the Telephone Network; Subpart F Connectors; Section 68.500 Specification".
- NOTE: The above document can be obtained from:
- Superintendent of Documents
Washington DC 20402
United States
Tel: + 1 202 512 18003
- [11] ETR 201: "Public Switched Telephone Network (PSTN); Register-recall [CEPT Recommendation T/CS 20-09 E (1980)]".
 - [12] ITU-T Recommendation Q.35/E.180 (1998): "Technical characteristics of tones for the telephone service".
 - [13] TR 101 041-1: "Human Factors (HF); European harmonization of network generated tones; Part 1: A review and recommendations".
 - [14] ETR 344: "Terminal Equipment (TE); The technical feasibility of a harmonized plug and socket standard for European Public Switched Telephone Network (PSTN) access".
 - [15] ES 201 187: "2-wire analogue voice band switched interfaces; Loop Disconnect (LD) dialling specific requirements".
 - [16] EG 201 120: "Public Switched Telephone Network (PSTN); Method of rating terminal equipment so that it can be connected in series and/or in parallel to a Network Termination Point (NTP)".
 - [17] ITU-T Recommendation Q.552 (1996): "Transmission characteristics at 2-wire analogue interfaces of digital exchanges".
 - [18] ITU-T Recommendation G.117 (1996): "Transmission aspects of unbalance about earth".
 - [19] ITU-T Recommendation G.123 (1988): "Circuit noise in national networks".
 - [20] ITU-T Recommendation G.101 (1996): "The transmission plan".
 - [21] Directive 98/10/EC of the European Parliament and of the Council of 26 February 1998 on the application of open network provision (ONP) to voice telephony and on universal service for telecommunications in a competitive environment.
 - [22] ITU-T Recommendation V.90 (1998): "A digital modem and analogue modem pair for use on the Public Switched Telephone Network (PSTN) at data signalling rates of up to 56 000 bit/s downstream and up to 33 600 bit/s upstream".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

answer signal: indication that a terminal is answering an incoming call

called party answer signal: signal which may be provided at the call originating NTP by the network to indicate that the called party has answered the call

clear indication: indication that the network is attempting to release a connection

clear signal: signal indicating that a terminal is attempting to release a connection

end-of-call signal: signal provided at the NTP by the network to indicate that the call has been released

longitudinal conversion loss: measure of the degree of unbalance about earth. More information is given in ITU-T Recommendation G.117 [18] subclause 4.1.3

Network Termination Point (NTP): physical point at the boundary of the PSTN intended to accept the connection of a TE. See figure 1

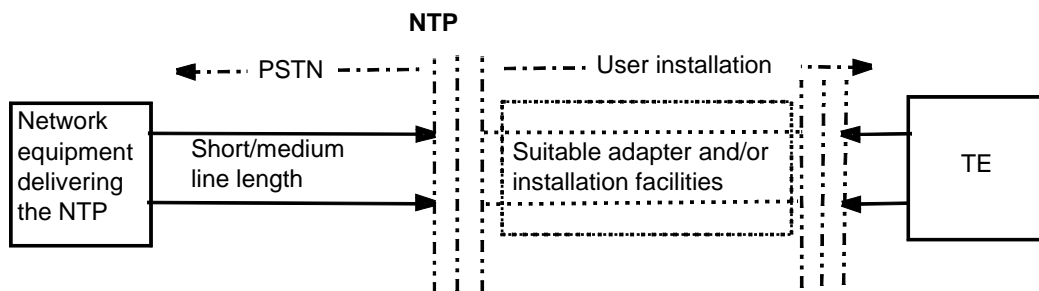


Figure 1: Network Termination Point

ringing state: condition of the network where a ringing/alerting signal has been applied at the NTP

ring trip: removal of the ringing signal at the NTP in response to a valid answer signal applied to the NTP

seize signal: signal indicating that a terminal is attempting to establish a connection by means of applying a loop condition

