TELENOR

SPECIFICATION

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Access to the public switched telephone network (PSTN). Specification of the network side of the user-network interface

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Index words	:	Access, public switched telephone network, PSTN, analogue interface, 2 Mbit/s digital interface, CAS, DDI/DDO
Abstract	:	Specification describing the network side of accesses to the public switched telephone network (PSTN), analogue and 2 Mbit/s digital interfaces (CAS, DDI/DDO).

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CONTENT

1 Scope

This specification describes the network side of different types of accesses to the public switched telephone network (PSTN). The physical characteristics and the functional characteristics (signalling) are described for the basic telephony service.

A number of supplementary services are offered, employing DTMF signalling using the R-button (register recall), the digits 0 - 9 and the *- and #-buttons. The different services are described in the service specifications for PSTN.

For some services (calling line identification presentation (CLIP), calling line identification in connection with the supplementary services "call waiting" (CW) and "message waiting" (MW)) FSK signalling on the subscriber line is employed. Specifications for the user-network interface when using FSK signalling are given in Telenor Nett Specification A21-1.

The network side of accesses to the integrated services digital network (ISDN) are described in the Telenor Nett Specifications A41-series (basic access), the A42-series (primary rate access), the A43-series (ISDN packet mode services) and the A44-series (supplementary services).

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.

2 References

2.1 Normative references

None

2.2 Informative references

[1] CEPT Rec. T/CS 46-02: "Multifrequency signalling system to be used for push-button telephones". (Innsbruck 1981, revised at Nice 1985.)

[2] 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)", V1.1.1 (1998-01).

3 Definitions and abbreviations

3.1 Definitions

a- and b-wire - The two wires in the 2-wire analogue PSTN interface

A-exchange - The exchange the A-subscriber is connected to

A-side - The interface towards the calling subscriber (A-subscriber)

A-subscriber - The calling subscriber

B-exchange - The exchange the B-subscriber is connected to

B-side - The interface towards the called subscriber (B-subscriber)

B-subscriber - The called subscriber

CENTREX - Network solution offering PABX functionality

Quiescent state - On-hook, open DC-loop, the subscriber equipment is prepared for incoming calls

Loading factor - The portion of PSTN resources used by a terminal equipment or a set of terminal equipments (installation) when connected to a network termination point

Loading unit - An arbitrary unit to measure (or evaluate) the coding factor

Loop state - Off-hook, closed DC-loop, the subscriber equipment is receiving dial tone, is dialling, are in the conversation state or in another state of communication

Network termination point - The physical point at the boundary of the PSTN intended to accept the connection of a terminal equipment

NT1+ system - This is an ISDN basic access combined with an adapter to give 2 analogue PSTN interfaces

Transferred - The subscriber equipment is connected through another subscriber equipment connected in series.

3.2 Abbreviations

CAS - Channel Associated Signalling

CCBS - Call Completion Busy Subscriber

CLIP - Calling Line Identification Presentation

CW - Call Waiting

DDI - Direct Dialling In

DDO - Direct Dialling Out

DTMF - Dual Tone Multi Frequency

EG - ETSI Guide

FDM - Frequency Division Multiplex

FSK - Frequency Shift Keying

ISDN - Integrated Services Digital Network

LF - Loading Factor

LU - Loading Unit (measuring unit for the loading factor (LF))

MFC - Multi Frequency Compelled

MFPB - Multi Frequency Push Button

MW - Message Waiting

NMFC - National MFC signalling

NTP - Network Termination Point

PSTN - Public Switched Telephone Network

4 Relevant interfaces

The following interfaces give access to the public switched telephone network (PSTN):

- 2-wire analogue interface
- 2 Mbit/s digital interface (CAS, DDI/DDO):
  - DDI with discontinuous line signalling and NMFC (incoming calls only)
  - DDI with R2 digital line signalling and NMFC (incoming calls only)
  - DDO with R2 digital line signalling and DTMF (outgoing calls only)
  - Special services signalling using line signalling only (incoming calls only)

The 2 Mbit/s digital interfaces (CAS, DDI/DDO) are no longer offered, instead solutions based on ISDN primary rate access will have to be used. These interfaces will therefore not be described in this specification.

5 2-wire analogue interface

5.1 Interface presentation (plugs/sockets)

The user-network interface will be presented in the form of

- screw/slot contact (LSA+, Trennliste or equivalent) at the interface to an internal subscriberowned cabling system
- socket (female) of the type EN 60603-7/RJ45 at the customers premises. The 2-wire PSTN access line is connected to pin 4 and 5
- 3-pole socket (female) at the customers premises. This connector type is not used for new installations. Figure 1 shows the dimensions of the associated 3-pole plug.

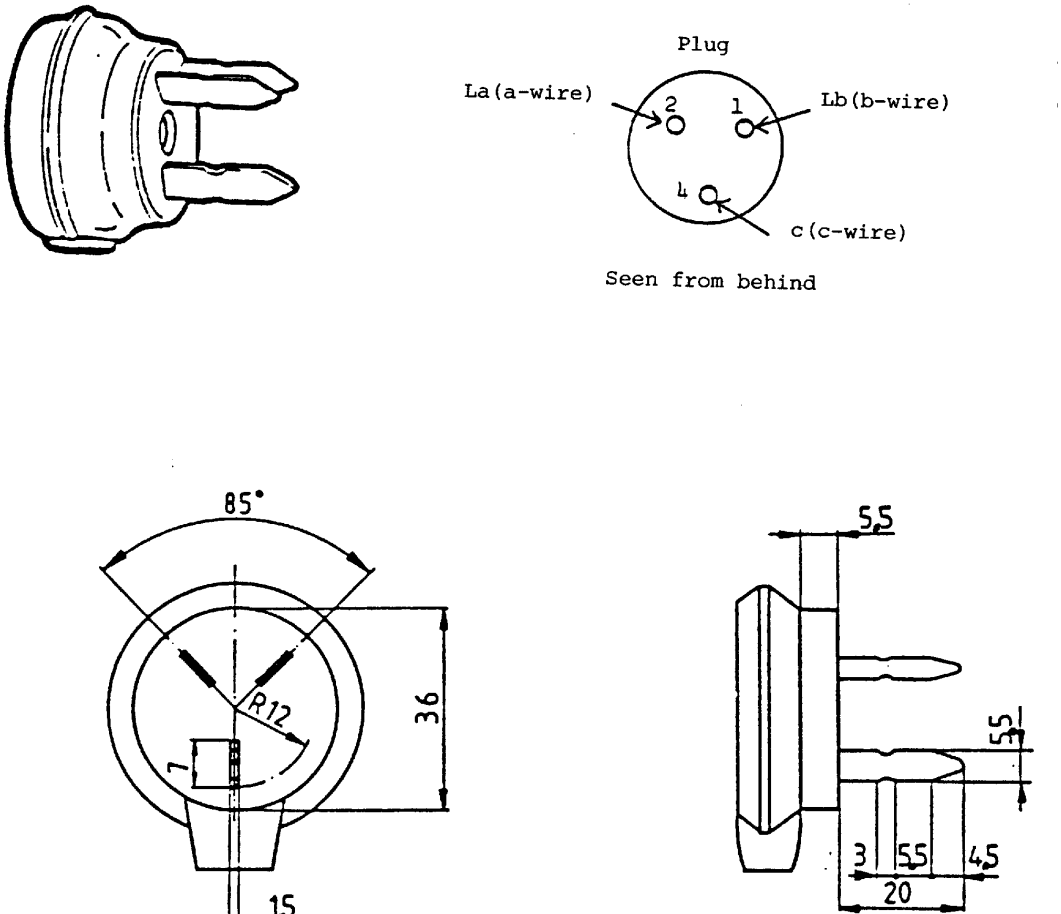

Figure 1. Dimensions of associated 3-pole plug.

