Installation and Reference Manual for Asterisk Interface Cards

(Version: 2.0)

Index of contents

Introduction..3
Installation and Configuration of Zaptel (Digium) Cards........................3
Downloading and compiling the Zaptel Sources........................3
The File "zaptel.conf"........................4
Installation and Configuration of different Cards........................5
TDMxxP (TDM400P)........................6
TDM24xxB (TDM2400(B/E))........................9
TE110P........................11
B410P (ISDN/BRI card)........................13
........................14
TE4xxP / TE2xxP........................15
Does the TE2xxP/TE4xxP fit in my PCI slot ?........................18
IAXy (S101I)........................19
Channel Configuration with Asterisk (zapata.conf)........................20
Analog Channel Configuration (FXS/FXO)........................20
ISDN Channel Configuration (PRI)........................21
Installation and Configuration of beroNet Cards........................23
Installation of the BN2S0/BN4S0........................23
Installation of the BN8S0........................25
Installation of the BN1E1........................26
Installation of the BN2E1........................27
Connection of the BNPW1........................29
Connection of the BNPW2 (only for BNxS0 Vers. 2)........................30
Connecting beroNet cards over PCM bus for Hardwarebridging........................31
mISDN Installation........................33
Install chan_mISDN automatically with beroNet's Makefile........................33
Configuration of your beroNet hardware........................34
Initiating the hfc_pci Kernel module........................36
The File misdn.conf........................37
Options of the "general" section........................37
Options of the "default" section........................38
Options of the port group sections........................40
Configure point-to-point (PTP) mode for NT ports........................41
chan_misdn CLI Commands........................41
mISDN dial parameter........................42
Words of advice on the operation of BNxS0 cards with the "bristuff"-driver from Junghanns.............43
Installation of Asterisk........................44
Installation automaticly including mISDN........................44
Installation by hand........................45
Additional Sources of Information........................46
Sample Configurations 47
E1 Cable Selection for Connection to PRI Circuits or other Telephony Devices........................48
Technical Data........................49
BN4S0 Board........................49
technical overview of BN4S0 rev. 1........................50
technical overview of BN4S0 rev. 2........................51
BN8S0 Board........................52
technical overview of BN8S0 rev. 1........................53
BN2E1 Board........................54
technicel overview of BN2E1........................55
TE410P / TE405P........................56
TE407P / TE412P........................56
TDMxxP / TDM400P 57

TE110P 58
S101I (IAXy)......59

1.Introduction

Thank you for choosing a beroNet or Digium interface card and the Asterisk open source PBX.

Our interface cards are build for use in an "Asterisk Open Source PBX" based system. The software PBX "Asterisk" and the drivers for the interface cards are covered under the GNU public license (GPL) agreement. Please understand that software deficiencies are not covered by our warranty. Only beroNet and Digium interface cards are covered by a warranty of one year for businesses and two years for private customers.

This manual assumes that the Asterisk system is located in Europe and uses European standard ISDN circuits and signalling. It was written to support the installation of our interface cards and is not exhaustive in covering all aspects, nor does it claim to be flawless. If you notice any incorrect statements or technical mistakes, please report them to support@beronet.com, so we can correct them as soon as possible.

2.Installation and Configuration of Zaptel (Digium) Cards

2.1.Downloading and compiling the Zaptel Sources

In order for the interface card to work, you have to install the necessary drivers in form of Linux kernel modules. For Digium interface cards, it means downloading the driver sources from Digium using SVN (Subversioning System).

This installation only works under the assumption that the kernel sources of your current Linux kernel are configured properly and that a working Internet connection is available.

Usually, the kernel sources are installed in folder "/usr/src/linux", where the directory "linux" is only a link to the actual source directory. The same is true for 2.6 kernels. Instead of "linux", the name of the link would then be "linux-2.6".

For the successful compilation of Zaptel and Asterisk, the following packages must be installed on your system:

- C compiler gcc
- Kernel sources of your current kernel, installed and configured
(make menuconfig dep)
- zlib, zlib-dev
- openssl, openssl-dev
- bison 1.875
- libreadline, libreadline-dev

To obtain the Zaptel sources with SVN, open a console, and with "cd /usr/src" enter directory "/usr/src". Then type the following:

```
svn co http://svn.digium.com/svn/zaptel/branches/1.2 zaptel <ENTER>
```

This will check out the driver source files from the Digium SVN server. You probably need the "libpri" and "Asterisk" sources as well. Therefore, type:

```
svn co http://svn.digium.com/svn/libpri/branches/1.2 libpri <ENTER>
```

and

```
svn co http://svn.digium.com/svn/asterisk/branches/1.2 asterisk <ENTER>
```

This results in the creation of three new directories in "/usr/src":

```
"/usr/src/zaptel"
"/usr/src/libpri"
"/usr/src/asterisk"
```

After completing the download, change to directory "/usr/src/zaptel" and enter:

```
make clean <ENTER>
make install <ENTER>
```

You now successfully compiled and installed the kernel modules on your system.

For ISDN Stack support, "libpri" must be installed. Enter directory "/usr/src/libpri/", and type:

```
make clean <ENTER>
make install <ENTER
```

To compile and install Asterisk, enter directory "/usr/src/asterisk/", and type::

```
make clean <ENTER>
make install <ENTER
```

By default, the following kernel modules should have been installed in the directory "lib/modules/<k*ernel version*>/misc". The drivers of interest are in bold:

- **zaptel.o**	-->	Zaptel modul layer, needed for all Zaptel drivers
- tor2.o	-->	driver for the obsolete E400P and T400P (4xPRI)
- torisa.o	-->	driver for the obsolete ISA PRI card
- wcusb.o	-->	driver for the USB-FXS device S100U
- wcfxo.o	-->	driver for the obsolete X100P (1xanalog FXO)
(- wcfxs.o)	-->	*obsolete driver for the TDM400P board*
- **wctdm.o**	-->	new driver for the TDM400P board
- ztdynamic.o	-->	necessary for TDMoE
- ztd-eth.o	-->	driver for TDMoE
- wct1xxp.o	-->	driver for the obsolete E100P
- **wct4xxp.o**	-->	driver for the TE410P and TE405P
- **wcte11xp.o**	-->	driver for the new TE110P (replacement for E100P)
- pciradio.o	-->	obsolete
- ztd-loc	-->	obsolete

Before you can load the necessary kernel module, you need to configure the channel information in "zaptel.conf".

2.2.The File "zaptel.conf"

The File "zaptel.conf" is in the directory "/etc". This is different from all other Asterisk configuration files, which are located in "/etc/asterisk". The file "zaptel.conf" contains all necessary information the driver modules need to configure the card and themselves.
Once you load a driver module (modprobe <moduleX>), a "ztcfg" will be executed, usually automatically. If it does not happen automatically, you can complete it manually by entering "ztcfg <ENTER>". Compiling Zaptel will generate this executable file "ztcfg". It configures all channels registered by Zaptel (by the proper driver) with the settings in "zaptel.conf".

To load the associated kernel module, type the following (here an example for a TE110P):

```
modprobe wcte11xp.o <ENTER>
```

2.3.Installation and Configuration of different Cards

The following section describes the various configurations of different Zaptel cards in "zaptel.conf". Please keep in mind that the sections refer to the presence of a single card in your system. Should more than one (different or duplicate) card be in your system, the following applies:

The channels are configured in the same order that the drivers are loaded.

For example, if you have a TDM card (i.e. TDM40B) and a PRI card (i.e. TE110P) in your system, and the TDM driver is loaded first, configuration of your "zaptel.conf" must address these channels first. Every driver produces so called spans (in the virtual file system "/proc/zaptel"), which contain the channels. Every number in that file represents a "span".

Please note that:

- For the Digium TDM cards, a "span" with four channels will be generated (four modules=four channels), even if not all channels are occupied.
- For the Digium PRI cards, every port will generate a "span" with 31(E1) or 24(T1) channels.

Finally, you should determine the country zone that you want to work with. The default settings are:

loadzone = us
defaultzone = us

"Loadzone" specifies which type of DTMF (dual-tone-multi-frequency) signal will be used, meaning the ring tone, busy signal, etc. These tone frequencies, or "zones", can be set for different countries in the file "/etc/asterisk/indications.conf". This file can be accessed only after compiling and installing Asterisk.

It is recommended that you change the default entry in "zaptel.conf" (generated by "make") and enter the following:

loadzone=de
defaultzone=nl

TIP: Add an empty line at the end of each configuration file.

We continue with the channel configuration, which usually is in the format:

[device]=[Channellist]

The [Channellist] can represent one or multiple numbers in the format:

- 1
- 1-4
- 1-15,17-31

2.3.1.TDMxxP (TDM400P)

The TDM400P is a mother board with space for a total of four analog modules. Each of the modules provides one analogue channel. The following combinations are available:

TDM01B, TDM02B, TDM03B, TDM04B, TDM10B, TDM11B, TDM12B, TDM13B, TDM20B, TDM20B, TDM21B, TDM22B, TDM30B, TDM31, TDM40B

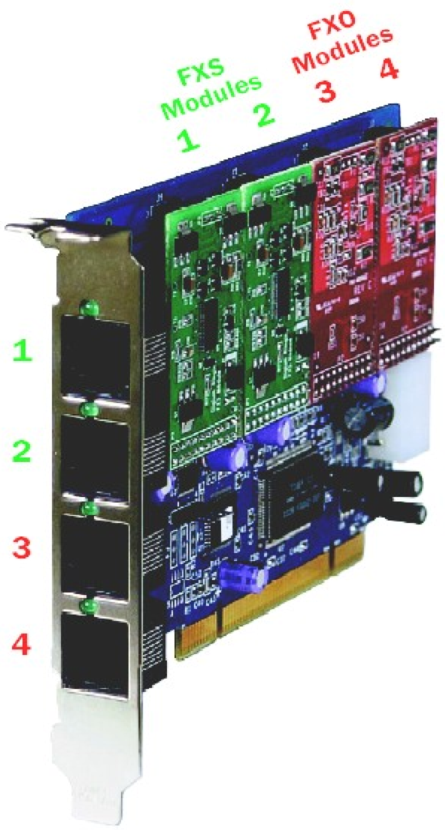
In this case, the first digit (after TDM) represents the number of FXS modules and the second digit the number of FXO modules.

!!!! ATTENTION !!!
PLEASE HANDLE CARDS AND MODULES WITH EXTREME CARE, THE PARTS ARE VERY DELICATE. AVOID STATIC DISCHARGE AT ALL COST.

Install the card by following these instructions:

1. Turn off your computer.
2. Disconnect your computer power completely by pulling the power cord from the power outlet.
3. Insert the card into an empty PCI slot.
4. Carefully connect an available 4-PIN 5/12V connector (from your PC power supply) to the associated socket on the side of the card.
5. Reconnect power to your computer and turn it on.

