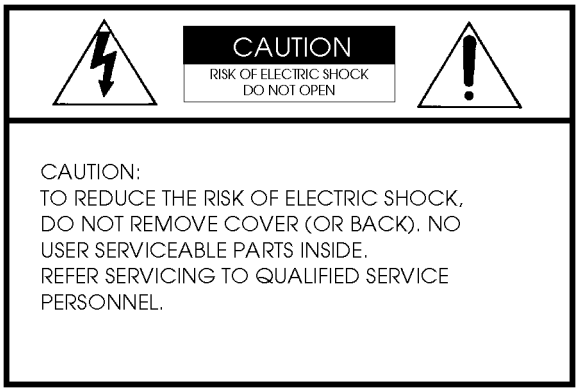
NT-IP

Enhanced ISDN Network Termination
with one RS-232 and two analog ports

Installation MANUAL
SW REVISION 2.0
DATE: December 23rd, 1998

safety rules



The electrical supply used for this equipment involves LETHAL voltage levels. If objects or liquids penetrate inside the workstation, immediately disconnect the supply cable. Before using the equipment again, have it checked by qualified personnel.

DO NOT ACCESS INTERNAL PARTS WHICH ARE NORMALLY PROTECTED WITH PANELS FIXED WITH SETSCREWS.

BEFORE ANY OPERATION ALWAYS CHECK THAT THE ELECTRICAL SUPPLY HAS BEEN COMPLETELY AND EFFICIENTLY DISCONNECTED.

If the user is not able to restore the regular functioning, he must refer to qualified service personnel.

In case of fire, avoid by all means using water to extinguish it.

warnings

Handling of devices which are subject to static electricity

Many of the components used in the workstation are subject to damage by electrostatic discharge. When handling connectors between different devices, disconnect the electrical supply using the switch located in the back part of the system.

Failure to do so could cause permanent damage to the equipment.

this product complies with the EEC Directive 89/336 relating to Electromagnetic compatibility and to the EEC Directive 73/23 (Low Voltage) concerning safety standards.

Glossary

The following terms will be used throughout this document:

ISDN	the Integrated Service Digital Network
PSTN or POTS	the standard analog phone network (Plain Old Telephone System)
basic rate access (BRA)	the standard ISDN access, with one signalling and two user channels
user bus, "S" or "S/T" bus	a four wire bus used to connect user terminals to the NT1
multipoint access	an ISDN basic access configured to provide support for up to 8 terminals on the user bus
point-to-point access	an ISDN basic access configured to provide support for a single terminal on the user bus
ISDN terminal	a generic terminal designed for connection to the S bus such as an ISDN phone, a videophone, a terminal adapter, a group 4 fax, a PC equipped with an ISDN board, etc.
analog terminal, POTS terminal	a generic terminal designed for the connection to the PSTN such as a phone, a modem, a fax, a key system, an answering machine, etc.
POTS port or a/b port	one of the two interfaces provided by the NT-IP for connection to analog terminals
normal conditions	the a.c. supply is available and adequate power is provided to the NT-IP
emergency conditions	the a.c. supply is not available and the NT-IP uses the remote power from the exchange to guarantee a (restricted) service to the user
local loop	the telephone line, consisting of a copper pair that connects the NT-IP to the ISDN exchange

1 INTRODUCTION

The NT-IP is a network termination for the ISDN basic rate access, which adds to the features commonly found in a standard ISDN network termination (NT1), two standard telephone ports and an RS232 interface to provide a fully digital, fast and reliable connection to a PPP terminal server, such as an Internet Service Provider (ISP), a remote access, an e-mail access server, etc.

When connecting to the ISDN through a NT-IP, you can use ISDN basic ***telephony services*** without any need to purchase additional equipment (digital phones and/or terminal adapters), and you can keep using standard devices, such as standard phone sets, cordless phones, analogue modems, group 3 fax machines, automatic answering machines, analogue micro PBX's etc.

The NT-IP also supports emergency phone operation and a range of supplementary telephony services (call hold, call waiting, 3-party conferencing, call forwarding, etc.).

A fully digital data service is provided by the NT-IP straight to the COM port of a PC with unrivalled performance compared to analogue modems, including sub-second call set-up times and a virtually error free data channel to the service provider at a guaranteed bit rate. No additional hardware or software need to be installed to operate the service.

Additionally, you can connect native ISDN terminals, such as videotelephony terminals, group 4 fax machines, etc., directly on the S-bus.

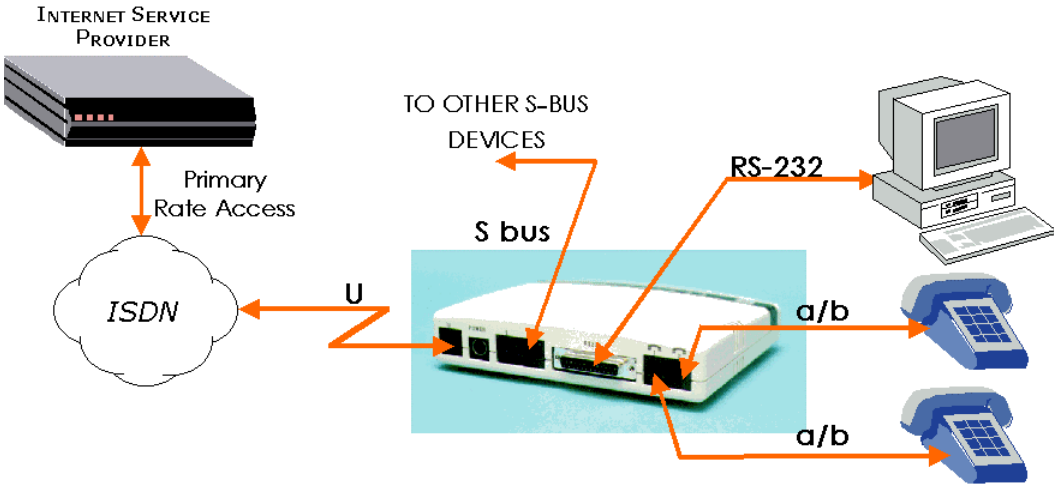


Figure 1

1.1 Feature Summary

Standard NT1

- 2-wire interface on the U reference point
- 4-wire user bus on the S/T reference point

POTS ports

- pulse and/or tone dialling, ringing signal, metering pulse generation
- PCM speech coder/decoder, according to G.711, A-law
- generation of Calling Line ID messages
- available in emergency conditions (mains off)

RS232 port

- Internet Access on a single B-channel or on both B-channels using the multilink PPP (MP) protocol
- Bandwidth on Demand (BOD)
- Bandwidth Allocation Protocol and Bandwidth Allocation Control Protocol (BAP/BACP)
- Peer to peer communication according to ITU-T V.120 and V.110 recommendations
- Enhanced AT command
- automatic bit rate recognition

Maintenance

- local system and port configuration and diagnostics
- local and remote download of firmware upgrades

2 SYSTEM OPERATION

2.1 Power Supply

An external a.c. adapter generates low-voltage power required for internal operation and to provide phantom power to the S bus.

When mains power is not available (*restricted power* mode), the NT-IP uses the power fed by the ISDN exchange through the local loop to power the POTS ports.

In restricted power mode, incoming calls are offered to both ports, provided that the call is compatible with the profile assigned to each port, but only one POTS port can be active at a time, i.e., going off-hook on one port automatically disables the other one.

No phantom power is supplied to the S-bus in restricted power mode, however regular operation of the S-bus (i.e. activation, communications, etc.) is guaranteed.

Power consumption in restricted power conditions from the network is limited to 1.7 W, thus allowing a greater range even with low voltage supply.

2.2 The RS-232 Port

When using its COM port to access an Internet Service Provider, your PC uses the standard Point-to-Point Protocol (PPP), with an asynchronous transmission format (asynchronous PPP).

When operating in the single channel PPP mode, the main function of the NT-IP is to operate as a format converter between the asynchronous format on the PC side at various speeds and the synchronous format at a fixed speed of 64 kb/s used on the ISDN channel.

When operating the Multilink PPP (MP) protocol, the NT-IP also provides for all the operations required to establish an additional link, to split and recombine the traffic between the channels and makes it completely transparent to the user's PC the use of MP.

The V.120 operating mode provides for a error-protected, high-speed transmission channel over a single B-channel. V.120 mode can be used for many applications, such as remote access (RAS) to a corporate server.

To guarantee a safe and proper operation in any environment, the RS-232 port is optically insulated from any other port of the NT-IP. This basically avoids any risk of coupling electrical noise or even dangerous voltages from the PC onto the phone sets or the telephone line.

The NT-IP has a standard, 25 pin female connector for straight connection to a PC COM port, equipped with the following circuits: 103 (TXD), 104 (RXD), 105 (RTS), 106 (CTS), 107 (DSR), 108 (DTR), 109 (DCD) and C125 (RI).

The RS-232 port operates up to 230.4 kb/s with automatic bit rate recognition (autobaud).

Port configuration and operation (such as call control) are carried out through an advanced AT-command set compatible with any standard communication software.

2.3 The a/b ports

The a/b ports support both pulse and DTMF dialling. Local tone generation (dial tone, congestion and call waiting) is provided when required. Register recall or hook-flash keys are also supported to invoke supplementary services.

Additional analog signalling functions such as m*etering pulses*, *delayed clear-back* and *forward clear indication* using a locally generated congestion tone are provided.

Each a/b port can be allocated one, two or three telephone numbers (also called directory numbers, **DN**). If no number has been programmed for that port, incoming speech and audio calls will be offered to the

port independently of the called party number. If instead one or more **DN** are programmed, then only the calls directed to one of the these numbers will be offered. The first **DN** associated with the POTS interface is also used when indication of calling party number is required in outgoing calls or when requesting some supplementary services.

2.3.1 Supplementary services

Most ISDN supplementary services are related to the deployment of advanced telephony services (e.g. call waiting, call forwarding, calling line indication, etc.) and, from the user's perspective, bear a close resemblance to the corresponding services provided by the analog networks. The NT-IP supports a large number of such services.

For these services, the NT-IP supports the ***ETSI Generic Functional Protocol*** (ETS 300 196-1) and the relevant service specific signalling ETS, and it provides for the necessary ***mapping*** between these protocols that describes user-network signalling and the various procedures available to the user in order to operate the service.

The NT-IP also supports the ***Generic Keypad Protocol***, according to ETS 300 122-1, to access supplementary services based on stimulus procedures. These procedures are often used to implement supplementary services according to national specifications. This protocol is much simpler and it basically results in the keys pressed being transparently transmitted as "keypad information" to the switch, where all the processing takes place.

The NT-IP makes it completely transparent to the user what kind of protocol has to be used to obtain a specific supplementary service. The user only presses the same "key sequence" required when connected to the POTS.

NOTE: Based on customer specifications a specific Supplementary Service can be implemented using of the Functional Protocol or the Keypad Protocol.

2.3.2 Additional telephony services

The a/b ports also provide for a number of ***additional*** services, such as

- generation of ***Calling Line Identification*** (CLI) display services based on on-hook (ETS 300 659-1) and off-hook (ETS 300 659-2) data transmission protocols. The internal modulators meet the ITU-T Recommendation V.23 for the forward data transmission channel
- distinctive ringing patterns, in order to discriminate incoming calls based on the called party number
- timed fixed destination call, using a pre-registered number (e.g. emergency or telco help-desk calls)
- incoming call pick-up (i.e. answering an incoming call ringing on the other a/b port)
- wake-up calls

2.4 The S0 interface

On the S_0 interface the NT-IP provides the same quality of service of a standard NT1, allowing the connection of up to 8 TE's in any bus configuration (short, extended) and a complete transparency to test procedures from the exchange. Standard PS1 phantom supply is provided to the S_0 bus when local ac power is available.

3 INSTALLATION

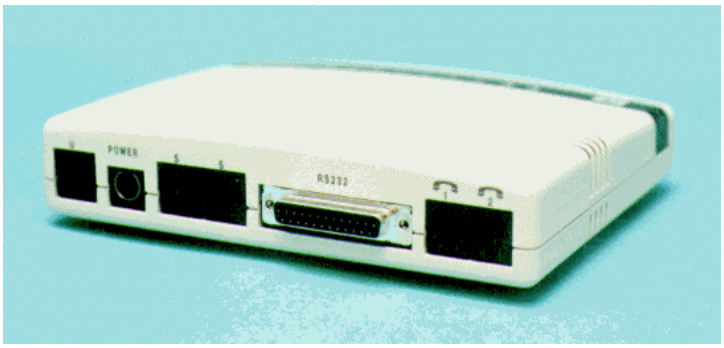
The NT-IP can be wall mounted or it can be used in a table-top installation.