5.2 DC characteristics

5.2.1 Quiescent state

In quiescent state the feeding voltage delivered by the exchange is between 43 and 60 V DC (open loop), and the voltage at the user-network interface lies between 35 and 60 V.

The polarity delivered at the user-network interface is arbitrary.

Note 1

The inner (source) resistance of the exchange is between 800 ohms and 5000 ohms. The loop resistance of the subscriber line does not exceed 1400 ohms (not including the subscriber installation).

The leakage, i.e. the resistance between the a- and b-wire, between the a-wire and ground and between the b-wire and ground, may be as low as 30 kohms on the subscriber line.

Note 2

The subscriber line may be delivered using different transmission systems. Some of these systems have DC characteristics different from those given above:

- *FDM subscriber system (1+1 system): The feeding voltage in quiescent state is nominally 9,6 V or 12 V DC with an inner (source) resistance of about 1 kohm. About 40.000 subscriber lines are delivered over such systems. These systems will be removed from the network within a few years.*
- *2 Mbit/s PCM subscriber system: This transmission system has a feeding voltage in quiescent state down to 43 V DC, with a source resistance of 660 ohms. About 4.000 subscriber lines are delivered over such systems. These systems will be removed from the network within a few years.*
- *2-channel digital system (1+1 system): Some of these systems have a feeding voltage in quiescent state down to 21,6 V DC. There are about 13.000 such systems in the network. There are no plans to remove these systems.*

5.2.2 Loop state

In this state, the DC current delivered from the subscriber line to the interface, will be dependent on the DC resistance in the subscriber installation and in the subscriber line. Some typical characteristics are shown in figure 2. The curves A, B and C applies for different line cards in the local exchange. In figure 2 the resistance includes the loop resistance of the line (up to 1400 ohms) and the resistance of the subscriber installation (up to 500 ohms).

The maximum line current is about 45 mA, and the minimum line current about 18 mA.

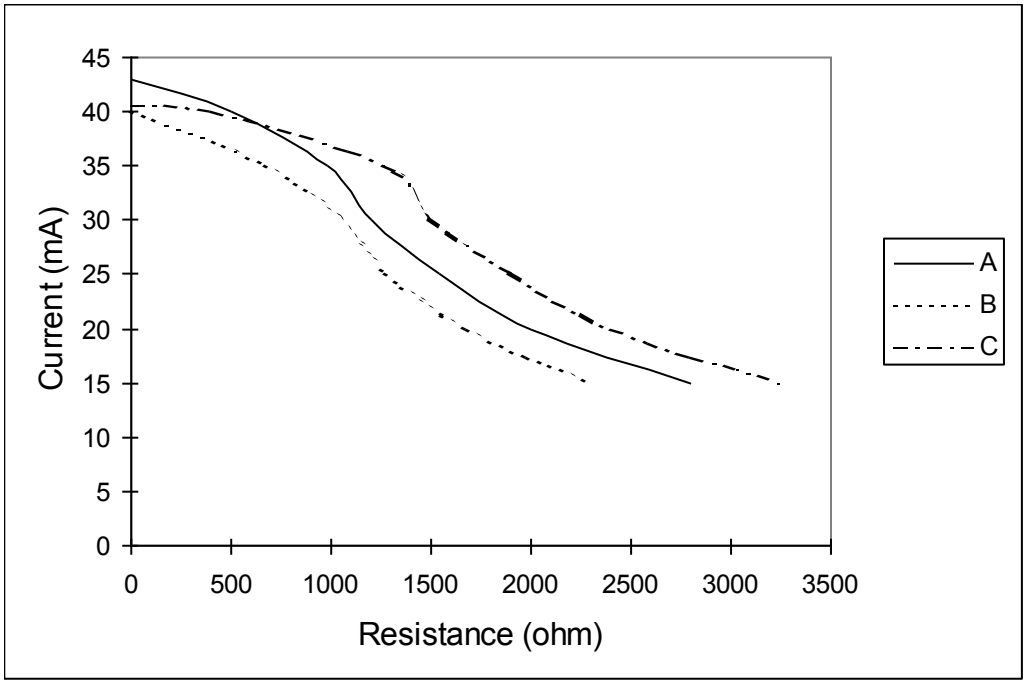

Figure 2. DC characteristics in the loop state.

Note

The subscriber line may be delivered using different transmission systems. Some of these systems have DC characteristics different from those given above:

- *FDM subscriber system (1+1 system): The feeding voltage in the loop state is nominally 9,6 or 12 V DC. About 40.000 subscriber lines are delivered over such systems. These systems will be removed from the network within a few years.*
- *2 Mbit/s PCM subscriber system: This transmission system has a feeding voltage in the loop state down to 43 V DC, through a feeding bridge of 660 ohms. About 4.000 subscriber lines are delivered over such systems. These systems will be removed from the network within a few years.*
- *2-channel digital system (1+1 system): This system has a constant current of about 20 mA towards the subscriber installation. About 80.000 subscriber lines are delivered over such systems, and the number will increase because these systems are still being implemented in the network.*
- *NT1+ system: This is an ISDN basic access combined with an adapter to give 2 analogue PSTN interfaces: This system has a constant current of about 20 mA towards the subscriber installation. There are about 70.000 such systems in the network. The number will be reduced, but there are no plans to totally remove these systems from the network.*

5.3 Characteristics for ringing signal (25 Hz)

At the interface the ringing signal consists of an AC voltage between 26 and 90 Vrms, with a frequency of 25 ± 2 Hz (sine wave). The AC voltage is superimposed on a DC voltage between 35 and 60 V. (The lower AC voltage (26 Vrms) applies for an impedance in the subscriber installation of 2 kohms with a capacitive part (reactance) equivalent to less than 4 μF, the higher AC voltage (90 Vrms) applies with an open loop at the interface.)

Note

Where transmission systems (FDM subscriber system, 2-channel digital system, 2 Mbit/s PCM subscriber system, NT1+, etc.) are used, the system will not be able to support an AC voltage of 26 Vrms for an impedance in the subscriber installation below 2,7 kohms with a capacitive part (reactance) equivalent to less than 3 μF.)

Some FDM subscriber systems deliver a ringing signal different from the ringing signal specified above. The ringing signal consists of an AC voltage between 40 and 60 Vrms and frequency 25 ± 3 Hz (sine wave), superimposed on a DC voltage between 70 and 90 V. Other FDM systems deliver a ringing signal consisting of a square wave signal with 155 V peak-to-peak, having a frequency of 25± 3Hz, superimposed on a DC voltage of about 80 V.