Notice how the modules are tied to the ports. The following picture shows the example of a TDM22B and how the port location corresponds to the module location



After installing the card, enter the following in your "zaptel.conf", based on card type:

Card Type	Configuration
TDM01B	fxsks=1
TDM02B	fxsks=1-2
TDM03B	fxsks=1-3
TDM04B	fxsks=1-4
TDM10B	fxoks=1

TDM11B	fxoks=1
	fxsks=4

TDM12B	fxoks=1
	fxsks=2-3

TDM13B	fxoks=1
	fxsks=2-4

TDM20B	fxoks=1-2

TDM21B	fxoks=1-2
	fxsks=3

TDM22B	fxoks=1-2
	fxsks=3-4

TDM30B	fxoks=1-3

TDM31B	fxoks=1-3
	fxsks=4

TDM40B	fxoks=1-4

After the card has been installed and configured correctly, you can load the driver. Keep in mind that with older Zaptel versions, you need to load the module "wcfxs.o". For the newer version, type:

modprobe wctdm <ENTER>

If needed, type "ztcfg <ENTER>" to complete the process.
Once the module loaded properly, the green LED associated with the port will light up and the following is shown in "/proc/zaptel/1" (here an example for a TDM22B):

```
Span 1: WCTDM/0 "Wildcard TDM400P REV E/F Board 1"

        1 WCTDM/0/0 FXOKS (In use)
        2 WCTDM/0/1 FXOKS (In use)
        3 WCTDM/0/2 FXSKS (In use)
        4 WCTDM/0/3 FXSKS (In use)
```

2.3.2.TDM24xxB (TDM2400(B/E))

The TDM2400P is a mother board with space for a total of six analog modules. Each of the modules provides four analogue channels (4xFXO or 4xFXS). The following combinations are available:

TDM2401, TDM2402, TDM2403, TDM2404, TDM2405, TDM2406, TDM2410, TDM2411, TDM2412, TDM2413, TDM2414, TDM2415, TDM2420, TDM2421, TDM2422, TDM2423, TDM2424, TDM2430, TDM2431, TDM2432, TDM2433, TDM2440, TDM2441, TDM2442, TDM2450, TDM2451, TDM2460

In this case, the first digit (after „TDM24") represents the number of FXS modules and the second digit the number of FXO modules.

!!!! ATTENTION !!!
PLEASE HANDLE CARDS AND MODULES WITH EXTREME CARE, THE PARTS ARE VERY DELICATE. AVOID STATIC DISCHARGE AT ALL COST.

Install the card by following these instructions:

6. Turn off your computer.
7. Disconnect your computer power completely by pulling the power cord from the power outlet.
8. Insert the card into an empty PCI slot.
9. Carefully connect an available 4-PIN 5/12V connector (from your PC power supply) to the associated socket on the side of the card.
10. Reconnect power to your computer and turn it on.

After installing the card, enter the configuration values in your "zaptel.conf", based on card type. Here are some examples:

Card Type	Configuration
TDM2401B	fxsks=1-4
TDM2410B	fxoks=1-4
TDM2406B	fxsks=1-24
TDM2460B	fxoks=1-24

TDM2466B	fxoks=1-12
	fxsks=13-24

After the card has been installed and configured correctly, you can load the driver.Please type:

modprobe wctdm24xxp <ENTER>

If needed, type "ztcfg <ENTER>" to complete the process.
Once the module loaded properly, the following is shown in "/proc/zaptel/1" (here an example for a TDM2401B):

```
Span 1: WCTDM/0 "Wildcard TDM2400P REV *"

        1 WCTDM/0/0 FXOKS (In use)
        2 WCTDM/0/1 FXOKS (In use)
        3 WCTDM/0/2 FXOKS (In use)
        4 WCTDM/0/3 FXOKS (In use)
```

2.3.3.TE110P

The TE110P (E100P, T100P) is a 1-Port T1/E1 card. The card has a jumper that lets you choose whether the card should work in the T1 or the E1 mode. Please set the jumper accordingly. This jumper is not present on the older, obsolete E100P and T100P cards because a different card exists for each mode. Install the card in an empty PCI slot and restart your system.

if operating your card in **E1** mode, add the following in your "zaptel.conf":

```
span=1,1,0,ccs,hdb3
bchan=1-15,17-31
dchan=16
```

if operating your card in **T1** mode, add the following in your "zaptel.conf":

```
span=1,1,0,esf,b8zs
bchan=1-23
dchan=24
```

Now load the driver module "wcte11xp.o" with the command:

```
modprobe wcte11xp <ENTER>
```

If you have a E100P or a T100P, load the driver module "wct1xxp.o":

modprobe wct1xxp <ENTER>

If needed, type "ztcfg" <ENTER> to complete the process.
Once the module loaded properly, the following should show in "/proc/zaptel/1" (E1 configuration):

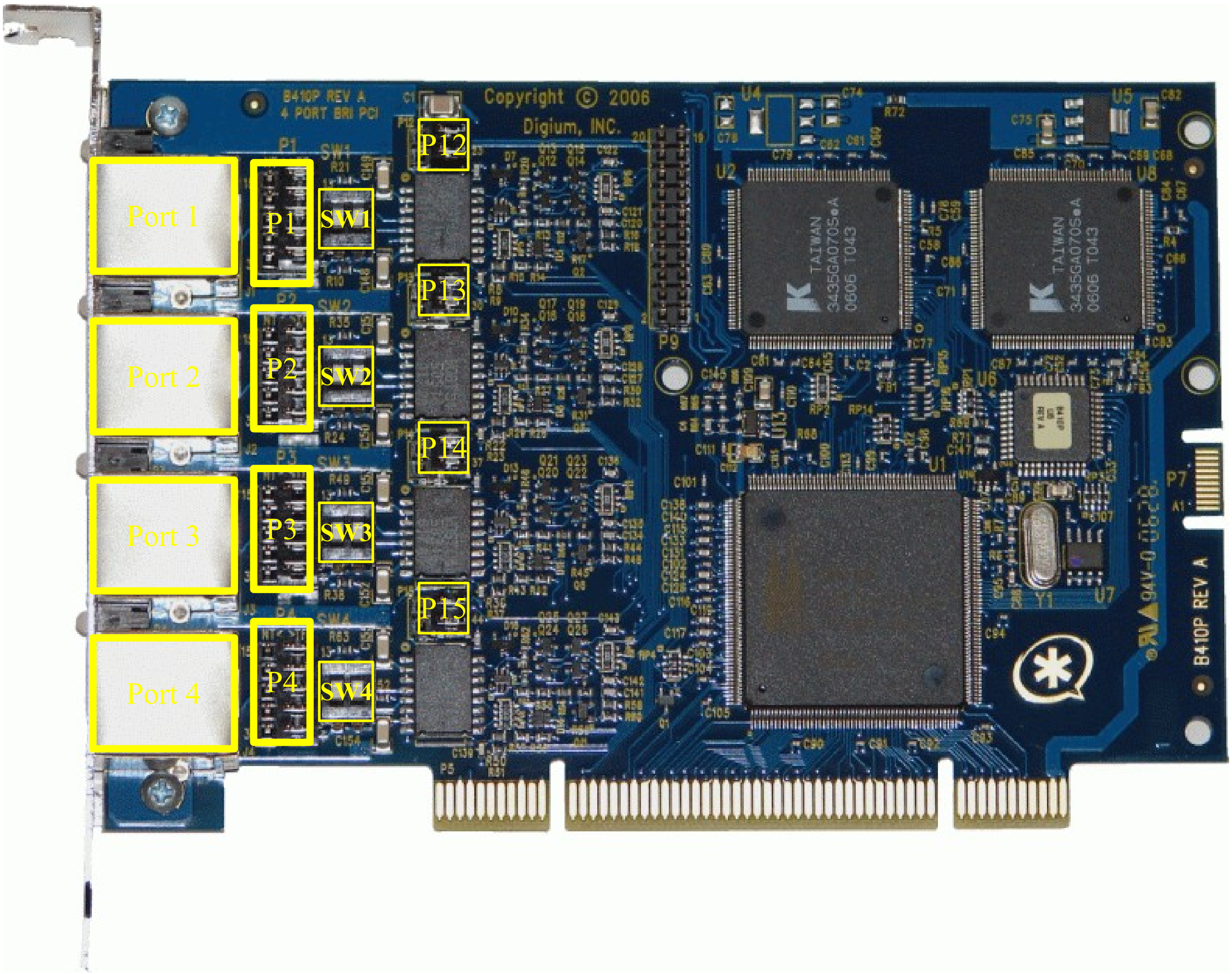
```
Span 1: TE1/0/1 "TE110P (PCI) Card 0 Span 1" HDB3/CCS/CRC4 ClockSource IRQ misses: 0

         1 TE1/0/1/1 Clear (In use)
         2 TE1/0/1/2 Clear (In use)
         3 TE1/0/1/3 Clear (In use)
         4 TE1/0/1/4 Clear (In use)
         5 TE1/0/1/5 Clear (In use)
         6 TE1/0/1/6 Clear (In use)
         7 TE1/0/1/7 Clear (In use)
         8 TE1/0/1/8 Clear (In use)
         9 TE1/0/1/9 Clear (In use)
        10 TE1/0/1/10 Clear (In use)
        11 TE1/0/1/11 Clear (In use)
        12 TE1/0/1/12 Clear (In use)
        13 TE1/0/1/13 Clear (In use)
        14 TE1/0/1/14 Clear (In use)
        15 TE1/0/1/15 Clear (In use)
        16 TE1/0/1/16 HDLCFCS (In use)
        17 TE1/0/1/17 Clear (In use)
        18 TE1/0/1/18 Clear (In use)
        19 TE1/0/1/19 Clear (In use)
        20 TE1/0/1/20 Clear (In use)
        21 TE1/0/1/21 Clear (In use)
        22 TE1/0/1/22 Clear (In use)
        23 TE1/0/1/23 Clear (In use)
        24 TE1/0/1/24 Clear (In use)
        25 TE1/0/1/25 Clear (In use)
        26 TE1/0/1/26 Clear (In use)
        27 TE1/0/1/27 Clear (In use)
        28 TE1/0/1/28 Clear (In use)
        29 TE1/0/1/29 Clear (In use)
        30 TE1/0/1/30 Clear (In use)
        31 TE1/0/1/31 Clear (In use)
```

The card has two status LEDs. After loading the driver and executing "ztcfg", one LED should flash red, while the port is not connected to a device. If the LED does not flash, the driver did not load properly and execution of "ztcfg" did not complete.
Once the port is connected to a NT PRI (i.e. NTPA, Deutsche Telekom), the LED should go green. Green indicates the circuit is connected physically and the link is active (Layer 1).

2.3.4.B410P (ISDN/BRI card)

The B410P is a four port BRI card. It supports hardware echo cancellation. **This card is not a zaptel card!** The B410P runs with the mISDN driver from beroNet. For that reason you have to follow the installaion instructions in section 3 (3.1 and 3.7). The jumper settings are maybe different from BN4S0, the following picture and table describe the jumpers on the B410P: see next page



P1-P4	A group of five jumpers determines the port type, NT or TE. If the jumpers short the two pins on the right (default setting), then the port is configured as "TE". If the jumpers connect the two pin on the left, the port is configured as "NT". Please note that a complete set of jumpers must be moved for each port.
P13-P15	This group of pins must to be shorted (horizontally) if the Digium power module is connected and the port should be powered (only for NT mode).
SW1-Sw4	The DIP switches are in the "off" position by default . This sets the terminal resistance to 100 Ohm. To change the terminal resistance, set the DIP switches to "on".