3.1 Connections

The followings connections are provided in the back panel:

S_0 bus	two modular RJ-45 ISO8877 connectors (8p/4c)
POTS	two screw terminal block or, optionally, two modular RJ-11 connectors (6p/2c)
RS232 port	25 pin, female, D-type connector
Line pair (U)	one screw terminal block or, optionally, one modular RJ-45 connectors
Power supply	Four-pole plug

!	***USE ONLY THE AC ADAPTER SUPPLIED WITH THE UNIT.*** ***NEVER CONNECT ANY OTHER EQUIPMENT TO THE POWER SUPPLY PLUG.***



3.2 LED's

The following status monitoring LED's are located near the front panel:

PWR AC power supplied
U Line interface connected (remote power sensed)
DTR Data Terminal Ready (C108)
DCD Line status or Carrier detect (C109)
CTS Clear to Send (C106)
TD Transmit Data (C103)
RD Receive Data (C104)
1 a/b port 1 (hook status)
2 a/b port 1 (hook status)

3.3 RS-232 Connector

The NT-IP is equipped with a standards 25 pin DB female connector (ISO 2110). The following connections are provided

signal		i/o	pin
C103	TXD	in	2
C104	RXD	out	3
C105	RTS	in	4
C106	CTS	out	5
C107	DSR	out	6
C102	GND	-	7
C109	DCD	out	8
C108	DTR	in	20
C125	RI	out	22

An adapter cable with a DB-25M and a DB-9 is provided with the following connections:

DB-25M DCE		DB-9M DTE
2	**C103**	3
3	**C104**	2
4	**C105**	7
5	**C106**	8
6	**C107**	6
7	**C102**	5
8	**C109**	1
20	**C108**	4
22	**C125**	9

3.4 Switches

Two dip switches are located on the bottom side of the device. They are used to:

- select the S_0 bus configuration (short passive / extended)
- include terminating resistors for the S_0 bus (100 Ω / 50 Ω / off)

All other settings are made via configuration procedures.

3.5 Accessories

The NT-IP is supplied with:

- the AC power adapter
- a cable for connection to the PC serial port (1.8 m, DB-25 male to DB-9F);
- a diskette containing the installation software including all necessary drivers;
- a user's manual;
- screws used for wall mounting.

4 CONFIGURATION

4.1 General Information on Configuration Modes

Local and *remote* configuration procedures are provided to access and modify configuration and diagnostics registers and to download the operating firmware.

Generally speaking, configuration parameters are divided in two broad categories:

- **global** parameters affect the general operation of the NT-IP
- **port specific** parameters only refer to the operation of an individual a/b or data port

After downloading, the new firmware is stored on a secondary permanent read-only memory. This firmware can be activated either immediately or at a later time using a separate activation command.

Local configuration

Two types of local configuration are possible:

tone based	using key sequences from a DTMF phone connected to an a/b port, with voice announcements guiding the configuration process
PC based	from a local PC connected to the RS-232 port of the NT-IP. The PC runs MS-Windows 95® or Windows NT 4.0 (or later).

To prevent users from tampering with critical parameter, two local configuration modes are provided:

- a ***user*** configuration mode allows for modifying non-critical parameters
- an ***operator*** configuration allows for complete control over all the operating parameters

Remote configuration

Remote configuration can also be accomplished in two ways:

tone based	using key sequences from a DTMF phone connected over the ISDN, with voice announcements guiding the configuration process
PC based	from a remote PC port running MS-Windows 95® - Windows NT 4.0 (or later). The PC connects to the NT-IP over the ISDN via another specially configured NT-IP or an Aethra TA1008 terminal adapter

Remote configuration calls are accepted based on following criteria:

- the CLIP service must be active on the access where the NT-IP is installed (i.e. the calling party number must be available in the call-set up message)
- the Calling Party Number contained in the call set-up message matches with one of the registered configuration numbers, contained in configuration registers **70** to **89**

- **OR** -

- the Called Party Subaddress contained in the call set-up message matches with the registered configuration subaddress (register **90**)

Up to 20 remote configuration numbers can be registered within the NT-IP.

The proper remote configuration process is started *based on the bearer service* indicated in the call set-up message: the tone-based requires a speech or audio call, while the PC based process is activated through a data call.

!	Local configuration operations related to the RS-232 port can be only be configured using AT-commands.

The local and remote PC-based configuration modes support download of firmware upgrades.

A delay longer than 2 minutes between two subsequent operations will make the NT-IP leave the configuration mode after executing any previously entered commands.

4.2 Tone-based configuration procedures

4.2.1 Local configuration

Connect a DTMF phone to one a/b port. To enter the **operator** configuration mode:

- disconnect any existing POTS or RS-232 call
- disconnect the line pair
- connect a DTMF phone to one of the a/b port and lift the handset
- dial the access command sequence according to §4.2.3.

To enter the **user** configuration mode:

- disconnect any existing POTS or RS-232 call
- connect a DTMF phone to one of the a/b port and lift the handset
- dial the access command sequence

4.2.2 Remote Configuration

A call meeting the required conditions (bearer service, calling party number / called subaddress) is automatically answered by the NT-IP, provided there is at least one B-channel available.

When the configuration call is answered and one B-channel is in use, the NT-IP will not immediately affect global parameters and will not activate a new firmware release until all the a/b and RS-232 ports have returned to an idle state. The activation of port specific parameters is postponed until that port goes back to the idle state.

Please refer to §4.3.3.1 for the read parameter status command.

4.2.3 Access command

The access command sequence is the following:

#	T	#	#	T	#

When entering the command, keep pauses between digits to less than one second

4.2.4 Structure of Commands

Each command specifies a "parameter index". Some parameters can be read and modified. Some other can be read, but not modified.

The following commands are used:

- *modify commands*, used for parameter configuration
- *read commands*, used to read the current value of a configuration parameter
- *reset commands* are used to restore configuration values to the factory default

Modify commands have the following structure:

T	<parameter index>	T	<parameter value>	#

Read and *reset* commands have the following structure

T <index> **#**

4.2.5 Entering commands

When the NT-IP enters the configuration mode the device emits an audible tone. When the initial ***** key is operated, the NT-IP stops the generation of the tone and prompts the user with the message:

"*enter the parameter index*":

The user enters a two digit code representing the parameter index and: terminated by the ***** key for modify commands, or the # key for a read command. Only the last two digits entered are considered, so in case of an error the user simply re-enters the correct digits and then press ***** or #.

If the entered index is not valid, a:

"*wrong entry*"

message is generated, followed by the audible tone indicating the ready state.

If the entered index is a valid one, then the user is prompted with a message:

"*enter the parameter value*".

4.2.5.1 Modify commands

The new value can now be entered, followed by the # key. Valid operations are confirmed via the message:

"*the parameter value <x> is <y>*"

where <x> and <y> represent the address and the assigned value.

If the assigned value is incorrect, the following message is given:

"*wrong entry*"

The configuration mode can be interrupted at any time by going on-hook.

4.2.5.2 Read Commands

The current value of the requested parameter is indicated via the message:

"*the parameter value <x> is <y>*"

4.3 Description of configuration parameters

The NT-IP has a number of user programmable configuration parameters, contained in a non volatile memory.

Some parameters (such as operating mode, access configuration, remote configuration numbers, etc.) refer to the system as a whole.

Other parameters (such as:

- assignment of network numbers, port profile, activation of call waiting
- generation of metering impulses
- delayed clear back
- level setting, etc.

are specified for each a/b port:

4.3.1 General configuration parameters

PARAMETER	ACC	INDEX	VALUES		DEFAULT
TEI assignment	O	02	point-to-point (fixed TEI)	00....63	multi-point
			multi-point (dynamic TEI)	64	
Voice announcements	O	03	no	0	No
			yes	1	
Operating modes	O	04	S bus enabled	0	enabled
			S bus disabled	1	
Incoming call management	U	05	broadcast	0	broadcast
			alternate	1	
			a/b port 1 preferred	2	
			a/b port 2 preferred	3	
Amount of currency per charging unit	O	08	amount	4 digits	none
			multiplier	1 digit	
Enable local configuration[1]	O	30	enabled	0	enabled
			disabled	1	
Remote configuration numbers	O	70…89	0…28 digits		Empty
Remote configuration subaddress	O	90	0..4 digits		9999

Table A - General parameters

Note: "U" = user access, "O" operator only access

4.3.1.1 TEI assignment

If the access has a ***multipoint*** configuration, the NT-IP must be configured for "automatic TEI assignment", by assigning the value 64 in the TEI assignment parameter (index 02).

If the access has a ***point-to-point*** configuration, the TEI must be programmed with a value ranging from 00 to 63, according to the value of the TEI assigned by the ISDN service provider (usually the value 0 is used).

T 0 2 T 0 0 #	for a point-to-point access with TEI 0
T 0 2 T 6 4 #	for a multi-point access

[1] this command is only active in remote configuration mode

4.3.1.2 Voice messages

The NT-IP may be programmed to generate voice announcements to provide the user with the results of operations involving some supplementary (e.g. when in band announcements are not provided by the network) or local services.

T 0 3 T 0 #	To activate the voice messages
T 0 3 T 1 #	To deactivate the voice messages

NOTE: Voice announcements generated to guide the user during the configuration procedures cannot be deactivated.

NOTE: For some localisation this parameter is disabled and cannot be modified

4.3.1.3 Operating mode

The NT-IP can be used as described above or simply as a pair gain (line doubler) by deactivating the S bus. The relevant configuration procedure is described in below:

T 0 4 T 0 #	full NT-IP configuration; S bus enabled
T 0 4 T 1 #	line doubler configuration; S bus disabled

4.3.1.4 Incoming call management

When an incoming call is compatible with *both a/b ports* (i.e. matching MSN and port profile), four different options can be specified

mode	***operation***	***value***
broadcast	simultaneously offered to both a/b	0
alternate	alternatively offered to either a/b 1 or a/b 2	1
a/b 1 preferred	preferentially offered to a/b1	2
a/b 2 preferred	preferentially offered to a/b1	3

Of course, if either a/b port is not free and not CW-enabled, the call will be offered to the other port independently of the setting of this parameter.

As an example to program the broadcast mode, use:

* 0 5 * 0 #

4.3.1.5 Amount of currency per charging unit

This parameter representes the amount of currency for a charging unit. It contains four significant digits and an additional digit to indicate the number of digits after the decimal point.

For example, to program a value of 6.05 units of local currency for a single pulse, either use:

* 0 8 * 6 0 5 0 3 #

or

* 0 8 * 0 6 0 5 2 #

4.3.1.6 Enable local configuration

This parameter can be used to disable local configuration. The command

*	3	0	*	1	#

disables any locally initiated configuration procedure.

4.3.1.7 Remote configuration numbers and subaddress

Remote configuration numbers and subaddress are used to recognize remote configuration calls (see §4.2.2). Up to 20 remote configuration numbers and one subaddress can be programmed into the NT-IP. These number should only be assigned during the installation.

As an example, to assign the *second* remote configuration numbers to ***21345***:

*	7	2	*	2	1	3	4	5	#

To program the subaddress to ***9876*:**

*	9	0	*	9	8	7	6	#

4.3.2 a/b port Specific Parameters

Separate commands are used for each a/b port: N = 1 holds for the 1st a/b port, N = 2 for the 2nd a/b port. The value of some port specific parameters contain a sequence of digits. Each digit holds the value of a specific sub-parameter.

When entering a new value, use 9 to skip a digit position without altering the current value of the sub-parameter.

It is not necessary to update all digit positions in the dialling mode and a/b port service parameters: e.g. if only digit position 1 and 2 have to be modified, then press # after entering the two digits to terminate the command.