3.2 Symbols

For the purposes of the present document, the following symbols apply:

dBV	the absolute voltage level expressed as dB relative to 1 V
dBm0	the absolute power level in dBm referred to a point of zero relative level (dBm the absolute power level expressed as dB relative to 1 mVA)
dBr	the relative level of a signal in a transmission path referred to the level at a reference point on the path

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AC	Alternating Current
AGC	Automatic Gain Control
ALASS	Analogue Local Access Signalling Services
DC	Direct Current
DCE	Data Circuit-terminating Equipment
DTE	Data Terminal Equipment
DTMF	Dual Tone Multi Frequency
IDP	Inter-Digital Pause
LD	Loop Disconnect
LF	Loading Factor
LU	Loading Unit
NTP	Network Termination Point
ONP	Open Network Provision
PCM	Pulse Code Modulation
PSTN	Public Switched Telephone Network
RLR	Receiving Loudness Rating
SLR	Sending Loudness Rating
TE	Terminal Equipment
xDSL	x (A, H, V, lite...) Digital Subscriber Line

4 General

The operator should describe any functions that are provided at the NTP such as protection, line test or filtering to support other services such as private metering or xDSL, insofar as these influence the behaviour at the NTP.

The performance at the NTP is intended to ensure that:

- the interface presented by the NTP will interwork successfully with TE compliant with PSTN TE TBRs (TBR 21 [1] and TBR 38 [3]) and will support voice band services accessible across the interface;
- the network being presented at the NTP will not suffer harm as a result of signals normally appearing at such an interface, when used under real-life conditions, including when TE compliant with PSTN TBRs (TBR 21 [1] and TBR 38 [3]) are connected via the NTP.

The following states and conditions are described in the present document:

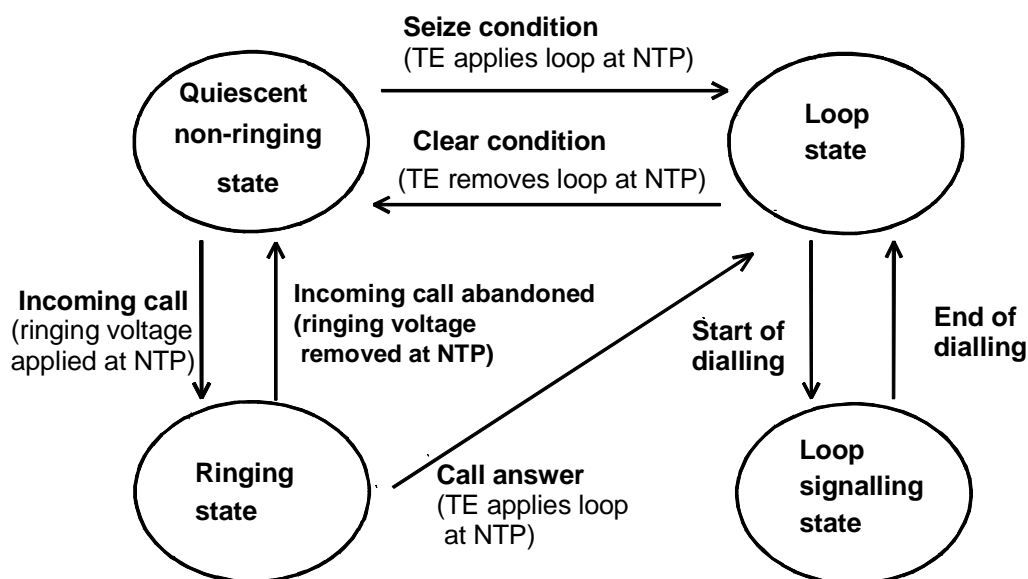


Figure 2: States and conditions

5 Physical connections

5.1 Mechanical Aspects

The physical presentation should be specified in such a way that a terminal manufacturer can supply a suitable terminal connector. The connection arrangements should either be according to established national practice or by the arrangement described below. A selection of national arrangements are described in ETR 344 [14].

Recommended harmonized arrangement:

Where the NTP is presented as a socket it should be a socket capable of connecting with a miniature 6-position plug as specified in FCC 47, CFR 68.500 [10] clause (a) with contact assignments as specified in table 1. This connector is often referred to as RJ 11/12.