For further installation please read section 3.

2.3.5.TE4xxP / TE2xxP

TE405P/TE410P

TE407P/TE412P

TE205P/TE210P

TE207P/TE212P

The TE4xxP (TE405P, TE406P, TE410P, TE411P) is a 4-Port T1/E1 card. The difference between the TE405P/TE410P and the TE406P/TE411P is that the TE406P/TE411P has an additional daughter board for hardware echo cancellation.

ATTENTION !
The TE410P/TE411P is built for a 3.3V 64bit PCI Bus, and the TE405P/TE406P for a "regular"5V 32bit PCI Bus. The same is true for the TE2xxP series.

The card has a jumper that lets you choose whether to operate in T1 or E1 mode. Please set the jumper accordingly. This jumper is not present on the older, obsolete E400P and T400P cards, because a different card exists for each mode. Install the card in an empty PCI slot and restart your system.

When operating the card in **E1** mode, add the following in your "zaptel.conf":

```
span=1,1,0,ccs,hdb3,crc4
span=2,0,0,ccs,hdb3,crc4
span=3,0,0,ccs,hdb3,crc4
span=4,0,0,ccs,hdb3,crc4

bchan=1-15,17-31
dchan=16

bchan=32-46,48-62
dchan=47

bchan=63-77,79-93
dchan=78

bchan=94-108,110-124
dchan=109
```

When operating the card in **T1** mode, add the following in your "zaptel.conf":

```
span=1,1,0,esf,b8zs
span=2,0,0,esf,b8zs
span=3,0,0,esf,b8zs
span=4,0,0,esf,b8zs

bchan=1-23
dchan=24

bchan=25-47
dchan=48

bchan=49-71
dchan= 72

bchan=73-95
dchan=96
```

In both configurations, span 1 is listed as "Clocksource".

Load the driver module "wct4xxp.o" with the following command:

```
modprobe wct4xxp <ENTER>
```

If you have a E400P or a T400P, load the driver module "tor2.o":

modprobe tor2 <ENTER>

If needed, type "ztcfg <ENTER>" to complete the process.
If the module loaded correctly, the first "span" should show the following in "proc/zaptel/1" (E1 configuration):

```
Span 1: TE4/0/1 "TE410P (PCI) Card 0 Span 1" HDB3/CCS/CRC4 ClockSource IRQ misses: 0

         1 TE4/0/1/1 Clear (In use)
         2 TE4/0/1/2 Clear (In use)
         3 TE4/0/1/3 Clear (In use)
         4 TE4/0/1/4 Clear (In use)
         5 TE4/0/1/5 Clear (In use)
         6 TE4/0/1/6 Clear (In use)
         7 TE4/0/1/7 Clear (In use)
         8 TE4/0/1/8 Clear (In use)
         9 TE4/0/1/9 Clear (In use)
        10 TE4/0/1/10 Clear (In use)
        11 TE4/0/1/11 Clear (In use)
        12 TE4/0/1/12 Clear (In use)
        13 TE4/0/1/13 Clear (In use)
        14 TE4/0/1/14 Clear (In use)
        15 TE4/0/1/15 Clear (In use)
        16 TE4/0/1/16 HDLCFCS (In use)
        17 TE4/0/1/17 Clear (In use)
        18 TE4/0/1/18 Clear (In use)
        19 TE4/0/1/19 Clear (In use)
        20 TE4/0/1/20 Clear (In use)
        21 TE4/0/1/21 Clear (In use)
        22 TE4/0/1/22 Clear (In use)
        23 TE4/0/1/23 Clear (In use)
        24 TE4/0/1/24 Clear (In use)
        25 TE4/0/1/25 Clear (In use)
        26 TE4/0/1/26 Clear (In use)
        27 TE4/0/1/27 Clear (In use)
        28 TE4/0/1/28 Clear (In use)
        29 TE4/0/1/29 Clear (In use)
        30 TE4/0/1/30 Clear (In use)
        31 TE4/0/1/31 Clear (In use)
```

The same should be listed for spans 2, 3 and 4.

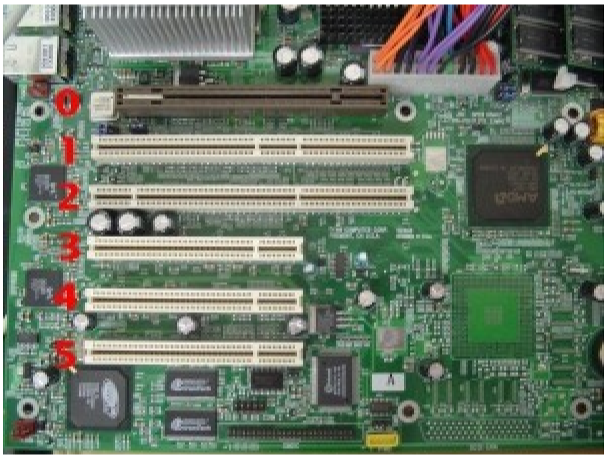
After loading the driver and the executing "ztcfg", status LEDs for each port should be flashing red, unless the port is connected to a device. If the LED does not light up, the driver did not load properly and execution of "ztcfg" did not complete. When you connect a port to your NT PRI, the LED should go green. Green means that the circuit is connected physically and the link is active (Layer 1)

2.3.5.1.Does the TE2xxP/TE4xxP fit in my PCI slot ?

Today's PC motherboards feature a variety of PCI slot types. Here, for example, is a typical dual processor motherboard with various slot types.

Slot Number:

- 0: AGP Pro slot
- 1: 64-bit 5.0 volt PCI slot
- 2: 64-bit 3.3 volt PCI slot
- 3: 32-bit 5.0 volt PCI slot
- 4: 32-bit 5.0 volt PCI slot
- 5: 32-bit 5.0 volt PCI slot



The **TE411P** is a 32-bit 33MHz card keyed for 3.3 volt operation. In the motherboard pictured here, the TE411P will **only** fit into slot #2. The TE411P **will not** fit into slots 1, 3, 4, or 5.

The **TE410P** is a 32-bit 33MHz card keyed for 3.3 volt operation. In the motherboard pictured here, the TE410P will **only** fit into slot #2. The TE410P **will not** fit into slots 1, 3, 4, or 5.

The **TE406P** is a 32-bit 33MHz card keyed for 5.0 volt operation. In the motherboard pictured here, the TE406P **will fit** into slots 1, 3, 4, and 5. The TE406P **will not** fit into slot #2.

The **TE405P** is a 32-bit 33MHz card keyed for 5.0 volt operation. In the motherboard pictured here, the TE405P **will fit** into slots 1, 3, 4, and 5. The TE405P **will not** fit into slot #2.

The **TE210P** is a 32-bit 33MHz card keyed for 3.3 volt operation. In the motherboard pictured here, the TE210P will **only** fit into slot #2. The TE210P **will not** fit into slots 1, 3, 4, or 5.

The **TE205P** is a 32-bit 33MHz card keyed for 5.0 volt operation. In the motherboard pictured here, the TE205P **will fit** into slots 1, 3, 4, and 5. The TE205P **will not** fit into slot #2.

2.3.6.IAXy (S101I)

The IAXy is a so called VoIP ATA (Voice over IP Analog Telephone Adaptor). This device can transform an off-the-shelf, analog telephone into a featured IP telephone.

The IAXy requires a regulated, 9V DC power supply with a connector having an outside diameter of 3-3.8mm and an inside diameter of 1-1.3mm. beroNet delivers the IAXy with an European power supply, since Digium only ships only the American version of the power supply.

For initial operation of the IAXY:

1. Connect your analog telephone by attaching the RJ-11 cable to the matching socket (on the left side) of the IAXy
2. Connect the network cable to the LAN port (in the middle)
3. Connect power to the IAXy and wait one minute.

The IAXy comes configured for DHCP and it will try to connect to a DHCP server to obtain an IP address. If you do not have a DHCP server on your network, you need to install one to connect the IAXy. Open the file "/etc/asterisk/iaxprov.conf" and configure it accordingly. Then, connect to the Asterisk console with:

```
asterisk -r <ENTER>
```

and type the command:

```
iax2 provision <IAXy IP address> <name of template in iaxprov.conf>
```

This should configure the IAXy. Restart it by briefly disconnecting and then reconnecting power.

2.4.Channel Configuration with Asterisk (zapata.conf)

It must be mentioned that configuration of "zapata.conf" can be a time consuming task and that this manual can not possibly list all cases or deal with all problems that can occur. The following simply illustrates channel configuration and related topics.

Each installed Digium card (Zaptel) registers its channels as "ZapChannels" with Asterisk. Unfortunately, Asterisk does not recognize available channels automatically. You need to tell Asterisk and configure all channels and their signaling. Take a close look at the sample configuration file "/etc/asterisk/zapata.conf" and you will notice a variety of parameters that can be activated or deactivated. It is not clear which parameter is linked to which channel. Often, annotated text scripts serve as an explanation. The following are only the most important aspects of "zapata.conf".

Basically, all Zapata channels are configured as follows:

```
option1= value1
option2= value2
option n = value sigh
channel => 1-4
```

Once again, we reiterate that the channels will be configured in the same sequence that loads the drivers.

"Option" describes a setting for a "channel object".

Any option in front of the keyword "channel" is valid for all channels. There can only be as many channel entries as there are available channels. If you want to change the options for a specific range of channels, set the options again with a different content:

```
option1= value1
option2= value2
channel => 1-4

option1=value1.5
channel => 5-8
```

This will set option 1 of channels 5-8 to a different value than channels 1-4. The value for option 2 remains the same since it is not altered by the second channel entry.

2.4.1.Analog Channel Configuration (FXS/FXO)

A TDMxxP card is configured by specifying channels in "zaptel.conf".

The following shows the configuration of a FXS channel:

```
signalling=fxo_ks
context=dialout
group=1
callerid=”TestName” <123456789>
channel => 1
```

This will configure one FXS-Port i.e. of a TDM10B.

For proper signaling set your analog channel to the opposite of its device designation. FXS-ports use FXO signaling **"*signalling=fxo_ks*"** and respectively, FXO ports use FXS signaling **"*signalling=fxs_ks*".**

The option "context" determines which section of the dial plan routes the call. In this case, an incoming call on channel 1 will be routed by context "dialout".

The option "group" selects a group of one or more channels. If more than one channel is available, it is possible to combine them into groups. For example, if an outbound call should use the first available channel, a group of available channels can route the call. In this case, the "dial string" does not refer to a single channel (*Dial(Zap/1/${EXTEN}*)), but rather to a group of channels ((*Dial(Zap/g1/${EXTEN}*))). Groups are defined as follows:

```
option1 ....
group=1
channel=>1-4
channel=>5-8

group=2
channel=9-12
```

Hereby, channels 1-8 are selected for group 1 and channels 9-12 are in group 2.

The option "callerid" sets the caller's name and caller's number on the channel or the device. Usually, this data is transferred as well.

The configuration of specific channels is complete at the keyword "channel". Any options beyond that are only valid for channels beyond that.

2.4.2.ISDN Channel Configuration (PRI)

The configuration of ISDN channels follows the same basic principles mentioned in section 2.4.1. This section only covers items that require special consideration.