PARAMETER	ACCESS	INDEX	VALUE	DEFAULT
1° network number	U	N1	0....28 digits	Empty
2° network number	U	N2	0....28 digits	Empty
3° network number	U	N3	0....28 digits	Empty
Port Status	U	N6	See Table C - Port Status	
POTS register 1	U	N7	See Table D - POTS register 1	
POTS register 2	U	N9	See Table E - POTS register 2	
Fixed destination call	U	3N	See Table F - POTS register 3 (FDC)	
POTS register 3	U	4N	See Table G - POTS register 4	
Special Service Enables	O	5N	See Table H - Special Service Enables	
Delayed Clear back duration	O	6N	value of delayed clear back duration (1…120)	60

Table B - Port specific registers

4.3.2.1 Port Status (N6)

POSITION	value	port status
1	0	IDLE
	1	error-status
	2	outgoing call
	3	active call
	4	off-hook
	5	ringing

Table C - Port Status

4.3.2.2 POTS register 1 (N7)

POSITION	SUB-PARAMETER	VALUES		DEFAULT
1	Tone dialing	pulse and tone	0	pulse and tone
		tone only	1	
2	Recall/flash key	enabled	0	enabled
		disabled	1	

Table D - POTS register 1

4.3.2.3 POTS register 2 (N9)

POS	SUB-PARAMETER	VALUE		DEFAULT
1	port profile	deactivated	0	speech/audio
		speech/audio	1	
		telephone	2	
		fax	3	
2	reserved			
3	generation of metering pulses	deactivated	0	deactivated
		activated	1	
4	delayed clear back	deactivated	0	deactivated
		activated	1	
5	audio level	high level	0	high level
		low level	1	
6	polarity inversion	disabled	0	disabled
		enabled	1	
7	presentation of CLI on waiting calls (off-hook)	disabled	0	disabled
		enabled	1	
8	presentation of CLI on incoming calls (on-hook)	disabled	0	disabled
		enabled	1	
9	voice or tone to confirm CF and CW services	tones	0	tones
		announcements	1	

Table E - POTS register 2

4.3.2.3.1 Port Profile

Each a/b port can be set according to the type of analog terminals connected[2]. The following settings are possible:

speech/audio	if different types of terminals (e.g.: a phone and a modem) are connected to the same port
telephone	if only telephones are connected to the port
fax	if only a fax machine is connected to the port.
deactivated	when the port is "deactivated", incoming calls are not offered to this port, so that the network and the calling user will be informed that no phone is ringing. This mode may be used when no terminal is connected to the port. Outgoing calls are however possible.

[2] this setting uses certain signalling features of the ISDN. For example, calls coming from an ISDN phone (or another NT-IP POTS ports set as "telephone") will not be answered by a POTS port confired with a "fax" profile.

4.3.2.3.2 Audio level selection

The NT-IP provides for two sets of reference audio levels for each a/b port. Higher levels meet reference levels values specified by most network providers and are suited for modems and fax devices. Lower levels provide for greater echo attenuation and better acoustic comfort.

4.3.2.3.3 Polarity reversal

When this feature is enabled, the voltage applied to the a/b interface is reversed when the *called* party answers the call (reception of the connect message). The voltage then reverts to the normal polarity when the *calling* user goes on-hook.

4.3.2.3.4 CLI presentation

Two separate parameters are used to respectively enable the CLI presentation on normal calls (on-hook transmission) and the CLI on waiting calls (off-hook transmission).

4.3.2.3.5 Voice or tone to confirm CF services

This parameter allows the user to choose between audible tones or voice announcements to confirm activation and deactivation of Call Forwarding services. Audible tones may be required when using special phone sets that decode the confirmation or rejection tones, usually provided on POTS networks when requesting CF activation or deactivation.

4.3.2.4 POTS register 3 (FDC) (3N)

This register holds the timed delay and the target number for the fixed destination calls (FDC). Separate values are stored for either port.

1	call delay	FDC disabled	00	disabled
		delay (value+1)	01…30	
2…29	target FDC address	called number	1…28	empty

Table F - POTS register 3 (FDC)

As an example, use

*	3	2	*	9	5	5	5	3	3	3	3	#

to program a/b port 2 to generate a FDC to the number 555-3333, ten seconds after going off-hook.

The destination number can be modified by a keypad procedure outside configuration. Any modification will be reflected in this parameter.

4.3.2.5 POTS register 4 (4N)

1	Reminder ringing of held call	deactivated	0	deactivated
		activated	1	
2	Reserved			
3	Activation of Waiting call	disabled	0	
3		enabled	1	
4	ringing pattern associated to 1st MSN	ringing pattern ID (0 to 5)	0	pattern 0
5	ringing pattern associated to 2nd MSN	ringing pattern ID (0 to 5)	0	pattern 0
6	ringing pattern associated to 3rd MSN	ringing pattern ID (0 to 5)	0	pattern 0
7	CLIR service	no presentation id	0	no presentation ID
		presentation restricted	1	
		presentation allowed	2	
8	COLR service	no presentation id	0	no presentation ID

		presentation restricted	1	
		presentation allowed	2	

Table G - POTS register 4

4.3.2.5.1 Reminder ringing of held call

If a call on hold exists when the user goes on-hook and this feature is enabled, the a/b port will ring to remind the user of the held call.

4.3.2.5.2 Waiting calls

When enabled by this parameter, the user receives an audible tone when a call is waiting, or when a compatible call is received but the relevant a/b port is busy. This allows the user to take the call after clearing or holding the current call.

4.3.2.5.3 Ringing patterns

This feature allows the user to distinguish calls to different MSN based on the ringing patterns.

4.3.2.5.4 CLIR and COLR

Allows the user to include "presentation restricted" or presentation “allowed” in *all* outgoing messages (resp. set-up and connect messages).

4.3.2.6 Special Service Enables (5N)

This register can only be accessed via remote configuration. Using this register, the operator can selectively enable the relevant special services (Fixed Destination Calls, Call Capture, Alarm Calls)

1	Fixed Destination Calls	disabled	0	enabled
		enabled	1	
2	Call Pick-up	disabled	0	enabled
		enabled	1	
3	Wake-up calls	disabled	0	enabled
		enabled	1	

Table H - Special Service Enables

4.3.3 Read Commands

	ACCESS	***announcement***
T 0 0 #	U	manufacturer name, hardware and software revision
T 0 9 #	U	read activation status of port specific and global parameters
T 1 6 #	U	status of a/b port 1: 0 = OK, 1 = NOK
T 2 6 #	U	status of a/b port 2: 0 = OK, 1 = NOK
T 5 0 #	U	current power status: 0 = emergency, 1 = normal
T 6 0 #	U	current S bus configuration: 0 = short, 1 = extended
T 9 1 #	O	calling number of the last configuration call

T 9 2 #	U	date and time
T 9 8 #	U	reset all user configuration parameters to their default values.
T 9 9 #	O	reset all user and operator configuration parameters to their default values

Table I - Direct Commands

4.3.3.1 Read activation status of port specific and global parameters (command **09**)

This command is used to check if some parameters have been changed via a remote configuration call, but are still waiting to be activated. Four digits are read back, according to the following table:

Pos	refers to	Value	Meaning
1	a/b1 specific parameters	1	waiting for activation
		0	activated
2	a/b2 specific parameters	1	waiting for activation
		0	activated
3	global parameters	1	waiting for activation
		0	activated
4	data port parameters	1	waiting for activation
		0	activated

4.3.3.2 Read date and time

This command allows to read date and time as maintained by the NT-IP.

The NT-IP uses date and time information contained in some messages from the network to update its internal clock. After reset, no such information is maintained until the internal clock is synchronized to date and time provided by the network.

4.3.3.3 Default reset commands

These commands are used to reset all configuration parameters to the factory default values.

NOTE: remote configuration numbers ***are not affected*** by these commands.

4.3.4 Examples of configuration procedures

4.3.4.1 Programming a/b port registers

To deactivate a/b port 2 if not connected to any terminal (phone or modem):

* 2 9 * 0 9 9 9 9 #

or

* 2 9 * 0 #

To configure a/b port 1 as "speech/audio":

* 1 9 * 1 9 9 9 9 #

or

* 1 9 * 1 #

To configure a/b port 2 as "telephone" (i.e. only a phone is connected to the a/b port):

or

4.3.4.1.1 Metering pulses

To activate the pulse generation for a/b port 1:

or

To deactivate the pulse generation for a/b port 2:

or

4.3.4.1.2 Delayed clear back

To activate the clear-back feature for a/b port 2:

or

4.3.4.1.3 Audio levels

To program a/b port 1 for high audio levels (recommended option when modems are used):

To program a/b port 1 with low audio levels:

4.3.4.1.4 An example of complete programming

The command

will program a/b port 2 as follows:

type of terminal	telephone
call waiting	type I and type II CW enabled
delayed clear-back	enabled

generation of metering pulses	enabled
audio levels	low

5 SUPPLEMENTARY SERVICES

Two types of services are supported by the NT-IP:

- ISDN supplementary services, i.e. services that rely on network features
- Local additional services, that do not imply interactions with the network

5.1 ISDN supplementary services

Most ISDN supplementary services are related to the deployment of advanced telephony services (e.g. call waiting, call forwarding, calling line indication, etc.) and, from the user's perspective, bear a close resemblance to the corresponding services provided by the analog networks.

NOTE: Most supplementary services may not be available on a general basis and may require a specific agreement with the ISDN service provider.

The NT-IP supports a number of such ISDN supplementary services:

number identification services

- multiple subscriber number **MSN**
- calling line identification presentation **CLIP**
- calling line identification restriction **CLIR**
- connected number presentation **COLP**
- connected number restriction **COLR**
- malicious Call Identification **MCID**

call offering services

- terminal portability **TP**
- call forwarding unconditional **CFU**
- call forwarding on busy subscriber **CFB**
- call forwarding on no reply **CFNR**
- explicit call transfer **ECT**

call completion services

- call hold **HOLD**
- call waiting **CW**

multiparty services

- three party conference **3PTY**

community of interest services

- closed user group **CUG**

charging services

- advice of charge **AOC**

5.2 User procedures

The use of some supplementary services, such as MSN, CLIP and COLP do not require any user procedure. They are made available on a general basis or by arrangement with the service provider, and no action is required to activate, deactivate or invoke the service.

Some services (e.g. call forwarding procedures) must be explicitly *activated* and *deactivated* by the user and then they are automatically operated when needed (e.g. when an incoming call meets the conditions for being forwarded). These services also usually support a *status interrogation procedure*.

Other services (e.g. 3 party conference, MCID) require instead an explicit *invocation* by the user to operate.

To operate these procedures when using NT-IP, the user usually presses a sequence of keys starting with ***** or # on the phone keypad, and in some cases precedes this sequence by the action of the register recall (RR) or hook flash (HF) key. These procedures usually mimic those used in POTS networks for the equivalent services.

The NT-IP therefore provides for the necessary "mapping" between such POTS-like procedures and the signalling procedures used on the network side. These latter procedures conform to the relevant ETSI standards[3], that describes signalling that takes place between the central office and the user terminal on the D-channel.

The NT-IP also supports the *Keypad Protocol*. This protocol is much simpler and it basically results in the keys pressed being transparently transmitted as "keypad information" to the switch, where all the processing takes place. The keypad protocol requires less processing on the part of the user's terminal, which basically has no knowledge of what service is being requested by the user. Older switch implementation tend to offer most services using the "keypad" protocol, although newer switch releases now offer supplementary services using the feature-rich "functional" protocols[4].

NT-IP makes it completely transparent to the user what kind of protocol has to be used to obtain a specific supplementary service. The user only presses the same "key sequence" required when connected to the POTS.

5.3 Service description and user procedures

The following sections provide a short description of each supplementary service supported by the NT-IP for the a/b ports and then details user procedures to configure or operate the service.

Information on the outcome of activation, deactivation, interrogation and invocation procedures are provided by a *voice announcement* or, for the Call Forwarding services and the Call waiting service, such announcements can be replaced by *audible tones,* according to the setting of the position 9 of parameter **N9**).

When tones are used, a positive outcome is signalled trough a dial tone while a negative outcome is signalled using a busy or a congestion tone.

5.3.1 Multiple Subscriber Numbers (MSN)

This service allows for multiple telephone numbers (**MSN**'s or directory numbers **DN**s) to be assigned to an ISDN access. This basically permits the user to allocate numbers to different terminals and/or services. The maximum number of MSN's per access is a network option.

5.3.1.1 User procedures

In the NT-IP, either a/b port can be allocated one, two or three MSN's, while the RS-232 port can only be assigned one MSN. When MSN's are allocated, the NT-IP routes incoming calls[5] to the relevant port(s), based on the called party number information contained in the incoming call set-up message. If no MSN are programmed for a port, then incoming calls are offered to that port independently of the called party number included in the incoming call set-up message.

The first MSN assigned to the a/b port is included as the "calling party number" in outgoing calls.

MSN numbers are separately programmed for either port in registers N1, N2 and N3.

It may be sufficient to program any number of digits as required to identify the number among those assigned to the access, but, as a general rule, it is safer to *enter the whole MSN* as some networks may not properly process such abbreviated MSNs.

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[3] ETS 300 196-1 and other services specific ETS

[4] Depending on the switch implementation, a service (e.g. call forwarding) can be supported either by a "functional" or the "keypad" protocol. Furthermore, when using the "functional" protocol, some variants may exist among different switch technologies or in option offering policies by the operator. These differences have an impact on the NT-IP, and some country specific "fine-tuning" may be necessary for proper operation.