Table 1: Contact assignments

Contact number	Pin allocation
1	Unspecified
2	Unspecified
3/4	Pair (A- and B-wire)
5	Unspecified
6	Unspecified

NOTE: In some cases the NTP is located outside of the user premises in which case the physical presentation may be realized as a set of connection contacts (e.g. a screw terminal block).

5.2 Support of more than one terminal

5.2.1 Wiring arrangement

The operator should inform his customers of wiring arrangements for the connection of additional terminals. The instructions should be expressed in a way that makes it straightforward for a customer to add additional points for connection of terminals.

5.2.2 Loading Factors

The operator should inform the users about the maximum numbers of terminals that can be supported at the NTP. This information should be supplied in terms of a Loading Factor (LF), as defined in EG 201 120 [16], for the parameters given in table 2.

The LF specified by the operator should be the lowest of the LFs for the individual parameters of table 2, rounded down to the nearest whole number.

The NTP should operate with an LF of at least 100 LU.

NOTE: In addition to the LF-value discussed above, the operator is invited to also give the applicable LF-values of each individual parameter. This more detailed information would enable a skilled user to take full advantage of the available resources at the NTP.

Table 2: Calculation of Loading Factors

Operating state of TE	Parameter	Test method	Value for 100 LU	Formula for calculation of LF and unit for input data
Quiescent	Resistance to earth	TBR 21 [1], A.4.4.4	$R = 10 \text{ M}\Omega$	$1\,000/R [\text{M}\Omega]$
Quiescent	DC resistance	TBR 21 [1], A.4.4.1	$R = 1 \text{ M}\Omega$	$100/R [\text{M}\Omega]$
Ringing	Lowest impedance at 25 Hz	TBR 21 [1], A.4.4.2.1	$Z = 4 \text{ k}\Omega$	$400/Z [\text{k}\Omega]$
Ringing	DC current during ringing	TBR 21 [1], A.4.4.2.3	$I = 0,6 \text{ mA}$	$100 \times I / 0,6 [\text{mA}]$

6 DC feed conditions

6.1 Polarity

The polarity of the DC voltage presented at the NTP is arbitrary with respect to the NTP terminals.

6.2 Quiescent state

6.2.1 Maximum voltage

The maximum open circuit DC voltage presented between the A- and B- wires of the NTP should not exceed 78 V.

NOTE: See notes in subclause 6.2.2.

6.2.2 Minimum voltage

When a resistor with a value of $100/\text{LF} \text{ M}\Omega$, where LF is the stated LF arising from subclause 5.2.2 (if individual LF-values are given as suggested by the note in subclause 5.2.2, the LF is taken from table 2, "DC resistance in quiescent state"), is connected between the A- and B- wires of the NTP, the continuous DC voltage appearing at the NTP should not be less than 38 V.

NOTE 1: It is intended to reduce this value in the future to 21 V. At the same time, the possibility to lower the maximum voltage should be considered.

NOTE 2: Some existing designs of terminal require a minimum DC voltage of 38 V at the NTP in order to function correctly in quiescent state. There are some pressures from the market to reduce the power consumption further for short loop line interfaces. It is recommended that future designs of terminal equipment should assume that a minimum DC voltage of 21 V at the NTP will be available in quiescent state.

6.2.3 Supply interruption

Many types of terminal equipment rely on the continuous application of exchange battery voltage for the correct functioning of features.

It is recommended that during the quiescent state the network feed voltage applied at the NTP should not be removed for periods longer than 10 s for maintenance or other purposes.

6.3 Loop current

6.3.1 Loop current range

When a resistor with a value in the range $0\ \Omega$ to $500\ \Omega$ is connected between the A- and B- wires at the NTP, a minimum DC current of 18 mA should flow but should never exceed 55 mA. It is recommended that the DC current is in the range of 25 mA to 40 mA.

NOTE 1: 18 mA is the minimum current required to match the TE access requirements for interworking with the network.