The following options must be set differently than the options described in section 2.4.1:

busydetect=no

Should be set to "no", since this option is used with analog channels and can cause problems with ISDN connections.

callprogress=no
The same applies to the option "busydetect”.

switchtype=euroisdn
Describes the type of signaling. In Germany and most EU nations this option should be set to "euroisdn". In the US, it should be set to "national".

pridialplan=unknown
Sets the outgoing ISDN numbering plan. Possible values:

unknown:	**Unknown**
private:	**Private ISDN**
local:	**Local ISDN**
national:	**National ISDN**
international:	**International ISDN**

prilocaldialplan=national
Sets the incoming ISDN numbering plan. For possible values, please check "pridialplan".

immediate=no
Controls whether an initiated call is transferred to the "s" extension dial plan immediately or whether the call receives a connection signal and has to wait for timeouts.

overlapdial=yes
Determines whether following digits can be dialed. If "overlapdial" is activated, then "immediate" must be deactivated.

echocancel=no
Here, software echo cancellation is turned on or off. Since ISDN rarely produces echoes and echo cancellation is time consuming, it should be turned off with ISDN.

echocancelwhenbridged=no
echotrainig=no

signalling=pri_cpe
Determines the type of Layer 3 signaling. Usually, you would like to configure the PRI-Port for the NTPM of your provider. In that case, the port needs to act as "TE" (Terminal Equipment). If you would like to use the port in the "NT" (Network) mode, please enter "pri_net"

Make sure you do not configure the d-channel, when setting up ISDN:

channel => 1-15,17-31

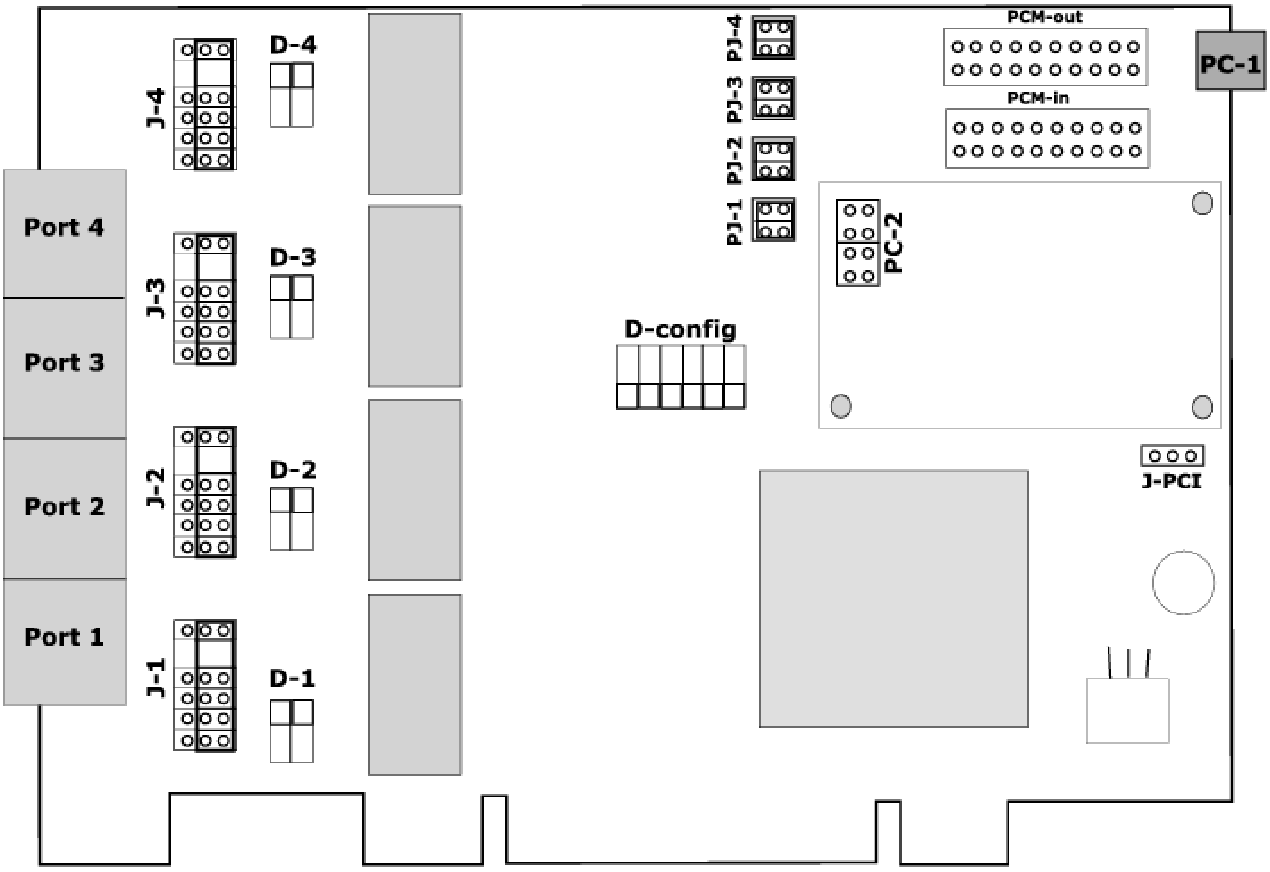
This leaves two ISDN PRI ports (i.e. 16 & 32) for configuration as d-channels by Asterisk.

Additional configuration examples are shown in the appendix.

3.Installation and Configuration of beroNet Cards

The BNxS0 are so called Basic Rate Interface cards (BRI). These cards are equipped with either four (BN4S0) or eight (BN8S0) ISDN ports. These ports can be configured individually as TE or NT. If you connect un-powered ISDN phones to the NT ports, you should use an additional power supply (BNPW1) with the card.
Also, you can specify the type of signaling on each port, selecting whether they function as "point-to-multi-point" (multiple devices) or as "point-to-point" (single device).

3.1.Installation of the BN2S0/BN4S0



pic. 3.1.1

This installation descripteion is also valid for the BN2S0 just with two ports less.

Before you install the BN4S0, you should decide how to utilize the four available ports. Determine which ports connect to terminal equipment and which ports connect to the network.

Picture 3.1.1 shows the card with four ports, each with an adjacent group of jumpers and DIP-switches to the right.

The following explains the jumpers, connectors and switches:

J1-J4	A group of five jumpers determines the port type, NT or TE. If the jumpers short the two pins on the right (default setting), then the port is configured as "TE". If the jumpers connect the two pin on the left, the port is configured as "NT". Please note that a complete set of jumpers must be moved for each port.
PJ1-PJ4	This group of pins must to be shorted (horizontally) if PC1 is connected to a BNPW1 power supply.
D1-D4	The DIP switches are in the "on" position by default . This sets the terminal resistance to 100 Ohm. To change the terminal resistance, set the DIP switches to "off".
JPC	Jumper for PCI Voltage (3.3V / 5V). Default is 3.3V
PC1	Powerconnector for BNPW1. If you are using this, all jumpers auf group PC2 has to be closed horizontally.
PC2	Powerconnector for BNPW2
PCMout- PCMin	Connectors for the PCM bus. The PCM bus potentiates to bridge calls in hardware across different beroNet cards whcih are connected over the PCM bus.

Important: If you have an older motherboard, it is possible the PCI voltage is not detected automatically. Please set jumper PJ1 (in pic. 3.1.1) to the right position "3V3 reg." (the two pins on the right should be shorted).

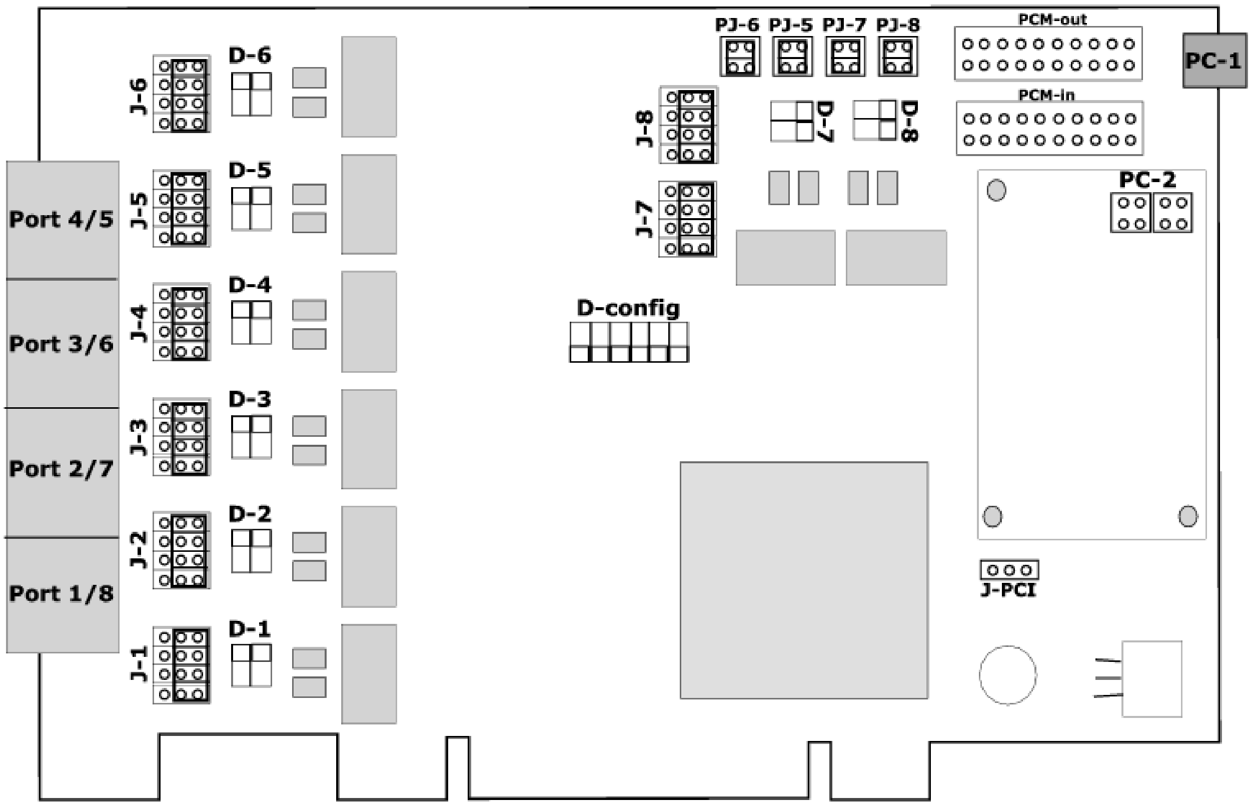
Tip: To set the jumpers, use a small tweezer and handle the jumpers from above.

After configuring the card according to your plan, you can install it in an empty PCI slot. Please follow these directions:

1. Turn off your PC.
2. Disconnect computer power completely by pulling the power cord from the wall socket.
3. Firmly insert the card into an empty PCI slot and tighten the screw.
   Use extreme care when inserting cards, so you do not damage components on it by touching other cards or the computer case.
4. Close the case, reconnect power and turn on the PC.

No further settings are necessary to connect to ISDN circuits or ISDN devices. Any crossover is done with the jumpers on the card.