[5] additional checks are performed to assure that the call is compatible with the port profile (speech, audio, fax)

5.3.2 Calling Line Identification Presentation (CLIP)

This service allows the called subscriber to receive information regarding the identity (telephone number and possibly subaddress) of the calling party. The calling user may either provide the calling number (in this case the number is screened, verified and formatted by the network), or the network itself uses the default accesses number. No checks are performed instead on the user-provided subaddress, which is transparently passed to the called user.

The service is activated or deactivated by the network operator and therefore no user procedures related to the service deployment.

5.3.2.1 User procedures

At the calling site, the NT-IP includes in the outgoing call set-up message the first programmed MSN associated with the port that originated the call. If the first MSN is not programmed, then no information is included.

5.3.3 Restriction of caller's ID (CLIR)

This service allows the calling user to request that her/his party's number (and subaddress) is not presented to the called party. There are different subscription options for CLIR:

option	operation
on a per-call basis (default ***allowed***)	the calling party identity is presented unless the user explicitly requests restriction
on a per-call basis (default ***restricted***)	the calling party identity is restricted unless the user explicitly requests to allow its presentation
permanent basis	the calling party identity is restricted independently of the user requesting the contrary

5.3.3.1 User procedures

Depending on the value assumed by the CLIR parameter (register **4N**, position 7), the outgoing SETUP message contains a "presentation indicator" set as shown in the following table:

value of CLIR param	no prefix	*31#	#31#
0 (default)	no indication	restricted	allowed
1	restricted	restricted	allowed
2	allowed	restricted	allowed

If the CLIR parameter is set to 0 and the CLIR service is available at the user's access, the user can restrict the presentation of the own number by dialling ***31#** in front of the called number.

Alternatively, the user can set the CLIR parameter to 1 to restrict presentation for ***all*** calls, unless **#31#** is dialled in front of the called number for a specific call.

Setting the CLIR parameter to 2 allows for a "presentation indicator" to be included by default in the SETUP message[6]. The user has however the possibility to request restriction, by prefixing ***31#** to the called number.

5.3.4 Connected Line Identification Presentation (COLP)

This service allows the *calling* subscriber to receive information regarding the identity (telephone number and possibly subaddress) of the party answering the call (due to possible call diversions, this number may be different from the called one).

[6] as required by some networks

5.3.4.1 User procedures

The NT-IP uses the first MSN for the relevant port and it includes this information (if present) in the CONNECT message. This service is only supported in the outgoing direction only: display of the connected party number is not available on a/b ports.

5.3.5 Connected Line Identification Restriction (COLR)

This service allows the *answering* user to request that the number (and subaddress) be not presented to the calling party.

5.3.5.1 User procedures

Each a/b port can be programmed to request COLR on each call by setting register **4N**, position 8 to 1. (See §4.3.2.5). No activation procedure is available, so the COLR is only provided for ***all calls***.

5.3.6 Malicious caller ID (MCID)

Upon invocation of this service during an incoming call, the network registers and stores under control of the network operator critical information regarding the call, such as calling and called party number, time and date of the call. A subscription option allows for automatic registering of all unanswered calls.

The MCID supplementary service is available by arrangement with the service provider. Cancellation is at the request of the subscriber or for service provider reasons.

5.3.6.1 User procedures

The NT-IP allows the user to invoke the MCID service by pressing **R 9** during the active phase of the call or immediately after the caller has disconnected.

5.3.7 Terminal Portability

This service allows a user to suspend a call and subsequently to resume it at the same terminal and at the same socket, or after moving the terminal to a different socket, or at a different terminal on a different socket.

When the call is suspended, the network maintains the connection to the remote user and it stores relevant information for the call (B channel), to allow the call to be re-established at a later time.

When suspending a call, the user may specify a "call identity", which has to be indicated when the call is being resumed.

5.3.7.1 User procedures

The TP service is used in the NT-IP to "transfer" active calls from one a/b port to the other. When a call is active on one port (say, port 1), the user suspends the call by pressing:

R * 7 9 #

if no call ID is entered, or

R * 7 9 * 1 2 3 4 #

if a call ID (e.g. "1234") is desired. The user then goes on-hook.

To resume the call at the other port, the user goes off-hook and dials

*** 7 9 #**

or, if a call ID has been associated with the call:

*** 7 9 * 1 2 3 4 #**

Note that the suspended call can also be resumed from the same port or from a terminal connected to the S bus.

5.3.8 Call Waiting (CW)

This service allows the user to be notified of an incoming call, even when both channels on the user's access are busy, and therefore no channel is available for the call. Were the CW service not available at that access, then the call would be cleared with cause "user busy". Standard calls are offered with indications of the associated channel, while call set-up messages for waiting calls bear the indication "*no channel available*".

Upon receiving this notification, the user can take appropriate actions to make one channel available (such as clearing or placing one of the existing calls on hold) and then answer the call.

The maximum number of waiting calls is a network option. The CW supplementary service is available by prior arrangement with the network operator.

5.3.8.1 User procedures

The NT-IP uses audible tones (CW tones) to inform the busy user of a "waiting call". As an *extension to the standard service*, the NT-IP also generates CW tones in the case that a "standard" (i.e. non waiting call is being offered) but the compatible port is busy.

The user can dynamically activate or deactivate the service by going off-hook and then pressing

*** 4 3 #**

to activate the service, or

 # 4 3 #

to deactivate the service.

Activation and deactivation of the CW service result in setting the position 3 of parameter 4N respectively to 1 or 0.

To interrogate the service the user presses

*** # 4 3 #**

to receive a voice announcement (or a tone) on the service status.

!	disabling CW tones may be necessary to avoid interference with operation of modem or fax devices.

When CW tones are heard during a call, the user can ignore the call or (depending on the services provided by the network and subscribed to by the user):

clear the waiting call	**R 0**
clear the active call and answer the waiting call	**R 1**
put the active call on hold and answer the waiting call	**R 2**

If the user goes on-hook when a waiting call is present, the a/b port will ring (provided that the conditions for delayed clear back are not met).

5.3.9 Call Hold and Retrieve (HOLD)

This service enables a user to place an existing call into a stand-by state and, subsequently, to retrieve the call. When the call is the held state, the associated channel becomes available for use with other calls by the same user (e.g. to start a new call or to accept a waiting call).

The HOLD service may available on a subscription basis or on a general basis.

The HOLD service is commonly used to start a new call or to accept a waiting call without releasing the currently active one. When one call is active and another one is held, the user can then switch between calls or activate other supplementary services such as Three Party or Explicit Call Transfer.

5.3.9.1 User procedures

With NT-IP, the user can place an active call on hold by and then start a new call by pressing the **R** key, waiting for the dial tone and then dialling the new number.

Once the second call is established, the user can:

clear the call on hold	**R 0**
clear the active call and resume the call on hold	**R 1**
switch between calls	**R 2**
starts a three party conference	**R 3**
request the explicit call transfer	**R 4**

When the user goes on-hook and a call is still on hold, a programmable feature of the NT-IP allows the user to be notified of the call still on hold. ("***reminder notification of held call***" register **4N**, position 1, see §4.3.2.5).

If this feature is enabled, the POTS will start ringing when the user goes on-hook and it keeps ringing for 60 seconds. If the user goes off-hook during this time, the held call is automatically retrieved and the conversation to the held party is re-established. When this time expires, the held call is disconnected.

If the feature is disabled, when the user goes on-hook both the active and the held call are immediately disconnected.

5.3.10 3-Party Conference (3-Pty)

This service enables the user with two ongoing calls (one active and one in the held state) to bridge the two calls into a three-way conference, so that a three-way conversation is possible among the promoting user and the two remote parties.

The promoting user has complete control over the conference, as he/she can disconnect or temporarily exclude either remote party from the conference, or terminate the conference.

5.3.10.1 User procedures

The 3-party conference can be entered when one active call (A) and one held call (H) exist. The user presses

R 3

to join call H into the conference.

Subsequently the user can:

release the connection added on conference (H)	**R 1**
resume private conversation with A (H returns to the held state)	**R 2**
request explicit call transfer	**R 4**
release the connection to A and retrieve the connection to H to the active state	**R 5**
resume private conversation with H (place A on hold, retrieve H to the active state)	**R 6**

5.3.11 Closed User Group

This service allows a user to be a member of one or more closed user groups. When such a membership is established, the network performs special access checks over calls originated or received by the user.

Members of the same CUG are usually allowed to communicate among themselves, but calls leaving or entering the group are usually restricted. Nevertheless, as subscription options, a CUG member can be

granted the right to place (*Outgoing Access*) and/or to receive (*Incoming Access*) calls outside the CUG (non-CUG calls). Some additional restrictions can be placed on CUG members to prevent them from placing (*outgoing calls barred*) or receiving calls (*incoming calls barred*) within the CUG.

The CUG service is available on a prior arrangement with the network provider.

As a subscription option, the user can subscribe to a *preferential closed user group.* In this case, outgoing calls are by default treated as CUG calls, and no action is required on the part of the user's terminals to place CUG calls.

If no preferential closed group has been subscribed to, then the user must explicitly indicate a CUG index when placing a CUG call.

5.3.11.1 User procedures

In the NT-IP, a user with a *preferential CUG* places a call *outside* the CUG[7] by dialling

*** 0 1 #**

in front of the called number. Calls *within* the CUG do not require any prefix.

Users *without* preferential CUG need to explicitly indicate a CUG index (in the example, **1 2 3 4**) to place CUG calls by dialling:

*** 0 1 * 1 2 3 4 #**

in front of the called number. Non-CUG calls do not require any prefix.

5.3.12 Advice of Charge (AOC)

This service allows the served user to receive charging information related to calls and to the invocation or activation of supplementary services.

The AOC supplementary service is usually activated on a general basis, i.e. the served user receives charging information at every call. On some networks, activation of the service may be required on a per-call basis. The AOC service actually consists of three services:

- the AOC-S provides information on charging rates at call set-up time and when charging rates change during a call
- the AOC-D service provides cumulative charging information during the active cycle of a call.
- the AOC-E service provides recorded charging information at the end of a call.

A network operator may choose to provide charging information either in "charging units" or in as a currency amount.

5.3.12.1 User procedures

The NT-IP is able to process the received charging information and to generate "charging pulses" on the a/b port that originated the call. Generation of charging pulses is enabled for either port by setting the relevant configuration parameter (registers N9, position 2) to 1.

Additionally, when charging information is provided as currency amount, the general configuration parameter 08 contains the amount of currency equivalent to a charging pulse. This register contains 4 significant digits and an additional multiplier digit that specifies the number of digits after the decimal point. For example, if 6.05 units of local currency correspond to a charging pulse, the register shall be programmed either with "60503" or "06052".

[7] the user must have subscribed to the Outgoing Access (OA) option

!	charging pulses may adversely affect operation of modem or fax devices.

5.3.13 Explicit Call Transfer (ECT)

This service enables the user with two ongoing calls (one active call to A and one held call to B) to request the network to join user A and user B in a single call. If the request is successful, the requesting user is then disconnected while user A and user B remain connected.

5.3.13.1 User procedures

In the NT-IP, the ECT is requested by pressing **R 4** when a call is active and another call is on hold (this also includes when the 3-PTY service is active).

5.3.14 Call Forwarding Services (CF)

These services are used to instruct the network to divert incoming calls to a different number. Three different types of service are provided:

- call forwarding unconditional (CFU) : all call are diverted
- call forwarding busy (CFB): calls are diverted if they meet busy
- call forwarding no reply (CFNR): calls are diverted if no reply is obtained from the called user

If the user's access has the MSN service, then the services can be activated on a "served number" basis or for "whole access" (i.e. independently of the called number). This feature may not be available on a general basis: i.e. it may require a specific subscription by the served user, or it may not be offered by the network provider.

Additionally, separate requests can be issued for different bearer services (e.g. audio, speech, and data). This feature may not be available on a general basis. In any case, the user can submit a request for diverting calls for "all services".

As each activation can specify a different "diverted-to" number, the user has the possibility to specify different target numbers for each different service and for each different number on the access.

The CF supplementary services are offered on a subscription basis, with several notification options:

- to the served user
  - notification of forwarding
  - notification of service being active[8]
- to the calling user
  - notification of forwarding
- to the “forwarded-to user”
  - presentation of the "served user" number when the diverted call is offered

Activation, deactivation and interrogation procedures are available.

5.3.14.1 User procedures

The NT-IP provides full support for the CF services using the ETS functional protocol specified in ETS 300 207-1. As a customer localisation option, the NT-IP also provides for support to the CF services using the stimulus procedures. The following description applies to the “functional” procedure.