Normal ringing current has the following cadence:
Immediate ringing pulse: 270 ms - 1100 ms, followed by a pause with duration 0 - 4,4 s, then repeated ringing: A ringing pulse of 1 s ± 10%, a pause of 4 s ± 10%, a ringing pulse of 1 s ± 10%, etc.

In addition the following cadences are used:

- Call completion busy subscriber (CCBS) ringing current:
  - Alt. 1: Ringing pulse 300 ms ± 10%, pause 300 ms ± 10%, etc.
  - Alt. 2: First ringing pulse 200 ms ± 10%, pause 200 ± 10%, second ringing pulse 400 ms ± 10%, pause 200 ms ± 10%, etc.
- Centrex ringing current:
  - Alt. 1: Immediate ringing pulse 270 - 1100 ms, pause 0,2 - 4,6 s, then repeated ringing: A ringing pulse 200 ms ± 10%, pause 200 ms ± 10%, ringing pulse 400 ms ± 10%, pause 4,2 s ± 10%, ringing pulse 200 ms ± 10%, etc.
  - Alt. 2: Ringing pulse 300 ms ± 10%, pause 400 ms ± 10%, ringing pulse 300 ms ± 10%, pause 4 s ± 10%, ringing pulse 300 ms ± 10%, etc.

5.4 Voice frequency characteristics

5.4.1 Impedance

The input impedance into the subscriber line will be dependent on the type of cable and the length of the cable in the subscriber line. In the guidelines for establishing subscriber lines, that has been in force since 1984, the maximum length of the most common cable types is given, as shown in table 1 below.

Table 1. The most common cable types used in the subscriber network.

Cable type (diameter)	Capacitance (nF/km)	Maximum length (km)
Buried cable (earth)		
0,4 mm	45	4,7
0,5 mm	45	7,0
0,6 mm	45	7,8
0,9 mm	45	10,0
Suspended cable (air)		
0,4 mm	45	4,5
0,5 mm	45	7,0
0,6 mm	45	7,8
0,9 mm	45	10,0
Sea cable		
0,6 mm	37	8,8
0,6 mm	45	7,8
0,7 mm	37	10,0
0,7 mm	62	6,4
0,9 mm	37	10,0
0,9 mm	55	7,8

Note

The maximum lengths given in table 1 may be exceeded for some old cables and in some cases where it has been necessary in order to obtain access for the subscriber.

The nominal input impedance to the public exchanges, concentrators and transmission systems are normally the impedance Z_n, given in figure 3. New transmission systems are designed for a nominal input impedance Z, as shown in figure 4 (the ETSI harmonized impedance).

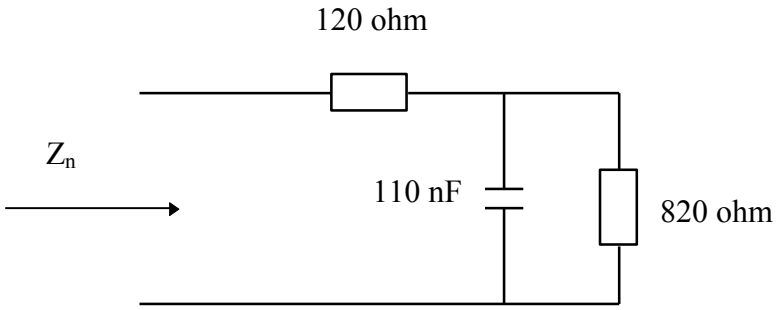

Figure. 3. Nominal impedance Z_n.

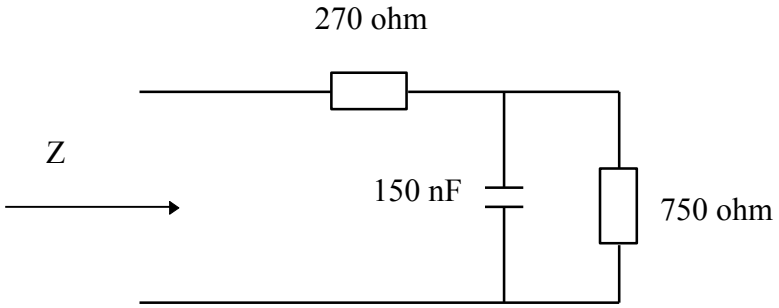

Figure. 4. Nominal impedance Z.

Note

Some old transmission systems (FDM subscriber systems and 2 Mbit/s PCM subscriber systems) have a nominal input impedance of 600 ohms.

Figures 5 to 8 show the impedance seen into the subscriber line for different lengths of 0,4 mm, 45 nF/km cable and 0,6 mm, 45 nF/km cable. The impedance has been calculated assuming an input impedance to the public exchange equal to Z_n given in figure 3.

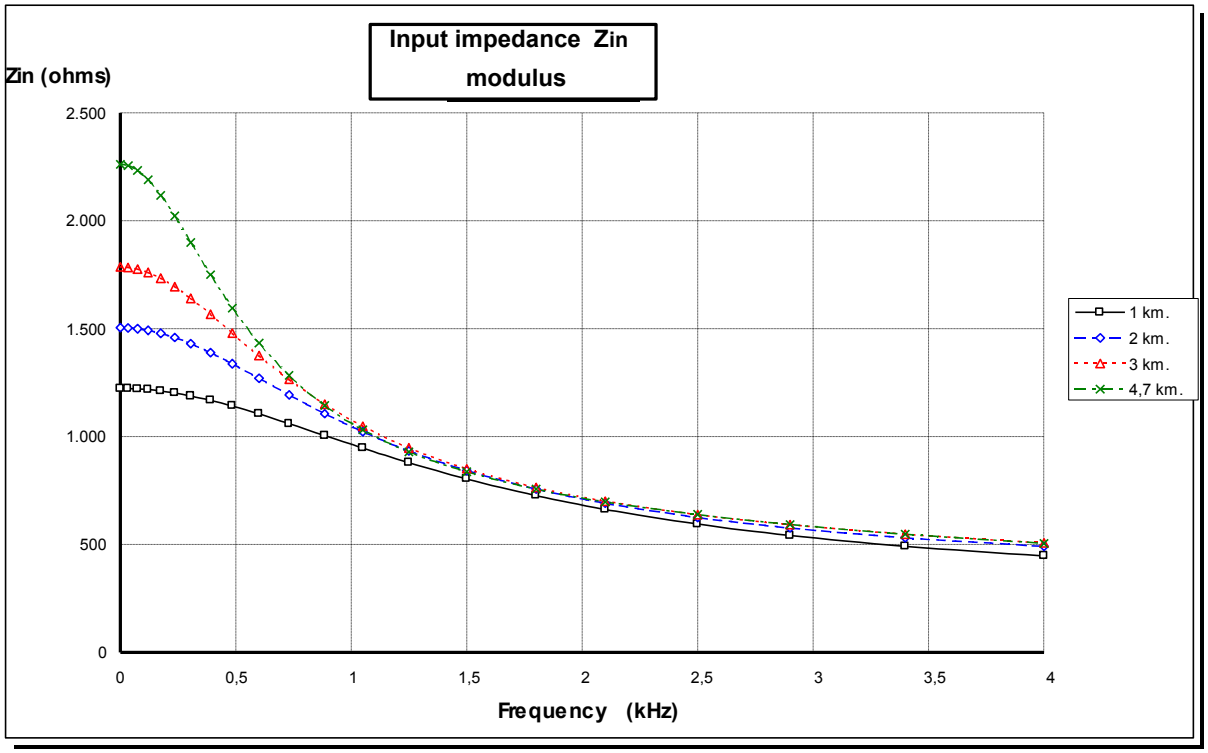

Figure 5. Input impedance (modulus) for 0,4 mm, 45 nF/km cable.