3.2.Installation of the BN8S0



pic. 3.2.1

First determine how to utilize the ports. Note that every RJ45 connector contains two ISDN ports. Connector pin outs are listed in the appendix (8.2.1). The jumpers and DIP switches always refer to two ISDN ports. They are color coded to each ISDN port.

Note that the ports are counted from bottom to top, and the Jumper and Dip switches are present twice per RJ45 connector!

Picture 3.2.1 shows the card with eight ports, each with an adjacent group of jumpers and DIP-switches to the right.

The following explains the jumpers, connectors and switches:

J1-J8	A group of five jumpers determines the port type, NT or TE. If the jumpers short the two pins on the right (default setting), then the port is configured as "TE". If the jumpers connect the two pin on the left, the port is configured as "NT". Please note that a complete set of jumpers must be moved for each port.
PJ5-PJ6	This group of pins must to be shorted (horizontally) if PC1 is connected to a BNPW1 power supply.
D1-D8	The DIP switches are in the "on" position by default . This sets the terminal resistance to 100 Ohm. To change the terminal resistance, set the DIP switches to "off".
J-PCI	Jumper for PCI Voltage (3.3V / 5V). Default is 3.3V
PC1	Powerconnector for BNPW1. If you are using this, all jumpers auf group PC2 has to be closed vertically.
PC2	Powerconnector for BNPW2
PCMout-PCMin	Connectors for the PCM bus. The PCM bus potentiates to bridge calls in hardware across different beroNet cards whcih are connected over the PCM bus.

Important: If you have an older motherboard, it is possible the PCI voltage is not detected automatically. Please set jumper PJ1 (in pic. 3.2.1) to the right position "3V3 reg." (the two pins on the right should be shorted).

Tip: To set the jumpers, use a small tweezer and handle the jumpers from above.

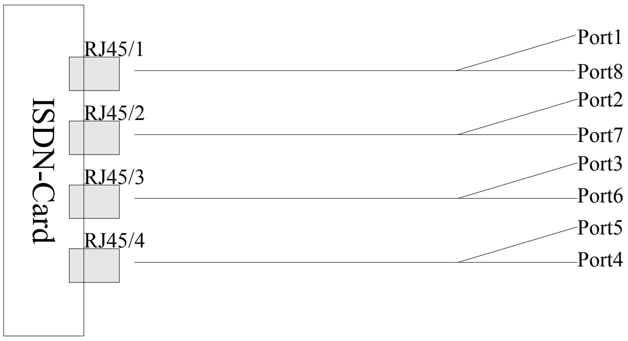
After configuring the card according to your plan, you can install it in an empty PCI slot. Please follow these directions:

5. Turn off your PC.
6. Disconnect computer power completely by pulling the power cord from the wall socket.
7. Firmly insert the card into an empty PCI slot and tighten the screw.
   Use extreme care when inserting cards, so you do not damage components on it by touching other cards or the computer case.
8. Close the case, reconnect power and turn on the PC.

No further settings are necessary to connect to ISDN circuits or ISDN devices. Any crossover is done with the jumpers on the card.

Once again, we like to point out that the card should be handled with extreme care.

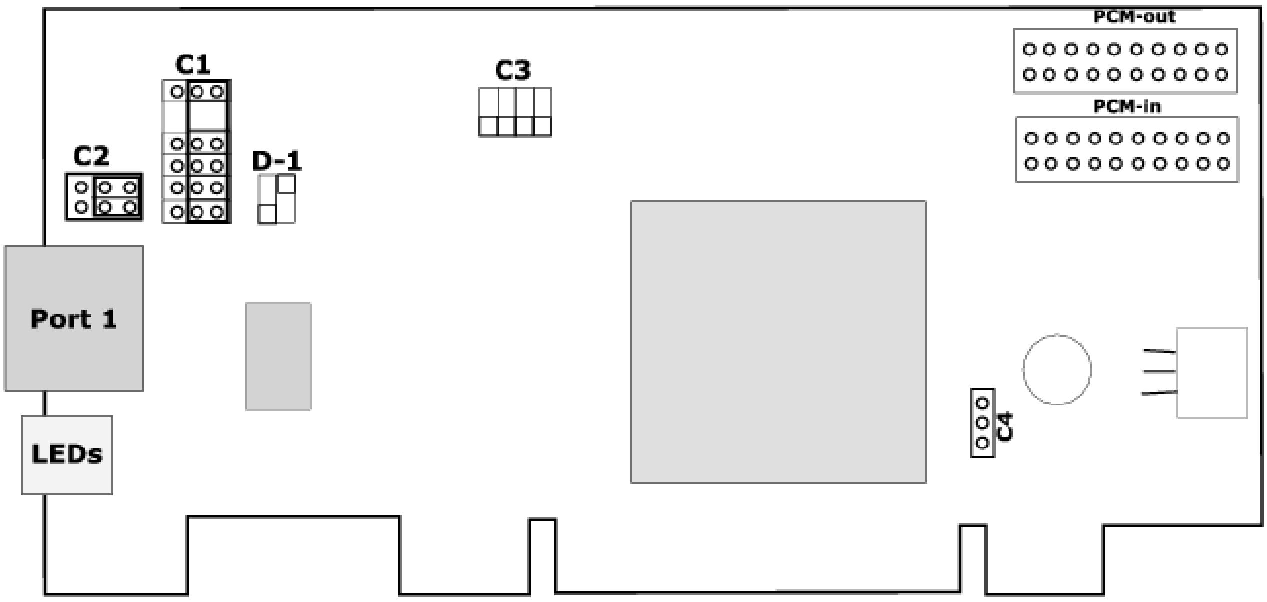
The BN8S0 comes with an Y-adapter cable. The connections must be split because two ISDN interfaces are combined into one port. Picture 3.2.2 shows the Y-cable port setup:



pic. 3.2.2

Each end of the Y-cable has an RJ45 jack. If you want to connect ISDN telephones, please use straight RJ45 cables.

3.3.Installation of the BN1E1



pic. 3.3.1

Before you install the BN1E1, you should decide how to utilize the two available ports. Determine which ports connect to terminal equipment and which ports connect to the network.

Picture 3.3.1 shows the card with two ports, each with an adjacent group of jumpers and DIP-switches to the right.

The following explains the jumpers, connecttors and switches:

C1	A group of five jumpers determines the port type, NT or TE, of port 1. If the jumpers short the two pins on the right (default setting), then the port is configured as "NT". If the jumpers connect the two pin on the left, the port is configured as "TE". Please note that a complete set of jumpers must be moved for each port.
C2	Pin out configuration for Port 1. The pins must be shortet vertically. If the two lower are shortet, the pin out is 3,4,5,6. If the two upper are shorted the pin out is 1,2,4,5
C3	Group of not used DIP switches.
C4	Jumper for PCI Voltage (3.3V / 5V). Default is 3.3V
C5	Jumper determines if the both HFC-E1 share one IRQ or not. The left two pins or none must to be shorted for getting each chip an own IRQ (not sharing).
D1	A group of two Dip switches to configure the line termination resistance of Port 1 to 75 Ohm or to 120 Ohm. The default setting is 75 Ohm (first switch „off", second one to „on"). If you want to set to 120 Ohm the the first switch must be set to „on" and the second one to „off".
PCMout-PCMin	Connectors for the PCM bus. The PCM bus potentiates to bridge calls in hardware across different beroNet cards whcih are connected over the PCM bus.

Important: If you have an older motherboard, it is possible the PCI voltage is not detected automatically. Please set jumper „C4" (in pic. 3.3.1) to the lower position "3V3 reg." (the two pins on the lower should be shorted).

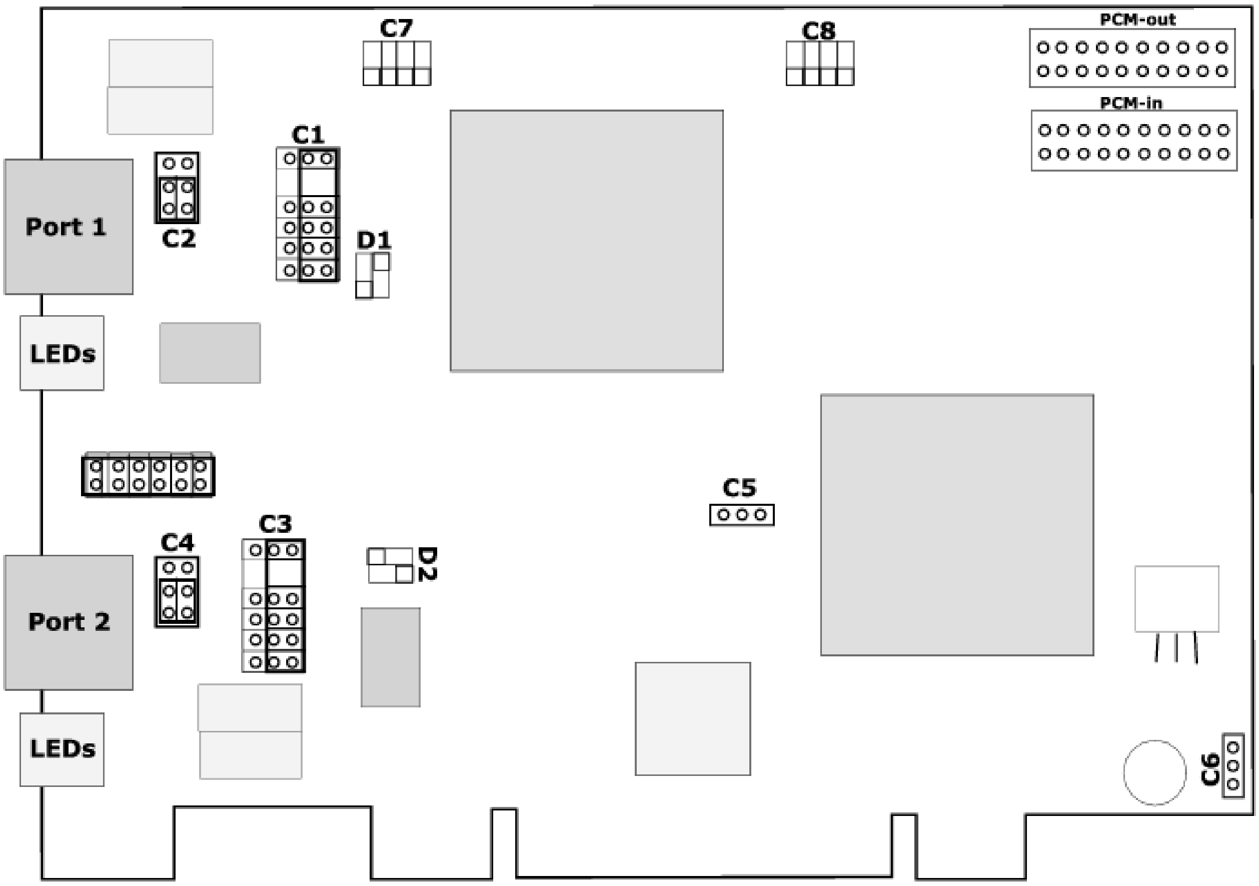
Tip: To set the jumpers, use a small tweezer and handle the jumpers from above.