[8] this notification occurs when the served user places an outgoing call

When wishing to request unconditional transfer of incoming calls to a defined number, the user goes off-hook and dials

T 2 1 T <diverted-to-number> #

This sequence translates into a request to the network to activate the CFU service for the "served number" that is represented by the *first MSN assigned to the port*.

The activation, deactivation and interrogation requests can also explicitly contain a ***served user number***: e.g.

T 2 1 T 8 7 6 5 4 3 2 T 2 3 4 5 6 7 8 #,

requires activation of CF from number 8765432 to the number 2345678. The same holds for deactivation (**# 2 1 T 8 7 6 5 4 3 2 #**) or interrogation (**T 2 1 T 8 7 6 5 4 3 2 #**).

If the first MSN is not assigned and no served user number is included in the request, then the "all number" version of the request is used[9]. In all cases, the request is issued for "all services".

To deactivate the CFU service the user goes off-hook and dials **# 2 1 #**.

The user is informed on the outcome of the activation, deactivation or interrogation requests either by a voice announcement or a tone by setting position 9 on register N9 to 0 or 1. (see §4.3.2.3).

The user can also interrogate the network on the activation status of the CFU by going off-hook and dialling

T # 2 1 #

A voice announcement or a tone informs the user about the status of the service. If the voice announcement are used, the user is also informed about the served user number and the diverted-to number[10].

Procedures for CFB and CFNR services are similar to the ones described for the CFU, except for the "service code" **21**, changing to **61** for the CFNR and to **67** for the CFB.

5.4 Additional services

The following services do not strictly rely on network provided supplementary services, but they are instead implemented locally and do not cause transactions with the network.

5.4.1 Call line identification (CLI) services

This service, also known as "CLASS" services, allows a user to be informed of the number of the calling party before answering a call. To this purpose, a specific display device must be connected to the a/b port or, alternatively, the display may be integrated in the phone.

5.4.1.1 User procedures

CLI services are provided for *normal* and *waiting* calls. They are available for both ports in *normal* and in *restricted* power mode and in every situation: e.g. simultaneous occurrence of call offering to both a/b, or when the other a/b port is already ringing, etc.

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[9] if the "per served user number" service is not available, the network will however process the request as if contained "all number".

[10] the activation, deactivation and interrogation requests may come out to be invalid in the case that the following conditions occur:

1. the network option "activation, deactivation and interrogation for all numbers" has the value "NO",
2. the MSN service is provided to the access,
3. the "all number" version of the request is used, due to the first MSN not being programmed.

In this case the first MSN must be programmed to allow proper service operation.

The NT-IP provides the calling party number or an indication that the number is not aviailable ("**O**") or restricted ("**P**").

Date and time are also included if this information is received form the network in the specific information element contained in a CONNECT or in other messages.

The NT1+ uses this information to update an internal clock. After reset, the content of the internal clock is invalidated and are therefore not used. When a message is received including this information, the internal clock is updated to the value indicated by the network and is then kept running.

When this date and time information is not available, a dummy string of question marks is substituted for the date and time in the CLI message.

These services can be selectively enabled by setting parameter 8 (CLI on standard calls) or parameter 7 (CLI on waiting calls) in configuration register **N9**.

5.4.2 Fixed Destination Call

This service allows a user to place a call to a selected number without any dialling. If the user goes off-hook but does not dial any digit within a certain time, then the NT-IP automatically calls the selected number.

5.4.2.1 User procedures

Configuration register **3N** holds the required parameters for either port. The first two positions are set to 0 to disable the service. If not set to zero, these digit contains a value (1 to 30) which represents the number of seconds for the timer. The following digits are used for the fixed destination number.

This service must be enabled using position **1** of register **5N**. This register is reserved for the operator and can therefore only be accessed via remote configuration.

The user can program the fixed destination number[11] by going off-hook and dialling:

T 5 3 T 4 5 6 7 8 9 0 #

where 4567890 represents the new fixed destination number.

Interrogation of the actual value of this number is possible by dialling

T # 5 3 #

5.4.3 Alarm Calls

This service allows the user to schedule an alarm call at a certain time of the day. The alarm time must be at least 10 minutes ahead of the current time. Up to three alarm calls per port can be scheduled, with a minimum difference of 5 minutes between calls.

When the scheduled time for an alarm call is reached, then the NT-IP rings the a/b port. If the alarm call is not answered or meets busy, the call is repeated once after 5 minutes.

When the alarm call is answered, a congestion tone is generated until the user goes on-hook.

5.4.3.1 User procedures

This service must be enabled using position **2** of register **51** (for port 1) and **52** (for port 2). This register is reserved for the operator and can therefore only be accessed via remote configuration. To schedule an alarm call, the user dials

T 5 5 T h h m m #

[11] the value of the FDC timer can only be modified in configuration mode.

where hh:mm represents the alarm time. The user receives a voice announcement for confirmation or rejection. The request can be rejected if three alarms are already active, or if time constraints are not met.

The deactivate an alarm call the user dials:

 # 5 5 T h h m m #

to deactivate a specific alarm, or

 # 5 5 #

to deactivate all alarms. The user receives a voice announcement for confirmation or rejection.

Interrogation of alarm status is accomplished using

T # 5 5 T h h m m #

to interrogate a specific alarm, or

T # 5 5 #

to interrogate all active alarms. Alarm times are indicated for every alarm call.

5.4.4 Distinctive Ringing

This service allows the user to receive different ringing patterns for incoming calls based on the called MSN contained in the call-set message.

5.4.4.1 User procedures

For either port, the user associates a specific ringing pattern to each of the three available MSN's.

To this purpose, positions 4, 5 and 6 of configuration register 4N allows for pattern selection. Patterns use values 0 to 5:

value	pattern
0	1.0 ON -3.0 OFF
1	0.4 ON - 0.2 OFF – 0.4 ON - 3.0 OFF
2	0.6 ON - 0.2 OFF – 0.2 ON - 3.0 OFF
3	0.2 ON - 0.2 OFF – 0.6 ON - 3.0 OFF
4	0.7 ON - 0.1 OFF – 0.2 OFF -3.0 OFF
5	0.2 ON - 0.1 OFF – 0.7 OFF -3.0 OFF

5.4.5 Delayed clear-back

This service allows a user with an *incoming* call active to go on-hook and to resume the call form another phone connected to the same a/b port.

5.4.5.1 User procedures

When this feature is enabled by setting position **4** of register **N9** to the value **1**, the NT-IP postpones the clearing of incoming calls for duration indicated in parameter **6N** (default value is 60 sec), so that the user is allowed to move the phone to another socket or to resume the call from another phone. Delayed clear-back is automatically disabled when more than one call are associated at the a/b port (e.g. a call on hold).

5.4.6 Call Pick-up

This service allows a user to pick-up an incoming call ringing on the other a/b port.

5.4.6.1 User procedures

This service must be enabled using position **3** of register **51** (for port 1) and **52** (for port 2). This register is reserved for the operator and can therefore only be accessed via remote configuration.

To capture the call when the other a/b port is ringing, the user goes off-hook and then dials:

T 8 2 #

6 OPERATING THE RS-232 PORT

6.1 Software installation for the MS™-Windows® 95 and Windows NT® 4.0 environments

!	It is recommended to install the driver ***before*** connecting the NT-IP to your PC.

A diskette with modem driver files (.INF files) is provided with the unit.

To install the unit:

1) Insert the floppy disk with the driver file in the floppy drive A:
2) Double click on **My Computer**, **Control Panel**, and then **Modem**. If the **Modem Properties** window appears, click on **Add**.
3) In the **Install New Modem** window, select option **Don't detect my modem; I will select it from a list**. Click **Next**.
4) A window listing many modem types will be displayed. Click on **Have Disk**. Choose the appropriate disk drive and click on **OK**.
5) When Windows 95 prompts you with a modem list, *select the proper modem driver according to the desired operation mode*. Then click **Next**.
6) Choose the appropriate Communication port and click on **Next.**

The following drivers (.INF files) are available for the Windows 95 and Windows NT 4.0 environment:

– single link PPP: this only allows for 64 kb/s single link PPP operation
– multilink PPP: this allows for 128 kb/s PPP operation, and, depending on specific AT commands, bandwidth-on-demand, call bumping and use of BAP/BACP
– V.120
– async to sync HDLC[12]

6.2 Hardware installation

1. Connect the a.c. adapter to the NT-IP and verify that the PWR LED on the NT-IP is ON
2. Connect the RS-232 port to the COM port of your PC, using a DB-9/DB-25 adapter cable (if needed)

To verify that the RS-232 is properly connected, use the Hyper-Terminal program supplied with Windows 95® may be used to exercise the NT-IP with AT-commands.

To ease installation, the NT-IP supports:

– automatic recognition of the PC speed up to 230.4 kb/s during the command phase of the AT command.
– Plug&Play operation

6.3 Configuration Parameters

Except for A0 and A9 these commands can only be reached using the configuration program supplied by Aethra. All S registers in the format *xx*zzzz…#

06	read port status (same as POTS)
A0	MSN

[12] this mode is only used when the NT-IP is used to remote configure another NT-IP

A9	Subaddress
D0	buffer length
D1	BOP
ED	endpoint discriminator

6.4 AT commands

The NT-IP RS-232 port accepts AT commands in the format 8 bit, no parity, one or more stop bits.

AT command processing varies according to the current NT-IP status.

- the ***command*** mode is entered after power-on or at at the end of a connection. Data from the PC are interpreted as commands
- the ***online*** mode is entered after an incoming or outgoing connection has been successfully established. Any data received from the PC are used for transmission.
- the ***online command*** mode is entered when an escape sequence (usually + + + with certain timing constraints) is received in the *online* mode: subsequent data from the PC are processed as commands, although the ongoing connection is still active

Some AT commands can only be accepted if no connection is established or in progress.

An AT string consists of the upper case **AT** or lower case **at** prefix followed by one or more commands possibly separated by a space and terminated by terminating character (usually $^{C}_{R}$, hex **0D**).

A reply is provided at every AT string. If all commands are correct a positive reply is sent (**OK**$^{C}_{R}{}^{L}_{F}$), otherwise the first occurrence of an invalid or incompatible command a negative acknowledge is sent (**ERROR**$^{C}_{R}{}^{L}_{F}$) and the rest of the string is ignored.

The special **A** or **a** commands can be used to repeat the last AT command.

Some internal registers are used to assign values to some parameters. These registers are identified by the letter S followed by a number : e.g. the character used as a command terminator is contained in S3 (default $^{C}_{R}$), whilst S5 (default *backspace* $^{B}_{S}$) indicates an editing character, which is interpreted as a command to cancel the last entered character in a command.

If the AT string contains more than one interrogation, a reply is provided for each request with a final **OK** or **ERROR**.

6.4.1 Automatic Speed Detection

In the ***command*** and in the ***online command*** phase, the NT-IP automatically detects the PC speed, and immediately upgrades its own speed to reflect the detected speed. Supported PC speeds are: 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600, 115200 and 230400 b/s.

The last speed detected before entering the online state is then used throughout the call.

6.4.2 AT command list

The description of every command is provided according to the following template:

Ex	**F**	Controls Local echo of received commands
	P	x = 0/1 local echo disabled /enabled
	V	command and online command mode
	R	OK o ERROR if 'x' is out of range

This scheme indicates that:

– the command “ATE1” or “ATE0” has the function (F) to control the local echo to the AT commands received,

- the command requires specification of one configuration parameter (P),
- the command is valid (V) in the *command* or in the *online command* mode,
- a positive (**OK**) o negative (**ERROR**) reply (R) is provided by the NT-IP.