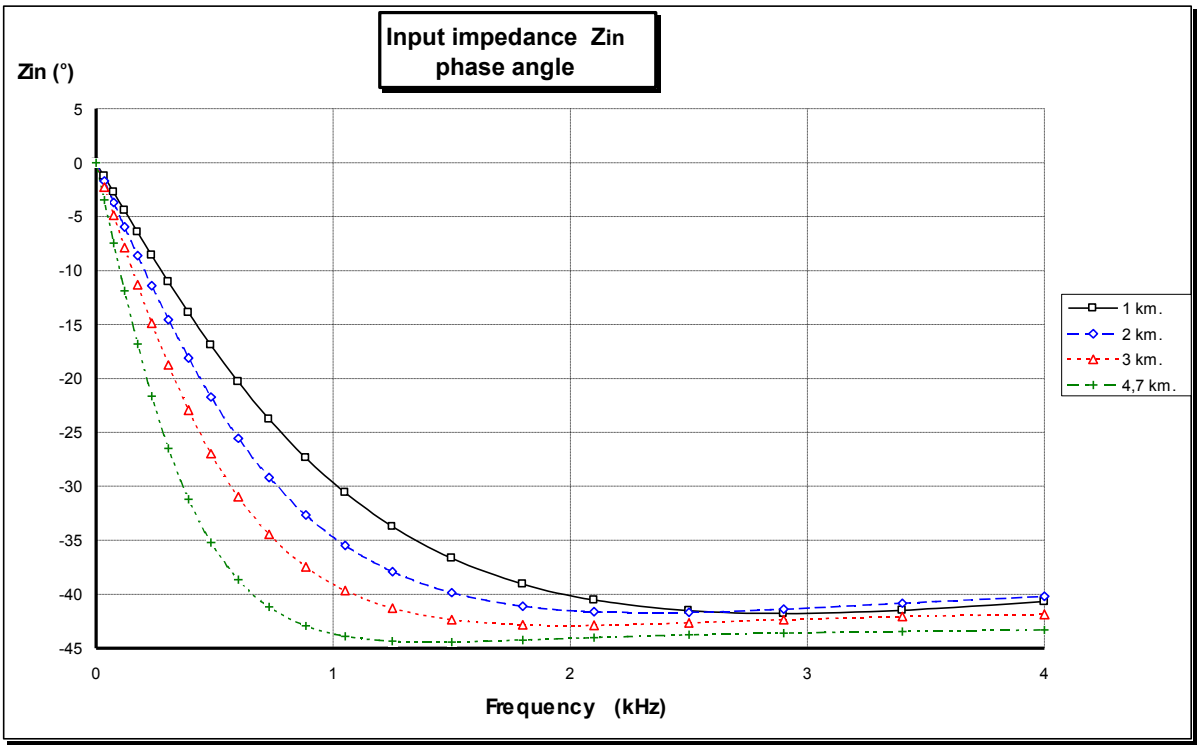

Figure 6. Input impedance (phase angle) for 0,4 mm, 45 nF/km cable.

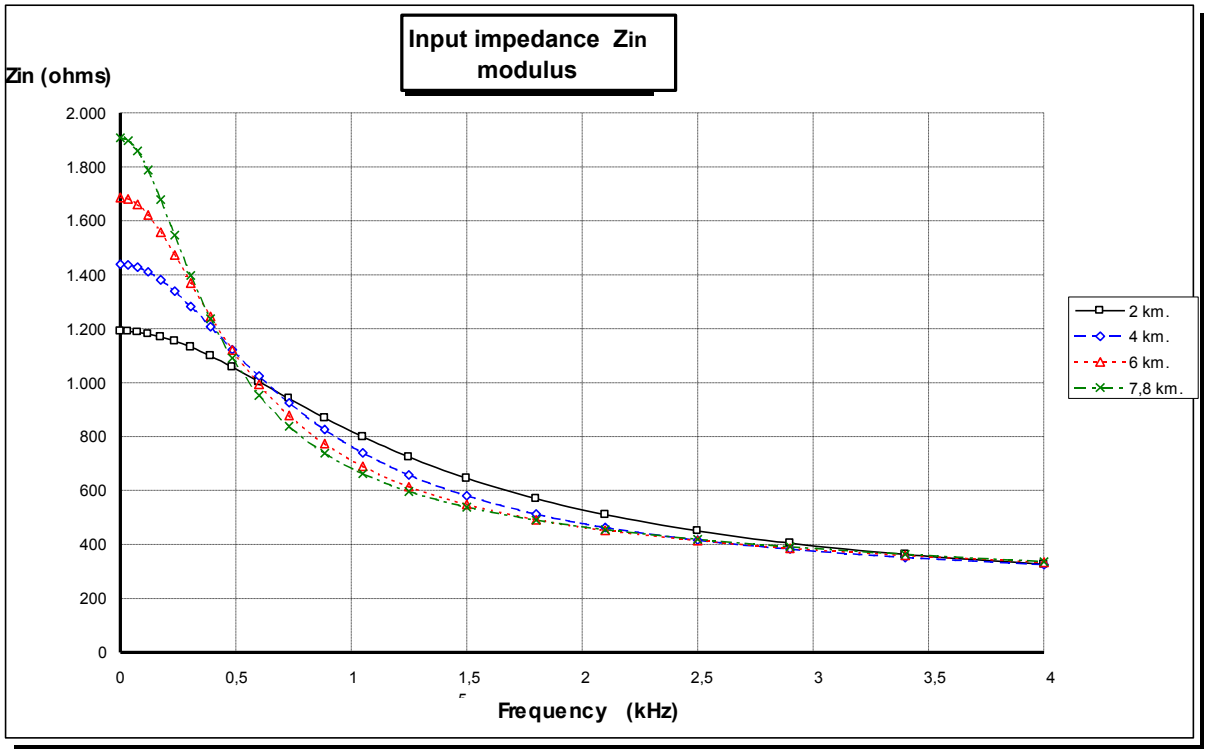

Figure 7. Input impedance (modulus) for 0,6 mm, 45 nF/km cable.