After configuring the card according to your plan, you can install it in an empty PCI slot. Please follow these directions:

9. Turn off your PC.
10. Disconnect computer power completely by pulling the power cord from the wall socket.
11. Firmly insert the card into an empty PCI slot and tighten the screw.
    Use extreme care when inserting cards, so you do not damage components on it by touching other cards or the computer case.
12. Close the case, reconnect power and turn on the PC.

No further settings are necessary to connect to ISDN circuits or ISDN devices. Any crossover is done with the jumpers on the card.

3.4.Installation of the BN2E1



pic. 3.4.1

Before you install the BN2E1, you should decide how to utilize the two available ports. Determine which ports connect to terminal equipment and which ports connect to the network.

Picture 3.4.1 shows the card with two ports, each with an adjacent group of jumpers and DIP-switches to the right.

The following explains the jumpers, connectors and switches:

J1	A group of 6 Jumpers for enabling the Watchdog. For activating the watchdog all pins must to be shorted vertically.
C1	A group of five jumpers determines the port type, NT or TE, of port 1. If the jumpers short the two pins on the right (default setting), then the port is configured as "NT". If the jumpers connect the two pin on the left, the port is configured as "TE". Please note that a complete set of jumpers must be moved for each port.
C2	Pin out configuration for Port 1. The pins must be shortet vertically. If the two lower are shortet, the pin out is 3,4,5,6. If the two upper are shorted the pin out is 1,2,4,5
C3	A group of five jumpers determines the port type, NT or TE, of port 2. If the jumpers short the two pins on the right (default setting), then the port is configured as "NT". If the jumpers connect the two pin on the left, the port is configured as "TE". Please note that a complete set of jumpers must be moved for each port.
C4	Pin out configuration for Port 2. The pins must be shortet vertically. If the two lower are shortet, the pin out is 3,4,5,6. If the two upper are shorted the pin out is 1,2,4,5
C5	Jumper determines if the both HFC-E1 share one IRQ or not. The left two pins or none must to be shorted for getting each chip an own IRQ (not sharing).
C6	Jumper for PCI Voltage (3.3V / 5V). Default is 3.3V
D1	A group of two Dip switches to configure the line termination resistance of Port 1 to 75 Ohm or to 120 Ohm. The default setting is 75 Ohm (first switch „off", second one to „on"). If you want to set to 120 Ohm the the first switch must be set to „on" and the second one to „off".
D2	A group of two Dip switches to configure the line termination resistance of Port 2 to 75 Ohm or to 120 Ohm. The default setting is 75 Ohm (first switch „off", second one to „on"). If you want to set to 120 Ohm the the first switch must be set to „on" and the second one to „off".
PCMout-PCMin	Connectors for the PCM bus. The PCM bus potentiates to bridge calls in hardware across different beroNet cards whcih are connected over the PCM bus.

Important: If you have an older motherboard, it is possible the PCI voltage is not detected automatically. Please set jumper „config6" (in pic. 3.4.1) to the lower position "3V3 reg." (the two pins on the lower should be shorted).

Tip: To set the jumpers, use a small tweezer and handle the jumpers from above.

After configuring the card according to your plan, you can install it in an empty PCI slot. Please follow these directions:

13. Turn off your PC.
14. Disconnect computer power completely by pulling the power cord from the wall socket.
15. Firmly insert the card into an empty PCI slot and tighten the screw.
    Use extreme care when inserting cards, so you do not damage components on it by touching other cards or the computer case.
16. Close the case, reconnect power and turn on the PC.

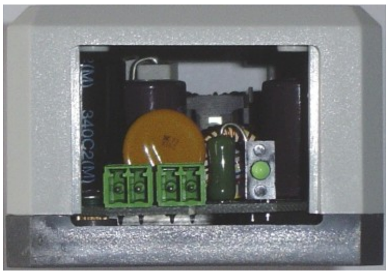
No further settings are necessary to connect to ISDN circuits or ISDN devices. Any crossover is done with the jumpers on the card.

3.5.Connection of the BNPW1

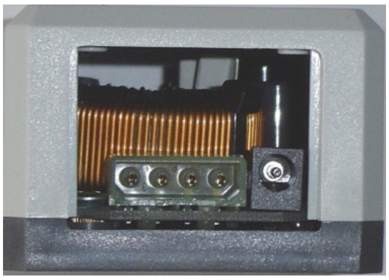
...pic 3.4.1

The BNPW1 is a power adapter that enables you to supply the ISDN ports with power, in case they are configured as NT devices and you want to connect them to non-powered ISDN terminal devices.

If you ordered an additional BNPW1, you should have a grey case power supply and two connecting cables as shown in picture 3.3.1. There are connectors at each end of the adapter.



pic. 3.4.2



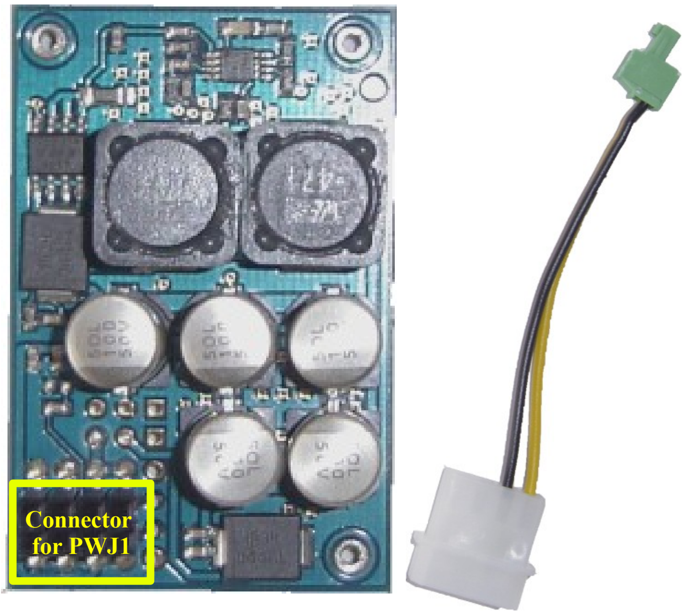
pic. 3.4.3

Picture 3.4.2. shows the connector that powers the BNxS0 card, which has an identical connector. Connect the power supply and the card with the supplied cable. Check your jumper settings, as described in section 3.1, to ensure the ports are set up properly.

Picture 3.4.3. shows the socket that connects to 5/12V power of your computer power supply. Please attach it to an unused 5/12V power connector.
Make sure to fasten the power supply BNPW1 inside your computer in such a way that it does not move. It would be best to screw it or to glue it to the floor of the computer case.

If you plan to connect the BNPW1 to a BN4S0 card version 2, then you have to close the whole group of jumper PWJ1 (see pic. 3.1.1) and connect the power supply directly how described.

3.6.Connection of the BNPW2 (only for BNxS0 Vers. 2)

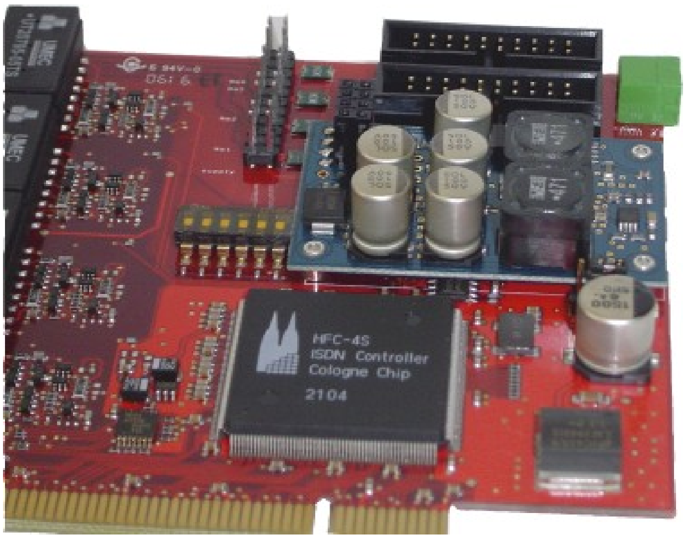


pic. 3.4.1

What you can see in pic. 3.4.1 is the new BNPW2 power module for feeding NT. This small module will be putted onto the BN4S0 or the BN2S0. The module delivers power for 2 Phones per BRI-Port at the maximum.

For installing the BNPW2 onto the BNxS0 card you have to connect it to the jumper array PWJ1 (see at pic. 3.1.1). If it is connected you should screw the three delivered screws from the back of the card, so that the module is fixed. Now you can connect the green power connector (PC1 in pic. 3.1.1.) on the card with one free 12V jack of your system power supply with the delivered cable (see pic. 3.4.1). After that you must close the corresponding jumpers of the jumper array P1-P4 (see pic. 3.1.1) for the ports you wish to feed.

How does it looks if the module is installed you can see at the following picture:



pic. 3.4.2

3.7.Connecting beroNet cards over PCM bus for Hardwarebridging

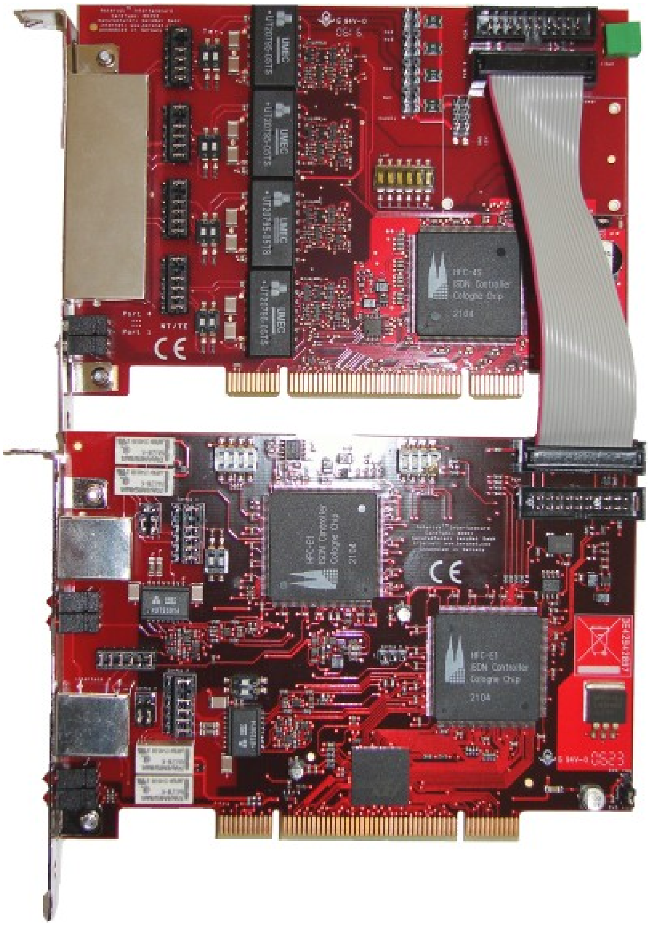
The HFC Chipbased cards are capable of transmitting timing and data between each other via the PCM Interface. Each card has 2 PCM Sockets, one "IN" and one "OUT". In a set of cards there is only 1 Master which generates the clock and the rest of the cards are Slaves. For example you have 1x2E1 card and 1x4S0 cards. then it would make sense that the 1xE1 (BN1E1) card is Master and the 1x4S0 (BN4S0) card is slave.