6.4.3 Basic commands

A	**F**	Immediately answer the incoming call
	P	None
	V	When an incoming call exists
	R	
D [P|T] [nnnnn] [/ssss]	**F**	Start a new call to the indicated number/subaddress
	P	P o T ignored, **nnnn/ssss** called number/subaddress (max.20/19 digits) Also supports the ATD**nnnn$_1$[/ssss$_1$]+nnnn$_2$[/ssss$_2$]** format for dual numbers.
	V	***Command***
	R	new state of connection (CONNECT, NO CARRIER, ..), ERROR (incompatible)
Ex	**F**	Controls echo of received commands to the PC
	P	x = 0/1 local echo disabled /enabled
	V	***Command*** and ***online command*** mode
	R	OK o ERROR if '**x**' is out of range
H	**F**	Release current call
	P	None
	V	***Online***
	R	OK
Ix	**F**	Query device status
	P	x = 0,2,4,5,7 Product code "AETHRA – NT-IP" x = 1 ROM checksum "XXXX" 4 hex digits x = 3 firmware version "Vx.y" x = 6 report link status on the last call
	V	***Command*** or ***online command***
	R	See parameters
O	**F**	Switch back to ***online*** mode
	P	None
	V	***online command***
	R	CONNECT o ERROR if send in an incompatible state
Qx	**F**	Display response codes
	P	X = 0/1 display of response codes enabled /disabled
	V	***Command*** and ***online command*** modes
	R	None if x = 1, if x = 0, either OK , ERROR if 'x' is out-of-range
Sn?	**F**	Read **Sn** register
	P	n = 0, 2, 3, 4, 5, 7, 18, 21, 23, 25, 27, 31, 32, 82, 83, 85, 87, 125, 126, 127
	V	***Command*** and ***online command*** modes
	R	Current value of register **Sn**, ERROR if **n** invalid.
Sn=v	**F**	Assign the value **v** to register **Sn**
	P	n = 0, 2, 3, 4, 5, 7, 18, 21, 23, 25, 27, 31, 32, 82, 83, 85, 87, 125, 126, 127
	V	***Command*** and ***online command*** modes
	R	OK, ERROR if **n** invalid
Vx	**F**	Set verbose mode
	P	x = 0/1 response in abbreviated/extended format
	V	***Command*** and ***online command*** modes
	R	**OK** ifx = 1, **0** if x = 0, **ERROR** otherwise
Xn	**F**	Defines the format of the CONNECT message
	P	n (0~7)
	V	***Command*** and ***online command*** modes
	R	OK, ERROR if n out of range

Z	**F**	Reset all parameters to the values in the non-volatile memory
	P	None
	V	***Command*** mode
	R	OK, ERROR if status invalid

6.4.4 Extended "AT&" commands

&Cx	**F**	C109 management
	P	x = 0/1 C109 always ON/connection status
	V	***Command*** mode
	R	OK, ERROR if status incompatible
&Dx	**F**	C108 Management
	P	x = 0 simulated C108 (always ON), C108/1, C108/2)
		x = 1 use as C108.1: start a call using stored number when C108.1 goes ON
		x = 2 use as C108.2: clear call when C108.2 goes off
	V	***Command*** mode
	R	OK, ERROR if status incompatible.
&F	**F**	Resets all parameters to default values
	P	None or 0
	V	***Command*** mode
	R	OK, ERROR if status incompatible.
&Hx	**F**	flow control management
	P	x = 0 flow control disabled
		x = 3 hardware flow control (RTS/CTS), default
		x = 4 software (XON-XOFF) flow control
	V	***Command*** mode
	R	OK, ERROR if status incompatible
&Sx	**F**	C107 management
	P	x = 0/1 C107 always ON/ follows C108
	V	***Command*** mode
	R	OK, ERROR if status incompatible
&W	**F**	Save current settings in non-volatile memory
	P	None
	V	***Command*** and ***online command*** mode
	R	OK
&ZO= <nnnn> / <ssss>	**F**	Assign Directory number and subaddress
	P	<nnnn>/<ssss> = assigned DN /subaddress (max. 28/19 digits)
	V	***Command*** mode
	R	OK, ERROR if status incompatible
&ZO?	**F**	Readback the assigned DN /subaddress
	P	none
	V	***Command*** and ***online command*** mode
	R	nnnn/ssss

6.4.5 Enhanced AT commands

Bnn	**F**	Set the protocol in use for B-channel communication
	P	**20** = V.120
		40 = PPP async to sync
	V	command
	R	OK or ERROR if **n** is out of range or if current status is not compatible
BPn	**F**	Enable/Disable BACP/BAP
	P	0 = disable, 1 = enable (default)
	V	command
	R	OK or ERROR if **n** is out of range or if current status is not compatible
CEn	**F**	Enable/Disable Call Bumping
	P	0 = disable, 1 = enable (default)
	V	command
	R	OK or ERROR if **n** is out of range or if current status is not compatible
JAn	**F**	add traffic threshold (S126)
	P	n kb/s, default 48
	V	command
	R	OK or ERROR if **n** is out of range or if current status is not compatible
JSn	**F**	subtract traffic threshold (S127)
	P	n kb/s, default 32
	V	command
	R	OK or ERROR if **n** is out of range or if current status is not compatible
KAMn	**F**	add persist time in minutes (S85, bit 1…6)
	P	0 to 63 (default 0)
	V	command
	R	OK or ERROR if **n** is out of range or if current status is not compatible
KASn	**F**	add persist time in seconds (S85, bit 1…6)
	P	0 to 63 (default 0)
	V	command
	R	OK or ERROR if **n** is out of range or if current status is not compatible
KSMn	**F**	subtract persist time in minutes (S125, bit 1…6)
	P	0 to 63 (default 0)
	V	command
	R	OK or ERROR if **n** is out of range or if current status is not compatible
KSSn	**F**	subtract persist time in seconds (S125, bit 1…6)
	P	0 to 63 (default 0)
	V	command
	R	OK or ERROR if **n** is out of range or if current status is not compatible
&Jn	**F**	enable/disable Multilink PPP
	P	0 = MP disabled (default)
		3 = MP enabled (both originate and answer)
	V	command
	R	OK or ERROR if **n** is out of range or if current status is not compatible
EPDxx	**F**	define endpoint discriminator to be used in MP configuration
	P	**OFF** (no EPD in use, default)
		c = "**<**" **`Octet_1 Octet_2 Octet_3.. Octet_n`**"**>**" — c = [0…5]
		c = **`ascii_string`**
	V	command
	R	OK or ERROR if **n** is out of range or if current status is not compatible
EPD?	**F**	return endpoint discriminator
	P	none
	V	command
	R	returns current EPD

7 GENERIC OPERATION

7.1 RS-232 control signals

DCD/C109 can be programmed to indicate connection status (**AT&C1**) or it can be set permanently ON (**AT&C0**).

DTR transition to OFF causes the current call to be cleared if the **AT&D1** or the **AT&D2** commands have been issued.

If hardware flow control mode is active (**AT&H3**), the CTS/C106 is used to flow control the local DTE.

DSR/C107 can also be set to be permanently ON (**AT&S0**) or to follow DTR/C108 status (**AT&S1**).

7.2 Handling data calls

7.2.1 Receiving calls

The RS-232 port can be allocated one MSN and one subaddress using the **AT&ZO** command.

If no MSN/subaddress has been programmed, incoming data calls will be offered to the data port independently of the called party number or subaddress contained in the incoming call SETUP message. If instead a MSN and/or a subaddress are configured, then only calls directed to that MSN/subaddress are answered. The programmed MSN/subaddress is also included as **COLP** information in CONNECT messages.

When the V.110 mode is selected, the NT-IP checks for V.110 rate adaptation information to be included in the incoming call SETUP message.

7.2.2 Placing calls

Calls are placed using the standard sequence **ATD<number>** or, optionally, **ATD <number>/ <subaddress>** sequence. The programmed MSN/subaddress is used for the **CLIP** service in outgoing calls.

7.2.3 Terminating calls

Calls are cleared by exiting the online state using the **+ + +** escape sequence and then disconnecting the call using the **ATH** command.

Alternatively, if the **AT&D1** or the **AT&D2** commands are in force, calls are cleared with DTR/C108 going OFF.

7.3 Flow control

Flow control on the interface to the local DTE can be configured using the **AT&H3** command:

AT&H0	Flow control disabled
AT&H3	Hardware (CTS/RTS) flow control (default)
AT&H4	Software (XON/XOFF) flow control

With hardware flow control enabled (**AT&H3**), the NT-IP stops forwarding data received from the line if the local DTE sets RTS to OFF. Depending on the protocol in use, this may in turn translate into the NT-IP exercising flow control mechanisms on the link (e.g. by sending RNR frames or withholding acknowledgement of received frames) to slow down the remote device.

Similarly, the NT-IP uses the CTS signal to instruct the local DTE not to send more data to avoid overflow of its internal transmit buffer (e.g. when the DTE speed is greater than the link speed or due to back pressure from the remote site).

Software flow control (**AT&H4**) is based on two control characters used to stop and resume traffic in the opposite direction. Character codes used for this purpose are contained in register S31(default 0x11, XON) and register S32 (default 0x13, XOFF).

7.4 Storing and retrieving parameter settings

Current settings can be stored in non-volatile memory with the **AT&W** command. The **ATZ** command restores all settings to the values contained in the non-volatile memory.

The **AT&F** command is used to reset all parameters to the factory default values:

parameter	*value*
TEI	AUTOMATIC
MSN	EMPTY
Subaddress	EMPTY
Auto Answer (S0)	OFF (0)
Escape char (S2)	'+' (43)
CR char (S3)	(13)
LF char (S4)	(10)
BS char (S5)	(8)
DTE speed (S18)	115200 (9)
C107 (S21 bit 3)	Follows C108 (1)
C109 (S21 bit 4)	Line status (1)
C108 (S21 bit 5)	From DTE (1)
Echo (S23 bit 0)	ON (1)

parameter	*value*
Verbose (S23 bit 6)	ON (1)
Result code (S23 bit 7)	ON (1)
XON char (S31)	(17)
XOFF char (S32)	(19)
Max. frame size	256
Multilink Protocol	disabled
Endpoint Discriminator	none
call bumping	enabled
BAP/BACP	enabled
Add persist time	0
Add threshold	48 kb/s
Sub threshold	32 kb/s

7.5 Response to the ATI6 command

The following information is given as a response to the ATI6 command:

```
"DTE Async-HDLC statistics
      Rx Good Frames    : 0
      Rx Bad Frames           : 0
      Rx Overflow             : 0
      Rx Aborted Frames       : 0
      Rx Frames too long      : 0
      Rx Discard Frames       : 0
      Tx Frames               : 0
      Tx Underrun             : 0
 B-Channel HDLC statistics
      Rx Good Frames          : 0
      Rx Bad Frames           : 0
      Rx FIFO Overflow        : 0
      Rx Overflow             : 0
      Rx Aborted Frames       : 0
      Rx Frames too long      : 0
      Rx Discard Frames       : 0
      Tx Frames               : 0
      Tx Underrun             : 0"
```

7.6 "ATXn" result code Option Table

CONNECT messages issued by the NT-IP at call establishment can have different format, as indicated by the following table.

As an example, if **ATX5** is active and a V120 call is established using the B-channel, the NT-IP sends a CONNECT 115200/V120 64000/LAPF message to the DTE.

ATV0	ATV1	X0	X1	X2	X3	X4	X5	X6	X7
0	OK	V	V	V	V	V	V	V	V

2	RING	V	V	V	V	V	V	V	V
3	NO CARRIER	V	V	V	V	V	V	V	V
4	ERROR	V	V	V	V	V	V	V	V
6	NO DIAL TONE			V		V	V	V	V
7	BUSY				V	V	V	V	V
8	NO ANSWER				V	V	V	V	V
1	CONNECT	V							
10	CONNECT 2400		%	%	%	%	@		
11	CONNECT 4800		%	%	%	%	@		
12	CONNECT 9600		%	%	%	%	@		
17	CONNECT 14400		%	%	%	%	@		
14	CONNECT 19200		%	%	%	%	@		
39	CONNECT 28800		%	%	%	%	@		
19	CONNECT 38400		%	%	%	%	@		
20	CONNECT 57600		%	%	%	%	@		
21	CONNECT 64000							$	#
22	CONNECT 115200		%	%	%	%	@		
23	CONNECT 230400		%	%	%	%	@		
47	CONNECT 128000							$	#

Symbol reference

symbol	operation	example
V	SUPPORTED	--
%	reports DTE_speed	**CONNECT 115200**
@	reports DTE_speed/protocol DCE_speed/error_control	**CONNECT 115200/V120 64000/LAPF**
$	reports the DCE speed/error code	**CONNECT 64000/NONE**
#	reports the DCE speed/error code/error control	**CONNECT 64000/NONE/LAPF**

where

Protocol	**V120**, V110, **PPP**
Dce_speed	**64000, 128000, 2400, 4800, 9600, 19200, 38400**
Error_code	**NONE**
Error_control	**LAPF, LAPD**

8 PPP OPERATION

The Point-to-Point Protocol (PPP) defines procedures to configure, maintain and terminate a link between two peers. This link is used for the transport of higher layer network protocols such as the Internet Protocol. Additionally, the PPP defines a framework for multiple peer-to-peer signalling protocols (such as authentication protocols, multilink protocol and bandwidth allocation protocol).

Multilink PPP (MP) is a protocol that allows two end-systems to use multiple physical channels to achieve a greater transmission speed. When using MP, the separate logical links existing on each physical connection are connected in a ***bundle***. For ISDN applications, separate calls are established on the two B-channels resulting in a transmission speed of 128 kb/s.