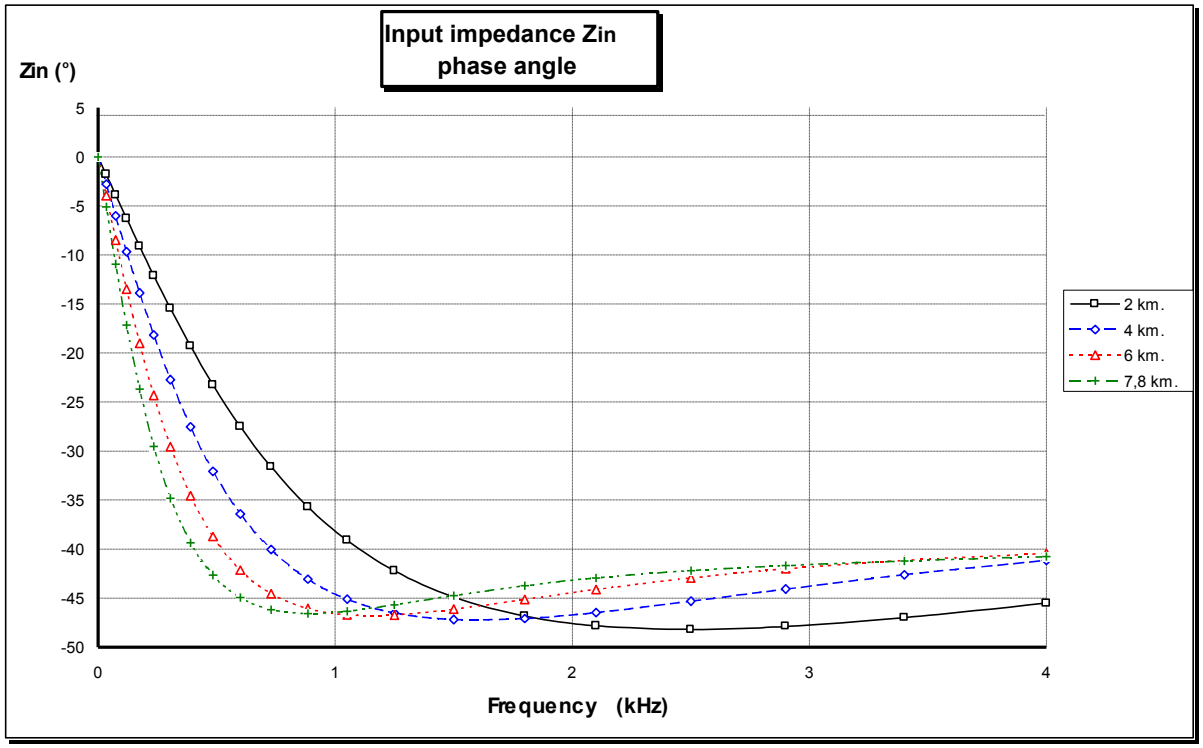

Figure 8. Input impedance (phase angle) for 0,6 mm, 45 nF/km cable.

In real life, the input impedance into the exchange will not be exactly equal to Z_n, given in figure 3. The variation in the input impedance seen into the subscriber line will therefore be larger than shown in the figures 5 to 8.

5.4.2 Signal handling capacity

The PSTN is able to carry any signal presented at the user-network interface with a one minute mean signal level of less than -9,7 dBV in the frequency band 300 - 3400 Hz. (Higher levels are accepted for DTMF signalling.)

The PSTN is able to carry a signal having an instantaneous peak-to-peak voltage less than 4 volts, when the signal is restricted to the frequency band 300 and 3400 Hz.

The PSTN is not suitable for handling signals having a frequency below 300 Hz or above 3400 Hz. Use of frequencies outside the frequency band 300 - 3400 Hz may cause degradation of the signals within the frequency band.

5.4.3 Noise

The noise at the user-network interface will normally not exceed -60 dBmp.

5.5 Signalling for basic call

5.5.1 On-hook/off-hook signalling

If the resistance of the subscriber installation is less than 2 kohms for more than 100 ms, this will be detected as an off-hook signal, and the exchange will go into the loop state. If the resistance of the subscriber installation is less than about 2 kohms for less than 15 ms (A-side) or 20 ms (B-side), this will not be detected as an off-hook signal, and the exchange will remain in the quiescent state.

If the DC resistance of the subscriber installation exceeds 200 kohms for more than 330 ms, this will be detected as an on-hook signal, and the exchange will go into the quiescent state. If the resistance of the subscriber installation exceeds 200 kohms for less than 310 ms, this will not be detected as an on-hook signal and the exchange will remain in the loop state. The subscriber receiving the call (the B-subscriber) may re-establish the connection within the expiry time of a timer which is set to 1,5 ± 0,5 minutes, if the calling subscriber (the A-subscriber) does not clear the connection in the meantime (goes on-hook).

5.5.2 Receiving digits

5.5.2.1 Decadic signalling

Decadic signalling sending the digits as dial pulses in the form of a series of break pulses from the subscriber equipment **will not be supported by the PSTN of Telenor.**

5.5.2.2 DTMF (MFPB) signalling

The digits are sent as a combination of two tones, as defined in table 2.

Table 2. DTMF (MFPB) signalling scheme.

Frequency (Hz)	1209	1336	1477	1633
697	1	2	3	A
770	4	5	6	B
852	7	8	9	C
941	*	0	#	D

Note: A, B, C and D are for future use.

The frequencies 697 - 941 are called the low frequency group, and the frequencies 1209 - 1633 are called the high frequency group.

The PSTN will operate correctly for these frequencies with tolerances of ± (1,5% + 2 Hz) and for levels between:

- -13 and -7 dBV for the high frequency group
- -15 and -8,5 dBV for the low frequency group

at the user-network interface. The level difference between the high frequency group and the low frequency group shall be between 1 and 4 dB, the high level frequency group having the highest level.

The DTMF receivers in the network are designed to receive DTMF signalling according to CEPT Rec. T/CS 46-02: “Multifrequency signalling system to be used for push button telephones”. (Ref. [1].)

5.5.3 Register recall (RR) signal

In the loop state, a register recall signal will be detected, if the resistance of the subscriber installation exceeds 200 kohms for a time period between 70 and 150 ms. A register recall signal is obtained when using the R-button on the subscriber equipment.

5.5.4 Signalling states

5.5.4.1 General

Below the different states and the transition between the states of the network side of the user-network interface are described. Figure 9 shows the state diagram for the interface towards the calling subscriber (A-side) and figure 10 the state diagram for the interface towards the called subscriber (B-side).