NOTE 2: The minimum current takes into account the resistance of the internal wiring between NTP and the sockets for TE connections, and possible series TEs.

6.3.2 Loop current interruptions caused by the terminal

Brief loop current interruptions (where the current is no more than 1,0 mA) of up to 20 ms between the A- and B- wires should not cause any change of condition at the NTP.

7 Seize signal

7.1 Must not seize condition

When a resistor with a value such as to cause a loop current not greater than 3,0 mA DC to flow is connected at the A- and B- wires of the NTP, it should not be recognized by the network as a seize signal.

The network should not recognize a seize condition when the loop current changes from quiescent to loop levels for a period of less than a value stated by the operator. This value should not be less than 10 ms.

7.2 Must seize condition

When a resistor with a value such as to cause a loop current not less than 10,0 mA DC to flow is connected for a period of greater than a value stated by the operator at the A- and B- wires of the NTP, it should be correctly accepted by the network as a seize signal. The stated value should not be higher than 150 ms.

NOTE: Some designs of line interface, particularly those with constant current feed, use a high impedance monitoring facility with a reduced current drive capability to check for a seize condition before applying the normal loop current drive capability. For example, 50 V may be applied via a 10 k resistor (i.e. a maximum current of 5 mA) with a seize current threshold of 4 mA. Similarly, some designs of terminal equipment, particularly line powered TE using solid state hookswitches, may assume the instant availability of a minimum loop current of say 18 mA. Such designs of terminal may not achieve the loop state condition if only 5 mA is available due to insufficient current to fully operate the electronic hookswitch. While in this partial loop state condition, TE may present an equivalent resistance up to 5 k instead of the normal loop state condition. Care needs to be taken to ensure that proper startup occurs when such terminals and line interfaces are inter-working. This may best be achieved by meeting the following additional transient seize condition: It is recommended that during the transition from quiescent state to loop state, the NTP should be capable of supplying a minimum current of 4 mA into a load of 5 k Ω for a minimum period of 20 ms. This implies that for TE to correctly seize network interfaces providing a partial loop current, they should be developed so as to present an equivalent resistance not exceeding 5 k Ω with a loop current of 4 mA.

8 Clear signal

8.1 Clear signal generated by TE

In order to ensure satisfactory operation of the seize/clear function, hysteresis of the seize and clear currents should normally be provided. The clear signal threshold current should be at least 2,0 mA lower than the seize signal threshold current.

When the load applied at the A- and B- wires of the NTP is such as to reduce the loop current below the clear threshold current for a period:

- a) less than 250 ms, the network should not accept this as a clear signal; and
- b) greater than 500 ms, the network should accept this as a clear signal and release the loop condition at the NTP.

These time period values are valid for the calling party. For the called party, other values are possible (usually much longer times, e.g. to allow for the called party to change from one TE to another), and should be stated by the operator.

8.2 Clear indication from the network

Depending upon the network characteristics, a connection may be cleared:

- a) as a result of calling party TE providing a clear signal to the network; or
- b) as a result of either the calling party or the called party TE providing a clear signal to the network; or
- c) at the instigation of the network itself, independently of the state of the calling party or the called party.

A PSTN end-of-call signal should be applied at the NTP when the connection is cleared. This should be given as a release tone as specified in subclause 13.3.

NOTE: In case other end-of-call signals are used in addition to the release tone, e.g. polarity reversal (see subclause 14.5) or K-break (see subclause 14.6), it needs to be specified by the operator.

8.3 Seizing the line for a new call

After the network has recognized the call clear signal from the TE, the NTP shall allow the TE to seize the line for a new call according to clause 7. In particular, an event indicating that a new seizure condition has been applied by the TE should not be ignored whenever it occurs following recognition by the network of a call clear signal.

NOTE: This applies to both cases (clearing from calling and called party) mentioned in clause 8.1.