The main purpose of MP is to distribute transmitted PPP packets over the channels in the bundle and to recombine received packets into a single logical flow.

The NT-IP makes the use of MP transparent to the user's PC: i.e., the user's PC is unaware of all the operations required to establish and release additional calls and to co-ordinate packet flows on the channels. Basically, from the PC point of view a single link exists with a higher throughput than if a single B-channel were in use.

PPP is described in RFC 1661. The CHAP authentication protocol is described in RFC 1994. MP is described in RFC 1990. BACP/BAP are described in RFC 2125.

8.1 Asynchronous HDLC to synchronous HDLC conversion

Personal computers use the asynchronous serial interface to exchange PPP packets. These packets are contained in character-oriented HDLC frames. The NT-IP provides for conversion between such frames and bit-oriented, synchronous HDLC frames suitable for transmission over the B-channel to communicate to access routers at the ISP.

8.2 PPP operations

8.2.1 Configuring PPP operations

The **AT** command used to enable PPP operation is the following:

ATB40	enable async to sync PPP

In order to use PPP, the proper modem driver must be installed and the destination you are calling (e.g. an access server at an Internet Service Provider) must also support PPP.

8.2.2 Placing a single link PPP call

The PC instructs the NT-IP to place a call using the **ATD** command. A link configuration phase is started as soon as the physical link is established. The NT-IP intervenes in the initial configuration process to locally negotiate the Asynchronous Control Character Map (ACCM) configuration option. This option is locally negotiated with the PC in order to increase the throughput on the B-channel by avoiding transmission of unnecessary escape codes on the B-channel[13].

8.2.3 Authentication

When the link has been configured, an authentication procedure is started, using a protocol negotiated during the link establishment phase. The NT-IP provides two modes for handling authentication:

[13] The PC only requires some characters (e.g. X-ON and X-OFF) to be control-escaped when sent by the peer. If the ACCM option is not negotiated locally, the PC assumes the default condition is in force and all 32 control characters (codes 0x00 to 0x1F) are control-escaped before being transmitted to the NT-IP.

mode	protocol required by the access server	operation
mode 1 S87.2=1 default	PAP or CHAP	PAP is locally negotiated between the NT-IP to the local DTE. The username/password included in the PAP authenticate request from the local DTE are cached by the NT-IP and then, depending on the protocol negotiated between the NT-IP and the access server, it is used for PAP authentication or to handshake CHAP/MD5.
mode 2 S87.2=0	PAP	The authenticate request on the initial link is passed to the access server.
	CHAP	Authenticate-request, response and success/failure packets are transparently passed between the local DTE and the access server.

Protocols other than PAP and CHAP must be handled in transparent mode. This may not guarantee proper authentication in all configurations.

8.3 MP operations

8.3.1 Configuring for MP

In order to use MP, the proper modem driver must be installed and the destination access server must also support MP. An attempt to place an MP call to a device that does not support it, results in a single B-channel PPP connection.

Once the PPP protocol as been selected using **ATB40**, the **AT&J***n* command is used to enable or disable MP operation:

AT&J0	Disable MP
AT&J3	Enable MP in answer and originate modes

NOTE: AT&J1 and **AT&J2** commands are rejected.

8.3.2 Placing an MP call

IF MP is enabled the NT-IP includes an MRRU configuration option and possibly the EID configuration option (see §8.3.6) when configuring the initial link.

If MP operation is rejected by the server, the additional channel is not established and the session continues on the initial link.

8.3.3 Establishing the additional channel

After successful negotiation of MP, the NT-IP establishes the second call to the server. By default, the same telephone number is used for both MP connections. If required, two different numbers may be specified by using the **ATD<DN_1>+<DN_2>** command, where **<DN_1>** and **<DN_2>** represent the phone numbers of the destination. The DTE will *not* be notified of this additional call.

If Bandwidth-On-Demand (see §8.4.1) is enabled, the NT-IP will not start the call immediately after negotiation of MP, but it will rather postpone the call until the conditions for establishing the second channel are met.

If this second call fails due to network reasons (e.g. network congestion, or the access server being busy, or the second B-channel being not available), the NT-IP will repeat the call at intervals of 60 seconds. If the call fails because one analog call or a configuration call is active, and the call bumping feature is enabled (see §8.4.2), the NT-IP will automatically retry when that call is cleared.

8.3.4 Configuring the additional link

Once the call is established, the NT-IP autonomously negotiates configuration parameters for the additional link, using the same option values negotiated for the first link.

If LCP cannot be properly configured or the authentication procedure does not complete, the B-channel is disconnected and single channel operation continues[14].

8.3.5 Authenticating the additional link

If the default non-transparent authentication mode is selected (S87.2=1), see §8.2.3, PAP or CHAP authentication are completely handled by the NT-IP using the username/password cached when establishing the initial link.

If the transparent authentication mode is selected (S87.2=0), then:

- if PAP authentication has been negotiated on the initial link, the NT-IP sends the PAP authentication request using the same username/password as in the first authentication
- if CHAP authentication has been negotiated on the initial link, the NT-IP transparently passes any CHAP authenticate-request, response and success/failure packets between the PC and the access server.

It is ***recommended*** to use the default mode, as some software implementations on the PC do not properly handle multiple CHAP authentication cycles during a PPP session. This would prevent additional connections to be authenticated. However, transparent CHAP authentication is the most secure method, as the user's password is not cached within the NT-IP.

8.3.6 MP data phase

If LCP configuration and authenticated on the additional link are successful, the NT-IP distributes outgoing traffic from the DTE between the two channels, and sequences the packets received on either channel in a single packet flow before handing them over to the DTE.

Should the connection on either channel be cleared for reasons other than "call bumping", the NT-IP will not re-attempt to establish the connection.

8.3.7 Endpoint Discriminator

The Endpoint Discriminator (EID) consists of a Class Field and a user defined Address Field. When this EID is configured into the NT-IP, it will be used during the PPP negotiations that occurs on the initial and the additional channels. The access server uses this EID to associate a PPP link to a specific endpoint and therefore either creates a new bundle or adds this link to the bundle to the same end-point. The use of EID is optional, but it may be required by some MP implementations at the server side.

Class values are assigned as follows:

Class		Length	Comments
0	Null Class	0	the default value if the option is not indicated
1	Locally Assigned	up to 20	a local assignment (e.g. a device serial number)
2	IP Address	4	an IP host address
3	MAC Address	6	an IEEE 802.1 MAC address
4	Magic-Number block	up to 20	1 to 5 concatenated 32 bit PPP Magic-Numbers
5	Directory Number	up to 15	an octet sequence representing an E.164 DN

Use of class 1 and class 4 is "deprecated" by the MP standards and should be avoided.

The EID Address field can be assigned by the **ATEPD** command:

ATEPD OFF indicates that no EID has to be included in the configuration. This is the default value.

ATEPDc = <Octet_1, Octet_2, Octet_3,.., Octet_n>, where **c** indicates the selected class (0 to 5) and each **Octet_i** is in the range from 0 to 255. The angle brackets "<" and ">" are part of the this command.

[14] A subsequent call is attempted after 60 seconds.

ATEPDc = ascii_string, where **c** indicates the selected class (0 to 5) and **ascii_string** is a string of ASCII coded character, which are transparently passed to the EID. The first character in this **ascii_string** must be not be an opening angle brackets ("<").

The command **ATEPD?** can be used to view current setting of the Endpoint Discriminator Address.

8.4 Call Management Procedures

The NT-IP implements call management procedures in order to optimise the usage of the B-channels and minimise costs: *call bumping*, traffic based *bandwidth on demand* (with and without *bandwidth allocation protocol*).

8.4.1 Traffic based Bandwidth-On-Demand

Bandwidth-On-Demand (BOD) or Dynamic Bandwidth Allocation (DBA) refers to the ability of a system to dynamically change the bandwidth of a multilink bundle by establishing and removing links.

BOD decisions are based on link utilisation. The decision to add a channel is based on ***either*** the transmit ***or*** the receive traffic on the existing channel staying above an "add threshold" for a defined "add-persist" amount of time.

The additional channel is removed when the ***both*** the transmit ***and*** the receive traffic on that channel stays below a "subtract threshold" for a defined "subtract-persist" amount of time.

Add and subtract threshold and persist time are specified in the following AT commands:

ATJAn	add traffic threshold for n kbps, (default, n = 48).	S126
ATJSn	subtract traffic threshold for n kbps, (default, n = 32).	S127
ATKAMn or **ATKASn**	add-persist time for n period in min/sec, n = 0-63	S85 Bit 1…7
ATKSMn or **ATKSSn**	subtract-persist time for n period in min/sec, n = 0-63	S125 bit 1…7

If the add-persist time is 0, then BOD is disabled (default). BOD is only effective if calls originate from the NT-IP.

8.4.1.1 Adding bandwidth

The NT-IP calculates the averages of transmit and receive traffic on the initial link in the last seconds (or minutes) as indicated by the ATKA command. The NT-IP then continuously compares these averages to the programmed add threshold. When either the transmit **or** the receive average passes this threshold, the NT-IP attempts to establish a call for the additional link according to §**Virhe. Viitteen lähdettä ei löytynyt.**

8.4.1.2 Removing bandwidth

The NT-IP calculates the averages of transmit and receive traffic on the bundle in the last seconds (or minutes) as indicated by the ATKS command. The NT-IP then continuously compares these averages to the programmed subtract threshold. When this threshold is passed, the NT-IP stops sending data packets on the additional link and it transmits a LCP **Terminate**-*Request* to the access server on that link. After receipt of the **Terminate**-*Ack* the NT-IP disconnects the B-channel supporting that link.

If no **Terminate**-*Ack* is received within 3 sec, the **Terminate**-*Request* is sent again. In case of no response, the link is assumed to be terminated anyway and the NT-IP disconnects the channel.

8.4.2 Call Bumping

"Call Bumping" refers to the capability of the NT-IP to drop the channel supporting the additional MP link and to use that channel when the user wants to place or to answer a voice call through a phone connected to one of the two a/b ports.

The following command are related to Call Bumping:

ATCE0	Disable call bumping

ATCE1	Enable call bumping (default)

The Call bumping enable status is also reflected in bit 0 of register S85.

8.4.2.1 Outgoing calls

If the user goes off-hook to start a voice call, the NT-IP stops sending packets on the additional channel and then requests link termination on the "additional channel". When the server acknowledges the termination request (indicating that no more packets are being transmitted on that link), the NT-IP clears the call, and then sends the call set-up message for the voice call.

NOTE: due to the time required to properly terminate the additional link, some delay may occur before getting the dial tone for the analog call.

8.4.2.2 Incoming calls

An incoming voice call is offered by the network as a waiting call[15] when both B-channels are in use. If Call Bumping is enabled, the NT-IP transmits an ALERTING message, it rings the a/b port(s) and it then waits for the user to go off-hook to start the link termination procedure on the additional channel.

NOTE: this avoids slowing down the data traffic until the call is actually answered; nevertheless the user may experience some delay before being connected to the calling party.

When the speech call has been cleared, the NT-IP attempts to re-establish the additional link, it therefore places an additional call, re-using the same phone number as for the first establishment:

- if BOD is enabled (add-persist value is not zero): the additional call is placed based on traffic statistics being collected during and after the speech call; nevertheless, a minimum of 10 seconds since the speech call has been cleared must elapse before the additional data call is placed
- when BOD is disabled (the add-persist value is zero): the additional call is started 10 seconds after the speech call has been cleared.

For the duration of the voice calls, the NT-IP does not process any other incoming call, unless the connection to the access server on the original channel is terminated.

Call Bumping does not obviously apply to a second voice call (i.e. the user on the other a/b port is not allowed to place calls).

8.4.2.3 Diagnostic calls

Call bumping also applies to remote diagnostic calls occurring during MP operation. Such a call takes precedence over PPP calls and therefore it is answered after the additional link has been terminated and the supporting physical connection has been disconnected. After the diagnostic call has been disconnected, the NT-IP attempts to re-establish the additional link.

8.4.3 THE BANDWIDTH ALLOCATION PROTOCOL

When using BOD as described in §8.4.1, bandwidth is added or removed based on some user-defined traffic thresholds internal to the NT-IP (or to the PPP server on the other side). Furthermore the NT-IP must know in advance the telephone number of the additional channel.

The ***Bandwidth Allocation Protocol*** (BAP) allows the two endpoints (i.e. the NT-IP and the PPP server) to gracefully *negotiate* when adding and dropping the additional bandwidth, and therefore it makes more likely that BOD decisions are better suited to the real traffic. BAP also provides a means to indicate the telephone number that has to be dialled to place the additional call.