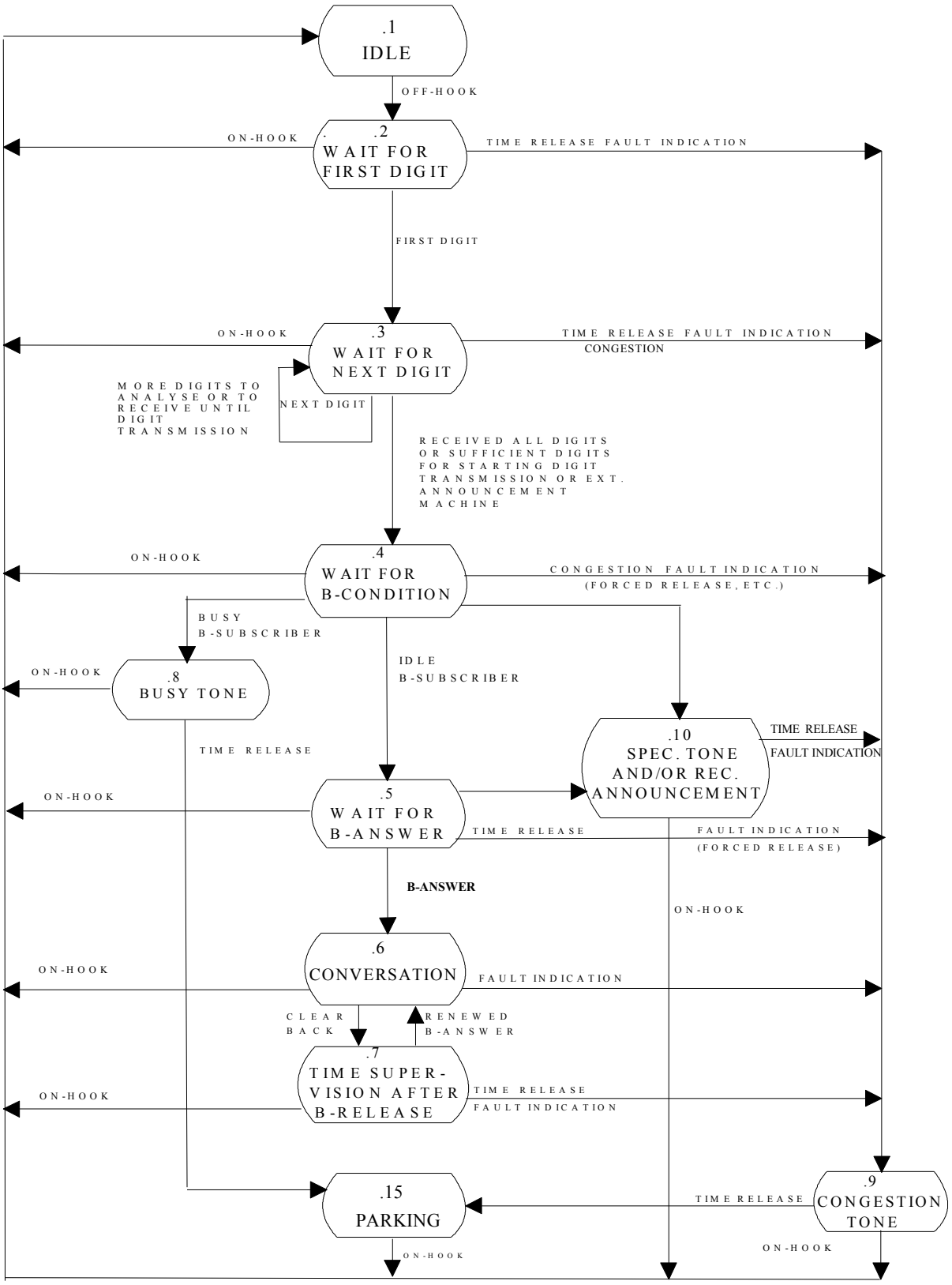

Figure 9. State diagram, A-side.

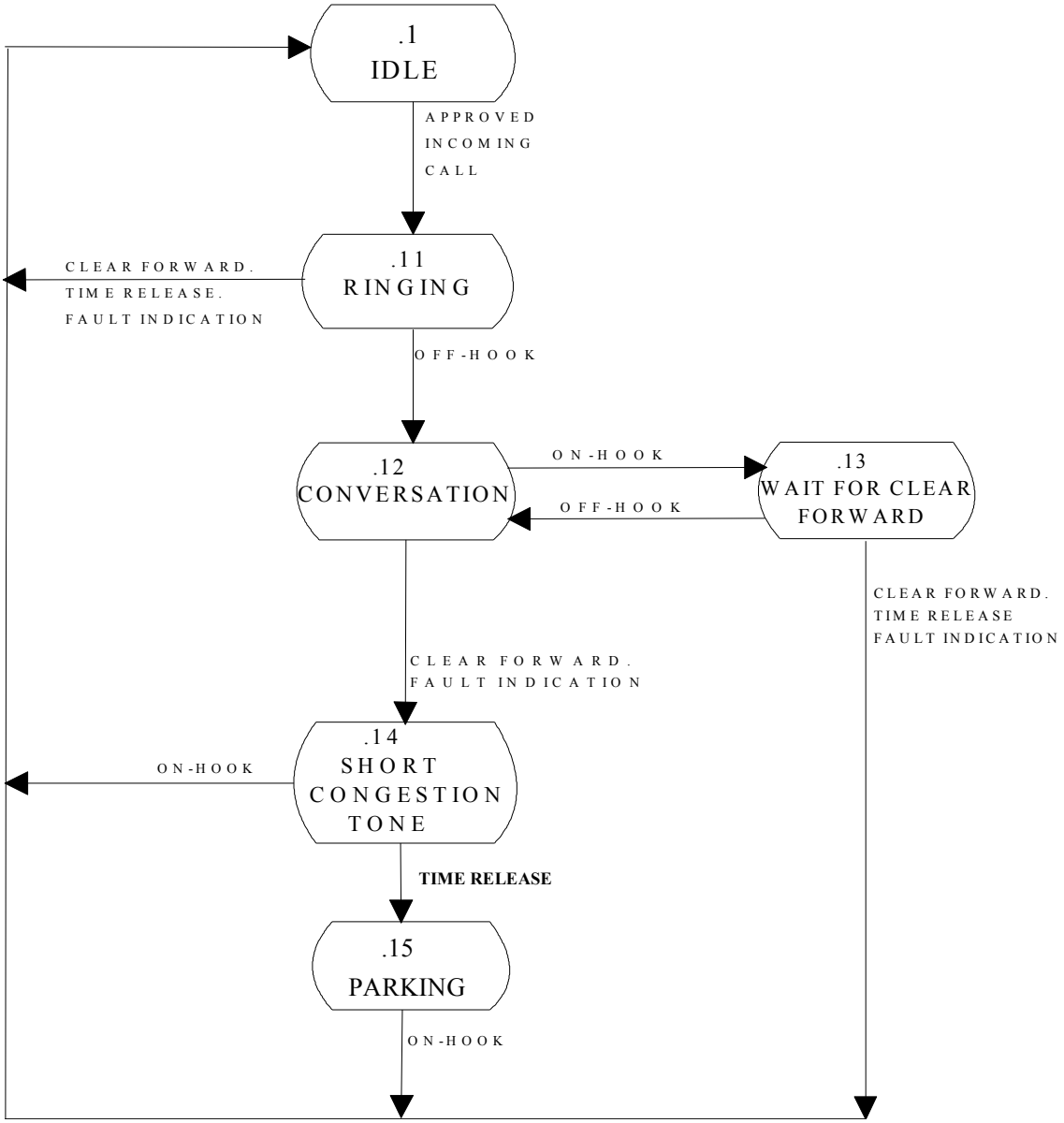

Figure 10. State diagram, B-side.

5.5.4.2 Quiescent state ("idle" state, state 1) (A- and B-side)

In this state, the resistance of the subscriber installation is above 200 kohms (on-hook).

A-side

When an off-hook signal is detected (the resistance of the subscriber installation falls below 2 kohms), the network enters the "wait for the first digit" state.