9 Impedance

9.1 NTP impedance

The impedance presented by the network between the A- and B- wires of the NTP when in the loop state should have a return loss not less than the values shown in table 3 (linear dB - logarithmic frequency scale) with respect to the reference impedance Z_{ref} shown in figure 3. This requirement should be met for any DC current that can be delivered at the NTP (i.e. between the short circuit current and 18 mA).

Table 3: Return loss requirements

Frequency [Hz]	Requirement [dB]
200 - 300	8
300 - 500	8 - 10
500 - 1 250	10 - 14
1 250 - 3 400	14
3 400 - 3 800	14 - 12

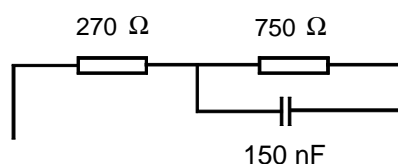


Figure 3: Reference impedance Z_{ref}

NOTE 1: Where the line length between the NTP and the interface card of the terminating unit is very short, it is assumed that return loss values are close to those specified for the interface card itself. It is advised that the design of the line card follows relevant ITU-T Recommendations, in particular Recommendation Q.552 [17]. It should be noted that the frequency range has been extended to accommodate voice band data applications.

NOTE 2: Values in table 3 at low to medium frequencies may not be achieved where the loop resistance between the NTP and the interface card of the terminating unit is greater than 750 Ω.

9.2 Balance about earth

The balance about earth at the NTP, measured as Longitudinal Conversion Loss, should not be less than the values given in table 4 (the higher value applies at the transition frequency):

Table 4: Balance about earth requirements

Frequency [Hz]	Requirement [dB]
50	40
200 - 600	40
600 - 3800	46

NOTE 1: It is recognized that this requirement may be difficult to measure at the NTP. It should be interpreted as a design target for the equipment delivering the NTP (where it can be measured), and also in the choice of cable (the copper pairs of the cable should have a sufficiently high balance).

NOTE 2: These values are taken from ITU-T Recommendation Q.552 [17], except that the frequency range has been extended to accommodate voice band data applications.

10 Transmission

NOTE 1: The transmission performance aspects are given at the NTP, not at the output/input of the equipment delivering the NTP. It is however advised that the design of such interface cards is based on ITU-T Recommendation Q.552 [17]. Interfaces complying with Q.552 [17] will meet the requirements of this clause (note that Q.552 [17] does not specify the exact value of relative levels).

NOTE 2: Due to the fact that this is a specification of the NTP and not a specification of the equipment delivering the NTP, only one observation point is available. Thus in principle it is not possible to state performance between two points. However, a fictitious point in the transmit- and receive digital path (A-law PCM, 0 dBr) is established for reference purposes. The following subclauses are based on the existence of this fictitious point.

10.1 Relative level

To enable full signal handling capacity, the nominal relative levels (at 1 020 Hz) at the NTP should be:

Input relative level $L_i = +4 \pm 2$ dBr;

Output relative level $L_o = -11 \pm 2$ dBr.

NOTE 1: The concept of relative levels is described in ITU-T Recommendation G.101 [20].

NOTE 2: These relative levels are chosen to obtain optimum performance for a speech telephony terminal in accordance with TBR 38 [3] having nominal SLR = +3 dB and RLR = -8 dB.

NOTE 3: Some types of line interfaces which provide constant DC current feeding will prevent the Automatic Gain Control (AGC) function of existing TEs from operating. Therefore it is recommended that such line cards provide an AGC function in order to provide acceptable performance especially on short line lengths.

The relative level is assumed to be 0 dBr on the digital side of the analogue/digital conversion point in the local network. See figure 4.