In order to use this Hardware bridging feature you need to connect the cards with a so called PCM cable. If you ever have connected a PCM cable it is ***necessary*** to configure the Master and the Slaves, because the timing will be automatically transported through the PCM. If you don't configure Slaves it might cause funny Problems!

It is only possible to set Chips into slave mode in the /etc/misdn-init.conf, the remaining single chip will be Master then. To set a chip into slave mode you need to add the "pcm_slave" flag to the cards definition like in the following example:

```
cards=1,0x1
cards=2,0x4, pcm_slave
```

Let's assume you have a 2xE1 (BN2E1) card with HFC-E1 chips and a 4S0-Card (BN4S0) like in pic. 3.6.1. Since there is no 2xE1 chip the card is in reality like 2 Single E1 cards on the same PCI slot. This means that the PCM Bus is automatically wired between the 2 Chips and you ***Need*** to configure the slave options.



The order of the PCI cards is very important regarding the Master/Slave settings. The order is defined by how you have entered the PCI card into the Computer and how the mainboard has wired the PCI Slots. In general it is not known how the order will be.

Regarding PCM it is important that the first found card is the PCM Master. Because this will be the first initialized chip and will generate the timing for all the slaves following. Slave Chips need a timing, otherwise the driver will fail to initialize.

If you want another chip to be Master which is not the first in the PCI Bus, you can do that if you add the flag "ignore_pcm_frameclock" to the cards option like:

```
cards=1, 0x4, pcm_slave, ignore_pcm_frameclock
cards=2, 0x1
cards=3, 0x1,pcm_slave
```

Note that the 2xE1 card is very special again, because it has a PCI Bridge onboard, which means that it is always the last card in the PCI Bus!

3.8.mISDN Installation

As you may know, mISDN (**www.isdn4linux.de/**) is the current and future ISDN layer for Linux. mISDN is the follow-up project of "hisax" and it is maintained and re-developed by SuSE AG (**www.suse.com/**) and other independant developers such as Andreas Eversberg (**www.jolly.de**). The highly flexible, modular design of mISDN makes it possible to integrate many different applications and middle layers into any ISDN device that employs mISDN. CAPI is a prime example. The previous CAPI4Linux project and all cards that implement „hisax" will be ported to mISDN.

BeroNet cards are built for the future. The cards utilize mISDN as a core channel driver, enabling beroNet cards and other supported cards to be used in the open source Asterisk PBX. Some people may say that chan_capi already exists for the use of mISDN in Asterisk. That is correct, but CAPI does not support NT mode and thereby does not deploy the full potential and all advantages of an HFC chip based card. Only beroNet cards offer that advantage.

Before you use the Asterisk channel driver provided by beroNet, you need to configure mISDN for your Linux system.

The instructions in the next paragraph assume that you are running a 2.6 kernel and that Asterisk is compiled and installed on your system.

3.8.1.Install chan_mISDN automatically with beroNet's Makefile

Please download the following package:

http://www.beronet.com/download/install-misdn-mqueue.tar.gz

Please make sure that Asterisk and kernel sources or kernel headers are installed first.

Copy the package to "usr/src/" and unpack it as follows:

```
tar -xzf install-misdn-mqueue.tar.gz <ENTER>
```

Then change to the newly created directory "/usr/src/install-misdn-mqueue/" and enter the following:

```
make install <ENTER>
```

This will start an installation script which downloads and installs all necessary packages. Once finished, you have the mISDN, mIDSNuser and chan_misdn drivers available on your system.

3.8.2.Configuration of your beroNet hardware

The misdn kernel driver module must be loaded to use chan_misdn with Asterisk. In our case, the module is named "hfcmulti". In section 3.1 and section 3.2 you decided on a particular port configuration and set the jumpers accordingly. It is not possible to read the configuration of each card by reading the driver. You must identify the individual ports as either TE or NT when loading the driver. In addition, you must specify which ports use "point-to-multi-point" (multiple device connection) or "point-to-point" (single device connection) mode. There are two ways to configure and load the driver modules. One is to load the modules by hand, the other is to use the "misdn-init” script, which is installed in "/etc/init.d" after installation of chan_misdn.

Before we describe how to load the drivers, one more hint:

Before you load module "hfcmulti", make sure that no other modules can access mISDN, such as CAPI, or modules that support the same chip set, such as hisax or bristuff !

If you want to use the "misdn-init" script, please execute the following command:

```
/etc/init.d/misdn-init scan
```

All installed misdn cards will be displayed. For example:

```
[OK] found the following devices:
card=1,0x4
[ii] run "/etc/init.d/misdn-init config" to store this information to /etc/misdn-init.conf
```

This is a status message only. If you want to create a configuration file for the "misdn-init" startup-script, you have to create a file named "misdn-init.conf". This is done with the following command:

```
/etc/init.d/misdn-init config
```

You now have a new "misdn-init.conf" file in the "/etc/" directory.
The file is includes four contegories of settings:

- Card settings
- Port settings
- Port options
- General settings

You can set the following options:

Card Settings

Syntax: card=<number>,<type>[,<option>...]

<number>	**count your cards beginning with 1**
<type>	**either 0x1,0x4 or 0x8 for your hfcmulti hardware, or the name of your card driver module.**
<option>	**ulaw uLaw (instead of aLaw)** **dtmf enables DTMF detection on all B-channels** **pcm_slave set PCM bus into slave mode** **ignore_pcm_frameclock this E1 is NT without PCM frame clock**

card=1,0x4

Port settings

Syntax: <port_type>=<port_number>[,<port_number>...]

<port_type>	**te_ptp**	**TE-Mode, PTP**
	te_ptmp	**TE-Mode, PTMP**
	nt_ptp	**NT-Mode, PTP**
	nt_ptmp	**NT-Mode, PTMP**
<port_number>	**port that should be considered**	

```
te_ptmp=1,2,3,4
```

Port Options

Syntax: option=<port_number>,<option>[,<option>...]

<option>	**master_clock**	**use master clock for this S/T interface(only once per chip, only for HFC 8/4)**
	optical	**optical (only HFC-E1)**
	los	**report LOS (only HFC-E1)**
	ais	**report AIS (only HFC-E1)**
	slip	**report SLIP (only HFC-E1)**
	nocrc4	**turn off crc4 mode use double frame instead (only HFC-E1)**

```
option=1,master_clock
option=2,ais
option=3,optical,los,ais,slip
```

General Options for your hfcmulti hardware

poll=<number>
Only one poll value must be given for all cards. Give the number of samples for each fifo process. By default 128 is used. Decrease to reduce delay, increase to reduce cpu load. If unsure, don't mess with it!!!
Valid is 32, 64, 128, 256.

pcm=<number>
Give the id of the PCM bus. All PCM busses with the same ID are expected to be connected and have equal slots. Only one chip of the PCM bus must be master, the others slave.

debug=<number>
Enables debugging (see hfc_multi.h for debug options).

dsp_options=<number>
set this to 2 and you'll have software bridging instead of hardware bridging.

dtmftreshold=<milliseconds>
Here you can tune the sensitivity of the dtmf tone recognizer. one poll value must be given for all cards.
Give the number of samples for each fifo process.

Now you can modify this file in accordance with your ISDN cards. Every time you enter:

```
/etc/init.d/misdn-init start
```

mISDN will start, using the configuration in your "/etc/misdn-init.conf".
If you start miSDN this way, you will get the following output:

```
----------------------------------------
 Loading module(s) for your misdn-cards:
----------------------------------------
modprobe hfcmulti type=0x4 protocol=0x2,0x2,0x2,0x2 layermask=0xf,0xf,0xf,0xf poll=64 debug=0
```

The following important argument options must be addressed when creating your own init script, or when loading the module by hand:

1. "layermask"
   possible values:
   "0x3" for NT
   "0xf" for TE
2. "protocol"
   possible values:
   "0x2" for point to multi point (PmP) with a TE port
   "0x22" for point to point (PP) with a TE port
   "0x12" for point to multi point with a NT port
   "0x32" for point to point with a NT port
3. "type"
   possible values:
   "0x04" for BN4S0
   "0x08" for BN8S0
   "0x01" for BNE1

Loading the driver is accomplished by:

```
modprobe hfcmulti layermask= 0xf,0xf,0x3,0x3 protocol=0x2,0x2,0x12,0x12 <ENTER>
```

Important: When using "chan_misdn", the following modules must be also loaded:

```
modprobe mISDN_dsp <ENTER>
modprobe mISDN_l1 <ENTER>
modprobe mISDN_l2 <ENTER>
modprobe l3udss1 <ENTER>
```

This will configure your BN4S0 card as follows:

Port 1	TE,PMP
Port 2	TE,PMP
Port 3	NT,PMP
Port 4	NT,PMP

The number and position of each option is determined by the number of ports and the configuration of each port.

3.8.3.Initiating the hfc_pci Kernel module

If you have a HFC-PCI chipset based card, like the Billion PCI ISDN, please load the driver as described in section 3.5.2, without the "type" parameter:

```
modprobe hfcpci layermask=0xf protocol=0x2
```

3.9.The File misdn.conf

Before you can use the chan_misdn, you need to configure the file "/etc/asterisk/misdn.conf". This file is divided into sections. Section names are put into brackets:

[sektionX]

Please note that there should always be one section named "general" and one named "default". These sections contain general and standard values for the ports.

3.9.1.Options of the **"general"** section.

misdn_init=/etc/misdn-init.conf
Sets the Path to the misdn-init.conf (for nt_ptp mode checking)

debug=0
Sets the debug-level. Possible values are:
0 - No Debug
1 - mISDN Messages and * - Messages, and * - State changes
2 - Messages + Message specific Informations (e.g. bearer capability)
3 - very Verbose, the above + lots of Driver specific infos
4 - even more Verbose than 3
default value: 0

ntdebugflags=0
ntdebugfile=/var/log/misdn-nt.log
set debugging file and flags for mISDNuser (NT-Stack)
flags can be or'ed with the following values:

DBGM_NET	0x00000001
DBGM_MSG	0x00000002
DBGM_FSM	0x00000004
DBGM_TEI	0x00000010
DBGM_L2	0x00000020
DBGM_L3	0x00000040
DBGM_L3DATA	0x00000080
DBGM_BC	0x00000100
DBGM_TONE	0x00000200
DBGM_BCDATA	0x00000400
DBGM_MAN	0x00001000
DBGM_APPL	0x00002000
DBGM_ISDN	0x00004000
DBGM_SOCK	0x00010000
DBGM_CONN	0x00020000
DBGM_CDATA	0x00040000
DBGM_DDATA	0x00080000
DBGM_SOUND	0x00100000
DBGM_SDATA	0x00200000
DBGM_TOPLEVEL	0x40000000
DBGM_ALL	0xffffffff

tracefile=/var/log/asterisk/misdn.log
the big trace
default value: [not set]

bridging=no
Set to yes if you want mISDN_dsp to bridge calls in hardware. Default is „yes".

stop_tone_after_first_digit=yes
stops dialtone after getting first digit on nt Port
default value: yes

append_digits2exten=yes
Decides if an added, dialed digit will be added to the extension (${EXTEN}).

dynamic_crypt=no
Wether to look for dynamic crypting attempt
default value: no

crypt_prefix=**
crypt_prefix, what is used for crypting Protocol
default value: [not set]

crypt_keys=test,muh
Keys for cryption, you referenced them in the dialplan, later also in dynamic encr.
default value: [not set]

3.9.2.Options of the **"default"** section.