B-side

When the B-exchange receives an incoming call to the B-subscriber, the network enters the "ringing" state (B-side).

5.5.4.3 "Wait for the first digit" state, state 2 (A-side)

In this state, the network is ready to receive digits in the form of decadic or DTMF signalling from the subscriber equipment, and dial tone is sent to the subscriber equipment.

The dial tone shall be disconnected within 70 ms after having received the first pulse of the first digit in case of decadic signalling or after having received the first digit in case of DTMF signalling, and the network enters the "wait for next digit" state.

If no pulses or digits have been received within 30 ± 0,1 s, or if congestion or a fault occurs in the network, the network enters the "congestion tone" state.

If an on-hook signal is detected, the network goes back to quiescent state.

5.5.4.4 "Wait for next digit" state, state 3 (A-side)

In this state the network waits for all digits necessary for starting digit transmission.

When sufficient digits have been received, the network enters the "wait for B-condition" state.

In special cases, e.g. if the numbers received are incorrect, the "special information tone and/or a recorded announcement" state is entered.

If the time between digits (interdigit time) exceeds 30 ± 0,1 s, or if congestion or a fault occurs in the network, the network enters the "congestion tone" state.

If an on-hook signal is detected, the network goes back to quiescent state.

5.5.4.5 "Wait for B-condition" state, state 4 (A-side)

If the B-subscriber is classified as being idle, i.e. the line is in quiescent condition, the network enters the "wait for B-answer" state, or, in special cases, a "special information tone and/or a recorded announcement" state is entered.

If congestion or a fault occurs in the network, the network enters the "congestion tone" state. If the B-subscriber exchange is in the "parking" state, it is defined as congestion.

If the B-subscriber is busy the network enters the "busy tone" state. The B-subscriber is defined to be busy when the B-side is in one of the states "ringing", "conversation", "wait for clear forward" or "short congestion tone".

If an on-hook signal is detected, the network goes back to quiescent state.

5.5.4.6 "Wait for B-answer" state, state 5 (A-side)

In this state, ringing tone is received by the calling subscriber and ringing signal is sent towards the called subscriber. When a B-answer (the called subscriber goes off-hook) is received, the network enters the "conversation" state.

If a B-answer is not received within 3 ± 0,5 minutes, the network enters the "congestion tone" state. Alternatively, the network enters the "special tone and/or recorded announcement" state, without charging.

If a fault occurs in the network, the network enters the "congestion tone" state.

If an on-hook signal is detected, the network goes back to quiescent state.

5.5.4.7 "Conversation" state, state 6 (A-side)

In this state a two-way communication path is established. The call is taxed according to tariffs. Tax pulses are sent to the subscriber if the subscriber has subscribed to the "home meter" service or has a line for a coin box.

If the B-subscriber goes on-hook (clear back), the network enters the "time supervision after B-release" state.

If a fault occurs in the network, the network enters the "congestion tone" state.

If an on-hook signal is detected, the network goes back to quiescent state.

5.5.4.8 "Time supervision after B-release" state, state 7 (A-side)

In this state a supervisory timer, set to 1,5 ± 0,5 minutes, is started.

If the B-subscriber goes off-hook before the timer expires, the network goes back to "conversation" state, and the time supervision is cancelled.

If the B-subscriber has not gone off-hook before the timer expires, the connection will be released, the charging of the A-subscriber will terminate, and the network will enter the "congestion tone" state.

If the A-subscriber goes on-hook before the time period expires, the network goes to quiescent state, the time supervision is cancelled and the charging of the A-subscriber will terminate.

If a fault occurs in the network, the network enters the "congestion tone" state.

5.5.4.9 "Busy tone" state, state 8 (A-side)

In this state busy tone is sent towards the A-subscriber for 30 ± 0,1 s, then the network enters the "parking" state.

Alternatively, a "jingle" consisting of 3 tone bursts (triads) followed by a speech announcement (16 s) followed by busy tone is sent towards the A-subscriber. After 30 ± 0,1 s, the network enters the "parking" state.

If an on-hook signal is detected, the network goes back to quiescent state.

5.5.4.10 "Congestion tone" state, state 9 (A-side)

In this state, congestion tone is sent towards the A-subscriber for 30 ± 0,1 s, then the network enters the "parking" state.

If an on-hook signal is detected, the network goes back to quiescent state.

5.5.4.11 "Special information tone and/or recorded announcement" state, state 10 (A-side)

In this state a special information tone and/or a recorded announcement is sent to the subscriber.

If the subscriber goes on-hook the "Idle" state is entered.

If the subscriber does not go on-hook within 30 ± 0,1 s, the "congestion tone" state is entered.

5.5.4.12 "Ringing" state, state 11 (B-side)

In this state, ringing tone is sent towards the A-subscriber and ringing signal (25 Hz) towards the B-subscriber. If the B-subscriber does not go off-hook before expiry of a timer (3 ± 0,5 minutes), or if a fault occurs in the network, the network enters the quiescent state.

If the A-subscriber goes on-hook a "clear forward" signal is sent to the B-exchange and the network goes to the quiescent state.

When the B-subscriber goes off-hook, the ringing tone and ringing signal shall be disconnected within 200 ms, and the network shall enter the "conversation" state (B-side).

5.5.4.13 "Conversation" state, state 12 (B-side)

When the B-subscriber goes on-hook, the network goes to the "waiting for clear forward" state.

If the A-subscriber goes on-hook, or if there is a fault in the network, a "clear forward" signal is sent to the B-exchange and the network enters the "short congestion tone" state.

5.5.4.14 "Wait for clear forward" state, state 13 (B-side)

In this state a supervisory timer, set to 1,5 ± 0,5 minutes, is started.

If the A-subscriber has not terminated the call and the B-subscriber has not gone off-hook before the timer expires, a "clear back" signal is sent to the A-exchange and the network will enter the quiescent state.

If the A-subscriber terminates the call, or if a fault occurs in the network, a "clear forward" signal is sent to the B-exchange and the network goes to quiescent state.

If the B-subscriber goes off-hook before the time period expires, the network goes back to "conversation" state, and the time supervision is cancelled.

5.5.4.15 "Short congestion tone" state, state 14 (B-side)

In this state congestion tone will be sent to the B-subscriber for maximum 6 s.

If the B-subscriber does not go on-hook before the end of the 6 s, the network will go to the "parking" state.

If the B-subscriber goes on-hook before the 6 s expires, the network will return to the quiescent state.

5.5.4.16 "Parking" state, state 15 (A- and B-side)

No tones are sent in the "parking" state.

The network will remain in this state until an on-hook signal is received.

5.5.4.17 Use of the register recall (RR) signal

An initial register recall signal (initial RR-signal) will only be accepted in the following network states:

- "Conversation" state (A-side)
- "Time supervision after B-release" state (A-side)
- "Conversation" state (B-side).
- "Busy tone" state (A-side)
- "Short congestion tone" state (B-side).

Depending on the supplementary service implemented, another register recall signal (RR-interrupt) will:

- Terminate the call initiated by the initial RR-signal and return to the original call
- Reorder or restart the new RR-call procedure
- Have a specific meaning depending on the supplementary service used.