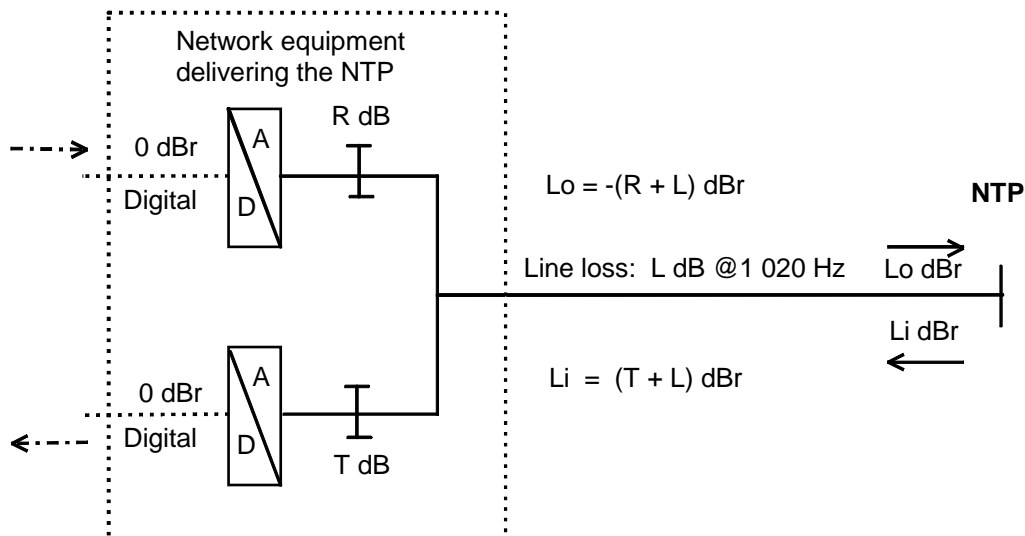


Figure 4: Relative levels

10.2 Frequency response

The nominal frequency band available at the NTP should be in line with ITU-T Recommendation Q.552 [17].

NOTE 1: It is assumed that the line card is designed according to ITU-T Recommendation Q.552 [17]. Where the line length is negligible, the frequency response at the NTP (when terminated with the reference impedance shown in figure 4) is about the same as for the line card itself.

NOTE 2: Attention is drawn to the need to accommodate voice band data applications which require a greater bandwidth for optimum operation (e.g. ITU-T Recommendation V.90 [22] modems). It is recommended that the bandwidth available be as wide as is practicable in order to accommodate such applications.

10.3 Coding law

Where other than A-law conversion according to ITU-T Recommendation G.711 [6] is used, this should be stated.

NOTE 1: The distortion depends on technology used to provide the path to the NTP. Where radio technology has been deployed, low bit rate coders are normally used. These usually produce a different type of distortion than A-law, and their effect on voice band data transmission may be greater than their effect on speech signals, and in some cases totally preventing voice band data operation.

NOTE 2: Low bit rate coders may also be used in other parts of the network. Cascading of low bit rate coders may further degrade speech and voice band data quality.

10.4 Noise

NOTE: The noise received at the NTP will depend on:

- noise generated by equipment in the network; and
- the amount of induced noise components on the line between the equipment delivering the NTP and the NTP itself.

It is recommended that the design of equipment delivering the NTP is in line with ITU-T Recommendation Q.552 [17] regarding noise performance of interfaces. The operator should specify the maximum level of noise appearing at the NTP regarding:

- a) in-band noise (psophometrically weighted);
- b) out-of-band signals where such information can be provided;
- c) noise at mains frequency (psophometrically weighted). For this aspect the objective of ITU-T Recommendation G.123 [19], clause 1 (noise induced from power lines) should be taken into account.

10.5 Input levels

The NTP should be able to accommodate sinusoidal input signals up to at least 1,8 Vrms without significant clipping.

NOTE: TBR 21 [1] limits the value of instantaneous levels sent to the NTP from the TE to 5 V peak-to-peak. Assuming a sinewave signal, this corresponds to 1,8 Vrms which by ITU-T convention is equal to +5,7 dBm across Z_{ref} (figure 3). The overload point in a PCM A-law coder is +3,14 dBm0. Thus an NTP with a relative level of 2,6 dBr and being capable of handling signals up to +3,14 dBm0 without clipping, will also be able to handle signals coming from a TBR 21 [1] compliant TE.

10.6 Stability

Stability in the network should be maintained for AC open and short circuit conditions applied at the NTP.