[15] If the waiting call supplementary service is offered by the network, and subscribed to by the user.

The ***Bandwidth Allocation Control Protocol*** (BACP) is a control protocol for BAP, and it is mainly used to determine if the peer supports BAP.

BACP/BAP can be enabled as follows:

ATBP0	Disable BACP/BAP function
ATBP1	Enable BACP/BAP function (by default)

BACP/BAP is transparent to the user. When the BACP/BAP function is enabled and the MP has been successfully negotiated, the NT-IP uses BACP to determine whether the peer supports BAP and to agree upon link discriminators. If the access server agrees to use BAP, this is used to negotiate addition and removal of the second B channel with the peer equipment based on user-defined traffic thresholds.

When BACP/BAP is enabled, the NT-IP includes the Link Discriminator option in LCP configuration for every link. If, during configuration of the first link in the bundle, either the Link-Discriminator option is code-rejected or the remote peer does not include the Link Discriminator option in its Configure-Request, then the NT-IP then assumes the BACP/BAP is not supported at the server, and no further BACP/BAP activity is taken.

If the Link-Discriminator option is acknowledged in both directions, then the NT-IP attempts to negotiate BACP on the first established link, (i.e. it sends a BACP Configure-Request, including the Favoured-Peer option with a Magic Number of 1).

If the BACP/BAP is not enabled, the NT-IP code-rejects the Link Discriminator option if this is offered in the LCP configuration.

8.4.3.1 Adding bandwidth using BAP

When BAP has been successfully negotiated and the traffic conditions for adding a channel to the bundle are met, the NT-IP sends a **Call**-*Request* BAP packet, including the link type option set to "ISDN".

If the **Call**-*Response* indicates ***Nak***, the NT-IP will not retry to establish the call until the conditions to add a channel are newly satisfied (i.e. the add-persist timer is restarted).

If the **Call**-*Response* indicates ***Rej*** or ***Full Nak***, no more attempts will be retried for the entire duration of the bundle.

If the server replies with a **Call**-*Response* indicating ***Ack***, the NT-IP starts the new call, possibly using any *Phone-Delta* information included.

The NT-IP does not implement the server side of BAP, i.e. when receiving a **Call**-*Request*, the NT-IP always responds with a Call-response indicating ***Rej***.

The request to add bandwidth may also come from the server, as a **Callback**-*Request*. Upon receiving this packet, the NT-IP replies with an ***Ack*** response if resources are available (i.e. the NT-IP is not already using two B-channels), and attempts to establish the call using any Phone Delta information included in the request packet.

In either case, when the call attempt is completed, the NT-IP transmits a **Call-Status**-*Indication* packet, indicating the result of the call attempt (either successful or reporting the Q.931 cause in case of failure). The NT-IP does not include the *retry* action and will not retry to establish the call until the conditions to add a channel are newly satisfied (i.e. the add-persist timer is restarted).

8.4.3.2 Removing a link using BAP

When the traffic conditions for removing the additional channel, the NT-IP transmits a **Link-Drop-Query**-*Request* indicating the link discriminator of the link deemed to be dropped.

If the **Link-Drop-Query**-*Response* indicates ***Nak*** or ***Full-Nak*** the NT-IP restarts the subtract persist timer and does not take any further action.

If the **Link-Drop-Query**-*Response* indicates ***Ack*** the NT-IP starts the link termination procedure as described in §8.4.1.2.

Upon receiving a **Link-Drop-Query**-*Request*, the NT-IP transmits an ***Ack*** response if its transmit traffic has been below the add-threshold for at least half the add-persist time. If the transmit traffic has exceeded the add-threshold during half the add-persist time, the NT-IP responds with ***Nak***. No immediate action is taken by the NT-IP, which keeps the link in use until the reception of a LCP **Terminate**-*Req*.

9 V.120 COMMUNICATIONS

V.120 is an international standard that defines a protocol for peer-to-peer communications over ISDN. The V.120 protocol allows two endpoints to exchange error-protected, flow controlled traffic. V.120 implements a variant of HDLC based Link Access Procedure known as LAP-F and described in the ITU-T recommendation V.120 and Q.922.

The NT-IP does not allow for link parameter negotiation or for establishment of multiple logical links on the same physical channel. Only the single default link (LLI = 265) is used.

9.1 Configuring the V.120 mode

In order to use V.120, the proper modem driver must be installed and the called destination must also support V.120. The **ATB20** command is used to select V.120 operation:

ATB20	Select V.120 protocol

9.2 Placing V.120 mode calls

The standard sequence **ATD<number>** or, optionally, **ATD<number>/<subaddress>** is used to place a V.120 call. The call SETUP message includes the Bearer Capability (BC) information element set to "unrestricted digital information".

When V.120 is configured, this is the expected B-channel protocol independently of any LLC information being included in the incoming call SETUP message.

9.3 V.120 operation

As soon as the connection is established, an initialisation procedure takes place. Should this initialisation fail, then the call is cleared.

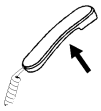
Once that the logical link has been established, characters received from the DTE are assembled into V.120 frames. Frames are then forwarded either when the maximum frame length is reached (as set in the **ATCL** command), or when a 100 msec timer since the last received character has expired.

The default maximum transmit frame size for V.120 is 256 octets, not including any FLAG, transparency bit and octets and FCS. The **ATCLn** command (n = 1~2048) can be used to select a different value. The maximum receive frame size is always set at 2048 octets. The NT-IP always uses a window size of 7.

The NT-IP assumes that the local DTE uses a character format of 8 bit data, no parity, 1 stop bit (8N1).

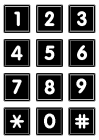
10 BASIC USER PROCEDURES

10.1 Placing a call



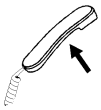
Lift the handset

Wait for the dial tone



Dial the desired number

10.2 Restricting the Caller ID



Lift the handset

Wait for the dial tone, then dial

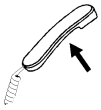
T 3 1 #

followed by the desired number.

10.3 Handling waiting calls

The user has an active call to B and receives audible tones for a waiting call.

To ***enable*** waiting calls



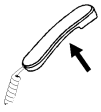
Lift the handset

then dial

T 4 3 #

and replace the handset

To ***disable*** waiting calls



Lift the handset

then dial

4 3

and replace the handset

!	disabling CW tones may be necessary to avoid interference with operation of modem or fax devices.

answering a waiting call

When a call is waiting, tones will be heard. You can ignore the call or (depending on the services provided by the network and subscribed to by the user):

clear the waiting call	R 0
clear the active call and answer the waiting call	R 1
put the active call on hold and answer the waiting call	R 2

If you go on-hook when a call is waiting, the a/b port will ring.

10.4 Starting a second call

!	This function is only available if the HOLD supplementary service is supported on your access

During a call:

R	wait for dial tone
1 2 3 4 5 6 7 8 9 * 0 #	Dial the number for connection B

NOTE: Pressing R before connection to B is completed (busy or no answer) restores the connection to A.

If the user does not start dialling within a few seconds, then the original call is resumed.

10.5 Handling two simultaneous calls

Once the second call is established, you can:

clear the call on hold	R 0
clear the active call and resume the call on hold	R 1
switch between calls	R 2
starts a three party conference	R 3
transfer calls (at least one call must be an incoming one)	R 4

10.6 3-party conference

Starting the 3-party conference

when you have one active call to A and one held call to H, press

R 3

to join A and H into a three party conference.

Handling the conference

release connection to H	R	1
resume private conversation with A (H on hold)	R	2
transfer call	R	4
release connection to A and retrieve connection to H	R	5
resume private conversation with H (A on hold)	R	6

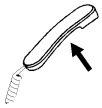
10.7 Malicious caller ID

During the active phase of the call or even after the calling user has gone on-hook, press:

R then 9

10.7.1 Call Forwarding Unconditional

to ***activate***



Lift the handset

dial

T 2 1 T

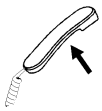
enter the number where you want your call to be transferred, then dial

#

a voice announcement or an audible tone will confirm the successful outcome of the request.

Replace the handset.

to ***deactivate***



Lift the handset

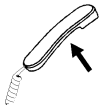
dial

2 1

a voice announcement or an audible tone will confirm the successful outcome of the request.

Replace the handset.

to ***interrogate*** the status of the service



Lift the handset

dial

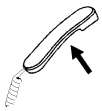
T # 2 1 #

the status of the service and the destination number will be announced.

Replace the handset.

10.7.2 Call forwarding on calls meeting busy

to ***activate***

 Lift the handset

dial

T 6 7 T

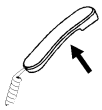
enter the number where you want your call to be transferred, then dial

#

a voice announcement or an audible tone will confirm the successful outcome of the request.

Replace the handset.

to ***deactivate***

 Lift the handset

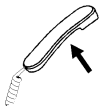
dial

6 7

a voice announcement or an audible tone will confirm the successful outcome of the request.

Replace the handset.

to ***interrogate*** the status of the service

 Lift the handset

dial

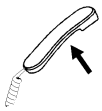
T # 6 7 #

the status of the service and the destination number will be announced.

Replace the handset.

10.7.3 Call forwarding on no reply

to ***activate***

 Lift the handset

dial

T	6	1	T

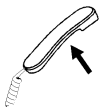
enter the number where you want your call to be transferred, then dial

#

a voice announcement or an audible tone will confirm the successful outcome of the request.

Replace the handset.

to ***deactivate***

 Lift the handset

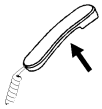
dial

#	6	1	#

a voice announcement or an audible tone will confirm the successful outcome of the request.

Replace the handset.

to ***interrogate*** the status of the service

 Lift the handset

dial

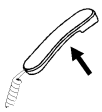
#	T	6	1	#

the status of the service and the destination number will be announced.

Replace the handset.

10.7.4 Fixed Destination Call

to ***enter*** the destination number

 Lift the handset

dial

T	5	3	T

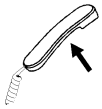
enter the destination, then dial

#

a voice announcement will confirm the successful outcome of the request.

Replace the handset.

to ***interrogate*** the destination number

 Lift the handset

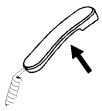
dial

T	#	5	3	#

the destination number will be announced.

10.7.5 Alarm Calls

To ***schedule*** an alarm call, dial

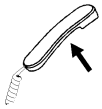
 Lift the handset

dial

T	5	5	T	h	h	m	m	#

where hh:mm represents the alarm time. The alarm time must be at least 10 minutes ahead of the current time. Up to three alarm calls per port can be scheduled, with a minimum difference of 5 minutes between calls.

to ***deactivate*** an alarm call

 Lift the handset

dial

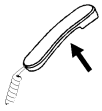
#	5	5	T	h	h	m	m	#

to deactivate a specific alarm, or

#	5	5	#

to deactivate all alarms.

to ***interrogate*** the status of a specific alarm call

 Lift the handset

dial

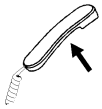
T	#	5	5	T	h	h	m	m	#

to ***interrogate*** all active alarms, dial

T	#	5	5	#

10.7.6 Call capture

To answer a call ringing on a phone connected to the other port

 Lift the handset

dial

T	8	2	#

the call will be answered and connected to your phone.

11 TECHNICAL SPECIFICATIONS

Mechanical

- Dimensions ..... 180 x 140 x 45 mm
- Weight ..... Xxx gr.
- Power Supply
- Voltage ..... 230 Vac +10%-15%, 50 Hz
- Max Current At Nominal Voltage ..... < 100 mA

Line interface

- Line codes 2B1Q
- Standard compliance ..... ETR 080
- Power consumption ..... max 1.7 W
- Range ..... >1 kΩ($V_{remote\ supply}$ > 90V_{dc})

RS232 port

- control circuits ..... TXD,RXD,RTS,CTS,DSR,DTR,DCD
- data rate ..... up to 230.4 kbit/s
- access protocol ..... PPP, internal async to sync converter
- dialling mode ..... Hayes® AT command set

a/b ports

- dialling mode ..... DTMF, pulse
- impedance ..... real (600Ω)
- transmission quality ..... exceeds Q.552

Ringing Generator

- frequency ..... 25 Hz, symmetrical
- voltage ..... > 37 V_{rms} (Z_{load}=2kΩ, 60°)
- max distortion 10%

Reference Standard for Environmental Quality

- Safety ..... EN60950 (oct. 96)
- EMC and protections ..... ETS 300 047, ETS 300 386-2-2
- Transport ..... ETS 300 019-1-1 class 1.2
- Storage ..... ETS 300 019-1-2 class 2.2
- Operation ..... ETS 300 019-1-3 class 3.2

subjet to change without notice