5.5.5 Information tones received from the network

The information tones described in table 4 are received from the PSTN in different situations.

The information tones have the following meaning:

Dial tone: The exchange is ready to receive digits in the form of dial pulses or DTMF tones from the subscriber.

Immediate ringing tone and ringing tone: Gives information to the calling subscriber that the called subscriber receives a ringing signal.

Busy tone: Informs the calling subscriber that the called subscriber is busy. (Alternatively, the calling subscriber receives a "jingle" consisting of 3 tone bursts (triads) followed by a speech announcement informing that the B-subscriber is busy (16 s) and busy tone.

Congestion tone: Informs the calling subscriber that there is not network resources available to establish the call.

Special dial tone: Informs the subscriber that special supplementary services have been initiated, e.g. redirection of incoming calls.

Confirmation tone: Informs the subscriber that the operation of a supplementary service has been successfully completed.

Special information tone: Informs the calling subscriber that it is not possible to establish the call, normally used in connection with a speech announcement (called number not in use, etc.).

Table 4. Information tones.

Tone	Frequency (Hz)	Cadence	Level at the user-network interface
Dial tone	425 ± 15 Hz	Continuous	-18 to - 6 dBm
Immediate ringing tone	425 ± 15 Hz	One tone burst: 1000 ms ± 10%	-23 to - 11 dBm
Ringing tone	425 ± 15 Hz	Signal: 1000 ms ± 10% Pause: 4000 ms ± 10% Etc.	-23 to - 11 dBm
Busy tone 1)	425 ± 15 Hz	Signal: 500 ms ± 10% Pause: 500 ms ± 10% Etc.	-23 to - 11 dBm
Congestion tone	425 ± 15 Hz	Signal: 200 ms ± 10% Pause: 200 ms ± 10% Etc.	-23 to - 11 dBm
Special dial tone and confirmation tone	470 ± 15 Hz 425 ± 15 Hz	470 Hz: 400 ms ± 10% 425 Hz: 400 ms ± 10% Etc.	-23 to - 11 dBm
Special information tone	950 ± 50 Hz 1400 ± 50 Hz 1800 ± 50 Hz	950 Hz: 330 ms ± 10% 1400 Hz: 330 ms ± 10% 1800 Hz: 330 ms ± 10% Pause: 1000 ms ± 10% Etc.	-23 to - 11 dBm
Immediate warning tone	1400 ± 50 Hz	One tone burst: 400 ms ± 10%	-37 to - 25 dBm
Warning tone	1400 ± 50 Hz	Signal: 400 ms ± 10% Pause: 15000 ms ± 10% Etc.	-37 to - 25 dBm
Intrusion tone	1400 ± 50 Hz	One tone burst: 2000 ms ± 10%	-37 to - 25 dBm
Call waiting tone	425 ± 15 Hz	Signal: 200 ms ± 10% Pause: 600 ms ± 10% Signal: 200 ms ± 10% Pause: 10000 ms ± 10% Etc.	-37 to - 25 dBm
Centrex dial tone	425 ± 15 Hz	Alternative 1: Signal: 600 ms ± 10% Pause: 15 ms ± 10% Etc. Alternative 2: Signal: 600 ms ± 10% Pause: 20 ms ± 10% Etc.	-23 to - 11 dBm

1) Alternatively, the calling subscriber receives a “jingle” consisting of 3 tone bursts (triads) followed by a speech announcement informing that the B-subscriber is busy (16 s) and busy tone.

Immediate warning tone and warning tone: Informs the subscriber that the other subscriber initiates a supplementary service and that he will be put on hold. Warning tone is repeated until the subscriber is taken back into the conversation or the call is terminated.

Intrusion tone: Information tone used in connection with Centrex, informing the subscriber that an operator is monitoring the call (listening in).

Centrex dial tone: Special dial tone applied in connection with Centrex solutions.

5.6 Signalling for supplementary services

A number of supplementary services are offered, employing DTMF signalling using the R-button (register recall), the digits 0 - 9 and the *- and #-buttons. The different services are described in the service specifications for PSTN.

For some services (calling line identification presentation (CLIP), calling line identification in connection with the supplementary services call waiting (CW) and message waiting (MW)), FSK signalling on the subscriber line is employed. Specifications for the user-network interface when using FSK signalling are given in Telenor Nett Specification A21-1.

5.7 Tax pulses

Tax pulses for home meters are presented at the user-network interface as 16 kHz pulses, having the following characteristics:

- Frequency: 16 kHz ± 80 Hz
- Pulse length: Normally: 150 ms ± 10%.
- Interval between pulses: In connection with drop charging, the interval between the pulses are more than 320 ms.
- Level: -30 to +7 dBm (measured over 200 ohms).

5.8 Network loading factor when connecting subscriber equipment in parallel

EG 201 120 V1.1.1 [2] describes a method for rating subscriber equipment in order to determine what types and number of subscriber equipment that may be connected in parallel in a user installation. Each type of subscriber equipment is given a loading factor (LF) determined by the characteristics of the subscriber equipment for 10 different parameters. The loading factor is measured in loading units (LU), defined in EG 201 120 V1.1.1 [2].

The network interface will support a loading factor determined by the network characteristics for the same 10 parameters.

The 2-wire analogue PSTN interface of Telenor supports a loading factor of 200 LU.

The loading factors supported by the 2-wire analogue PSTN interface for each of the 10 parameters are given in table 5.

Note

Where transmission systems (FDM subscriber system, 2-channel digital system, 2 Mbit/s PCM subscriber systems, NT1+, etc.) are used, the 2-wire analogue PSTN interface will have a loading factor of 148 LU. The loading factors given in table 5 do not apply for these cases.

Table 5. Loading factors for the 10 parameters.

Parameter	Operating state of the subscriber equipment	Loading factor
Resistance to earth	Quiescent, Transferred	800 LU
Impedance to earth at 50 Hz	Quiescent, Transferred	Not applicable
DC resistance	Quiescent, Transferred	266 LU
Lowest impedance at 25 and 50 Hz	Quiescent	200 LU
Lowest impedance in the range 0,3 - 3,4 kHz	Quiescent, Transferred	200 LU
Lowest impedance at 12 and 16 kHz (± 10%)	Quiescent, Transferred	500 LU
DC current during ringing	Quiescent	666 LU
Highest unbalance about earth in the range 50 - 3400 Hz	Quiescent, Loop	200 LU
Highest unbalance about earth in the range 50 - 3400 Hz	Transferred	200 LU
Noise	Quiescent, Transferred	398 LU

6 2 Mbit/s digital interface (CAS, DDI/DDO)

The following 2 Mbit/s digital interfaces (CAS, DDI/DDO) are used:

* DDI with discontinuous line signalling and NMFC (incoming calls only)
* DDI with R2 digital line signalling and NMFC (incoming calls only)
* DDO with R2 digital line signalling and DTMF (outgoing calls only)
* Special services signalling using line signalling only (incoming calls only)

The 2 Mbit/s digital interfaces (CAS, DDI/DDO) are no longer offered, instead solutions based on ISDN primary rate access will have to be used. These interfaces will therefore not be described in this specification.

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