NOTE: It is assumed that the design of equipment delivering the NTP is in line with ITU-T Recommendation Q.552 [17] regarding echo and stability performance of interfaces.

10.7 Crosstalk

The minimum crosstalk attenuation within the voice bandwidth between two pairs in the local network, one of them being the pair providing the NTP in question, should be stated by the operator.

11 Dialling

At the NTP the reception of DTMF signalling should comply with ETR 206 [9], however with a level range -5,0 dBV to -15,0 dBV.

NOTE: Levels taken from TBR 21 plus a small margin.

12 Ringing

12.1 Ringing drive capability

The NTP should provide a ringing supply with a nominal frequency of $25 \text{ Hz} \pm 2 \text{ Hz}$ and with a peak to rms voltage ratio in the range 1,2 - 1,6. The waveform should be essentially symmetrical with an even order harmonic content not exceeding 5 %.

NOTE 1: Some terminals are designed to operate with 50 Hz ringing currents, a fact which should be taken into account.

It is recommended that the ringing signal is balanced with respect to earth.

The AC ringing signal may be superimposed on a DC voltage as specified in subclause 6.2.1. Where the ringing signal is not superimposed on a DC voltage, a DC voltage should be presented during the off (silent) parts of the ring cadence.

NOTE 2: There are no requirements in TBR 21 concerning the behaviour of TEs with ringing signals without a DC superimposed voltage, or the off-hook impedance of TEs at 25 Hz. As a consequence, it cannot be assured that a TE complying with TBR 21 will correctly interwork with networks delivering AC ringing signals without a DC superimposed voltage.

NOTE 3: Care should be taken so that noise or other disturbances are sufficiently limited. This concerns especially switching on and off the ringing signal. Noise or other disturbances caused by this switching, particularly transients, may degrade the performance of xDSL or other enhanced services. Switching on and off at offset level and at the right time of the ringing (sine) wave is, possibly accompanied by other measures, a means for limiting the transients.

The open circuit AC voltage should not exceed 100 V_{rms} at the NTP.

The NTP should provide sufficient ringing current so as to produce a voltage not less than 35 V_{rms} across an AC load of 400/LF k Ω , where LF is the stated LF arising from subclause 5.2.2 (if individual LF-values are given as suggested by the note in 5.2.2, the LF is taken from table 2, "lowest impedance at 25 Hz").

NOTE 4: A single terminal equipment may present a load of 4 k Ω at the NTP. However, terminals normally present a considerably higher impedance at the NTP.

12.2 Ring cadence

The nominal ringing cadencing should be 1 s on and 4 s off.

Other ringing cadences can be supplied as an option. Where provided, these should be specified by the operator.

NOTE: Information of cadences frequently used in public networks is given in TR 101 183 [7].

12.3 Ring trip

Any ringing signal presented at the NTP should be removed within 200 ms of an answer signal consisting of:

- a) a DC condition as defined in clause 7 being applied to the NTP; or
- b) an impedance not exceeding 700 Ω at 25 Hz applied at the NTP for the case where the AC ringing signal is not superimposed on a DC voltage.

NOTE: Where the line length is at its maximum according to the scope of the present document, the requirement in b) corresponds to an impedance of around 1 450 Ω , when seen from the interface card of the terminating unit (which delivers the NTP).

13 Supervisory signals

NOTE: Further information on network generated tones may be found in TR 101 041-1 [13].

13.1 Supervisory tones

The following types of supervisory tone should be provided:

- a) dial tone;
- b) ring tone;
- c) busy tone;

- d) release tone (if such a tone is used as specified in case a) of subclause 8.2).

The frequency and tolerance of the tones should be in accordance with ITU-T Recommendation Q.35/E.180 [12].

It is recommended that the following additional supervisory tones are also provided:

- e) special dial tone (often used to indicate the presence of messages waiting, or call forward activated);
- f) special information tone;
- g) release tone (if not provided as d) above);
- h) call waiting tone;
- i) congestion tone.

13.2 Tone levels

The level of supervisory tones applied at the NTP into a reference impedance load Z_{ref} as shown in figure 3, should be within the range $-18 \text{ dBV} \pm 6 \text{ dBV}$.

13.3 Cadences and frequencies

Unless cadences and frequencies are in line with national supervisory signals, the following nominal values should be used (where relevant in accordance with ITU-T Recommendation Q.35/E.180 [12]):

Table 4: Supervisory signals - Nominal cadences and frequencies

Tone	Cadence		Frequency
Dial tone	Continuous		425 Hz
Ring tone	1 s on,	4 s off	425 Hz
Busy tone	0,5 s on,	0,5 s off	425 Hz
Special dial tone	0,5 s on,	0,05 s off	425 Hz
Special information tone (note)	3 x 0,33 s on,	1 s off	950 Hz, 1 400 Hz, 1 800 Hz
Release tone	0,25 s on,	0,25 s off	425 Hz
Call waiting tone	0,2 s on, 0,2 s on,	0,2 s off, 9 s off	425 Hz
Congestion tone	0,25 s on,	0,25 s off	425 Hz

NOTE: The above specification is consistent with current practice in a number of European countries. TR 101 041-1 [13] suggests that there is a case for rationalizing the application of this tone and the introduction of a new tone for this function subject to further research.

14 Optional functions

14.1 Loop Disconnect dialling

The network should correctly interpret Loop Disconnect (LD) signals applied at the NTP within the following limits:

- a) pulsing rate: 8 to 12 pulses per s;
- b) make to break ratio: break = 50 % to 75 % of the total pulse period;
- c) make current: loop current not less than 18 mA;
- d) break current: loop current not exceeding 2,5 mA;
- e) inter-digital pause (IDP): 240 ms minimum (see note 1).

NOTE 1: Terminals with automatic LD signalling will normally generate pulse trains with a maximum IDP of 920 ms. It is possible for terminals with manual LD signalling to exceed this limit.

NOTE 2: Information on the requirements for TE with LD signalling capability may be found in ES 201 187 [15].

14.2 Register recall

The network should recognize breaks in the loop current within the range 50 ms to 130 ms applied at the NTP as a register recall signal. The break period is the time for which the loop current is below 2,5 mA.

NOTE: Values from ETR 201 [11], Option 1.

14.3 Metering

If meter pulses using 12 kHz or 16 kHz signals are used the level between the A- and B-wires at the NTP should be at least 100 mVrms, when measured with a termination of 200 Ω .

14.4 ALASS services

It is recommended that in order to support the provision of ALASS services to the TE, the network should be capable of providing the NTP features selected from the list below, according to the implemented options:

- a) a single burst of ringing current with or without polarity reversal;
- b) provision of loop current up to 2,5 mA at a voltage greater than 32 V without it being treated as a seize signal;
- c) ignore on-line value DC current pulses not exceeding 25 ms duration, i.e. do not treat as a seize signal.

More details may be found in ETS 300 659 [4] and ETS 300 778 [5].

14.5 Polarity reversal

Where polarity reversal is provided, its purpose should be specified.

NOTE 1: In order to ensure compatibility with the installed base of terminals in certain European States it may be necessary to use polarity reversals to indicate start and end of ringing signal. In these cases, compatibility should be adequately ensured if the normal DC polarity is reversed when the first ringing voltage is applied. The polarity should revert to the normal polarity when the line is seized or cleared.

NOTE 2: Polarity reversal can be used to indicate called party answer and end-of-call.

NOTE 3: Polarity reversal can also be used for other signalling purposes (e.g. as given in ETS 300 659 [4]).

14.6 End of call signal ("K-break")

An end-of-call signal consisting of a reduction in the PSTN loop current to below 1 mA for a certain period is referred to as K-break. Two times are suggested for the break:

- a) a range of 90 ms to 130 ms;
- b) a range of 250 ms to 300 ms. This is preferred for new equipment to avoid overlapping with the register recall signal (see subclause 14.2).

14.7 Payphones

There may be a need to adapt certain parameters at the NTP in order to support a wide range of payphones available on the market. These aspects are for further study.

History

Document history		
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