The „default" section is not a group section, it just contains config elements which are inherited by group sections.

context=default
Define your default context here.
default value: default

language=en
Sets the language option.
Default: en

musicclass=default
sets the musiconhold class

senddtmf=yes
Either if we should produce DTMF Tones ourselve

far_alerting=no
If we should generate Ringing for chan_sip and others

allowed_bearers=all
here you can define which bearers should be allowed

nationalprefix=0
internationalprefix=00
Prefixes for national and international, those are put before the oad if an according dialplan is set by the other end.

default values:	nationalprefix:	0
	internationalprefix:	00

rxgain=0
txgain=0
set rx/tx gains between -8 and 8 to change the RX/TX Gain
default values: rxgain: 0
txgain: 0

te_choose_channel=no
Workaround incase NT requires an explicit channel number, because NT don't know the message. Some telcos espacially in NL seem to need this set to yes, also in Switzerland it seems to be important
default value: no

pmp_l1_check=yes
pp_l2_check=no
This option defines, if chan_misdn should check the L1 on a PMP before makeing a group call on it. The L1 may go down for PMP Ports so we might need this. But be aware! a broken or plugged off cable might be used for a group call as well, since chan_misdn has no chance to distinguish if the L1 is down because of a lost Link or because the Provider shut it down...
default: yes

need_more_infos=no
Send Setup_Acknowledge on incoming calls anyway (instead of PROCEEDING), this requests additional Infos, so we can waitfordigits without much issues. This works only for PTP Ports
default value: no

method=standard
Sets the method of channel selection:

standard	- always choose the first available channel with the lowest number
round_robin	- use the round robin algorithm to select a channel. Use this for load balancing.

dialplan=0
localdialplan=0
cpndialplan=0
dialplan means Type Of Number in ISDN Terms (for outgoing calls)
There are different types of the dialplan:

dialplan -> outgoing Number
localdialplan -> callerid
cpndialplan -> connected party number

dialplan options:

0 - unknown
1 - International
2 - National
4 - Subscriber

This setting is used for outgoing calls
default value: 0

early_bconnect=yes
Turn this to no if you don't mind correct handling of Progress Indicators

incoming_early_audio=no
Turn this on if you like to send Tone Indications to a Incoming isdn channel on a TE Port. Rarely used, only if the Telco allows you to send indications by yourself, normally the Telco sends the indications to the remote party.
default: no

always_immediate=yes
If set to yes, all calls will use the "s" extension , whether they contain a dialed number or not (you can still use "DigitTimeout" in the "s" extension context).
Note: This will jump to the "s" extension for every number !

nodialtone=no
set this to yes if you want to generate your own dialtonewith always_immediate=yes, else chan_misdn generates the dialtone
default value: no

immediate=no
Set this option if you want callers which called exactly the base number (so no extension is set) jump to the s extension. If the user dials something more it jumps to the correct extension instead.
default value: no

hold_allowed=yes
Set this option to have hold and retrieve support
default value: no

callgroup=1
pickupgroup=1
Determines the call group and pickup group. This is similar to other configuration files like zapata.conf or sip.conf.

presentation=-1
screen=-1
These are the exact isdn screening and presentation indicators. If -1 is given for both values the presentation indicators are used from asterisks SetCallerPres application.

s=0, p=0 -> callerid presented not screened
s=1, p=1 -> callerid presented but screened (the remote end does not see it!)

default values s=-1, p=-1

echocancel=no
This enables echocancellation, with the given number of taps be aware, move this setting only to outgoing portgroups!
A value of zero turns echocancellation off.
Possible values are: 0,32,64,128,256,yes(=128),no(=0)
default value: no

echocancelwhenbridged=no
Enables/disables echo cancellation when a call is bridged between mISDN channels.

echotraining=no
The value is a multiple of 0.125 ms.
Possible values are:

yes = 2000
no = 0

default value: no

jitterbuffer=4000
chan_misdns jitterbuffer, default 4000

hdlc=no
Change this to yes, if you want to bridge a mISDN data channel to another channel type or to an application.

3.9.3.Options of the **port group sections.**

ports=1,2,3,4
Controls the ports that belong to a particular group (section).

msns=*
Defines the MSNs that a port or multiple ports respond to.

callerid=1234
Sets the caller ID on outbound channels.

The "misdn.conf" in our sample configuration looks like this:

```
[general]
debug=0
method=standard
append_digits2exten=yes
bridging=yes

[default]
context=misdn
language=de
nationalprefix=0
internationalprefix=00
rxgain=0
txgain=0
dialplan=0

[TEports]
context=incoming
ports=1,2
msns=5555550,55555599,55555510

[NTports]
context=outgoing
ports=3,4
```

Values in the "default" section apply to all other sections, unless a specific entry exists in a particular section. For example, the option context is set to "misdn" in section default, this is overridden by "incoming" in section [TEports] and by "outgoing" in section [NTports]. Setting "msns" to "*" makes the following sections respond to all inbound MSN's, unless something else is listed in section [Teports], in which port 1 and 2 would respond to the listed MSN's. This is different for outbound calls: A call placed within the group [TEports] with "Dial(mISDN/g:TEports/${EXTEN})" would then use the first available channel in that group. In this example, we configured Asterisk with "chan_misdn" for a BN4S0 card with two TE and 2 NT ports. You can now start Asterisk with "chan_misdn".

3.9.4.Configure point-to-point (PTP) mode for NT ports.
To use an NT port with a point-to-point connection, you need to append the port number with a "ptp" suffix:

```
ports=3ptp,4
```

3.10.chan_misdn CLI Commands

Loading the chan_misdn module provides some new CLI commands:

misdn show config [<portno>]
Shows the current configuration for all misdn ports and channels

misdn reload
Command for the re-configuration of the chan_misdn module. This is executed together with a global "reload"of Asterisk.

misdn show channels
Shows a list of all active mISDN channels.

misdn show channel <channel-name>
Shows all relevant information on a single mISDN-Channel

misdn restart port <portno>
Re-initiates the given port.

misdn show fullstacks

Shows the status of the ISDN ports and the channels.

misdn show stacks
Displays only the status of the ports.

misdn set debug <debuglevel>
Determines the precision of the debug output. The following values are possible:

0 - no Debug
1 - mISDN Messages and * - Messages, and * - Statuschanges
2 - mISDN Messages with specific Information (i.e. bearer capability)
3 – very communicative, as Level 2 + many additional Driverinformation
4 – even more communicative than Level 3

misdn send display <channel> <msg>
Sends a display message to the named "channel". If the connected terminal device is capable of displaying a message, it will appear on its screen.

3.11.mISDN dial parameter

The "dialstring" for chan_misdn in "extensions.conf" looks like this:

Dial(misdn/<portno>/<extension>)

or for a group:

Dial(misdn/g:<grouname>/<extension>)

Example: **Dial(misdn/1/123456789)**

or for a group: **Dial(misdn/g:TEPorts/123456789)**

With mISDN you have the possibility to overgive several options within the dial string. The option string must look like this:

<optchar1><OptParam1>:<optchar2><OptParam2>

Example:

Dial(misdn/g:TEports/123456789/n:h)

Initiates a digital call without DTMF detection.

Possible options are:

d – sends a displaymessage to a ISDN channel. The parameter should be the text which should displayed .
n – deactivates DTMF detection on the outgoing channel
h – Initiates a digital Call
c – initiates an encrypted, outgoing call, whereas the parameter determines the key index of the keys defined in msidn.conf (crypt_keys= ....[Index=1],......[Index=2])
e – activates or deactivates echo cancellinng for the outgoing channel takes taps as arguments (32,64,128,256)
s - send Non Inband DTMF as inband
vr - rxgain control
vt - txgain control

chan_misdn registers a new application "misdn_set_opt" when loaded. This application takes the Optionsstring as argument. The Syntax is:

misdn_set_opt(<OPTIONSSTRING>)

When you set options in dialstring, the options are set for outbound channels. When you set options with misdn_set_opt, they are set for inbound channels.

3.12.Words of advice on the operation of BNxS0 cards with the "bristuff"-driver from Junghanns

Repeatedly the question comes up whether beroNet cards are compatible with Junghanns cards. The answer is such: The cards are identical in their construction. The only difference is the vendor ID stored on each card. The Junghanns "bri-stuff" driver differentiates between Junghanns cards and other cards. It is possible that the "bri-stuff" driver does not load properly when used with non Junghanns cards. Since the "bri-stuff" driver, as well as other drivers, are covered by the GPL licensing agreement, it would be possible to change the "bri-stuff" source code. beroNet cards do not make that that distinction. Therefore, cards from Junghanns should work with chan_misdn.
Please note that we do not offer support for the operation of beroNet cards with "bri-stuff" drivers.

4.Installation of Asterisk

We would like to repeat: The previous sections assume that Asterisk was compiled and installed on your system. Here is a quick overview on how to accomplish this.

4.1. Installation automaticly including mISDN

For an automaticly installation of „libpri", „zaptel", „asterisk", „mISDN" and „chan_misdn" please download http://www.beronet.com/downloads/install-asterisk.tar.gz . After that unpack it with the following command:

```
tar -vxzf install-asterisk.tar.gz <ENTER>
```

Now you have a new directory named „./install-asterisk". Enter that directory and just type:

```
make <ENTER>
```

After intsallation is completed you have installed anything you need to setup your Asterisk system together with Digium or beroNet interface cards.

4.2. Installation by hand

For installation by hand, it is best to get the Asterisk sources from the Digium SVN server and compile them. Alternatively, you can type the following on a Debian based system:

apt-get install asterisk <ENTER>

You still have to install the necessary kernel modules in accordance with your installed hardware. These modules must be compiled for the running kernel.

To obtain the Zaptel sources with SVN, open a console, and with "cd /usr/src" enter directory "/usr/src". Then type the following:

svn co http://svn.digium.com/svn/zaptel/branches/1.2 zaptel <ENTER>

This will check out the driver source files from the Digium SVN server. You probably need the "libpri" and "Asterisk" sources as well. Therefore, type:

svn co http://svn.digium.com/svn/libpri/branches/1.2 libpri <ENTER>

and

svn co http://svn.digium.com/svn/asterisk/branches/1.2 asterisk <ENTER>

This results in the creation of three new directories in "/usr/src":

"/usr/src/zaptel"
"/usr/src/libpri"
"/usr/src/asterisk"

After completing the download, change to directory "/usr/src/zaptel" and enter:

make clean <ENTER>
make install <ENTER>

You now successfully compiled and installed the kernel modules on your system.

For zaptel-ISDN Stack support, "libpri" must be installed. Enter directory "/usr/src/libpri/", and type:

make clean <ENTER>
make install <ENTER

To compile and install Asterisk, enter directory "/usr/src/asterisk/", and type::

make clean <ENTER>
make install <ENTER

Asterisk should display a message saying it compiled and installed properly.
To install the sample configuration files, please type:

make samples <ENTER>

This does not overwrite configuration-files already present. If your interface card is configured, you should be able to start the Asterisk with:

asterisk -c <ENTER>

You are now in the command line interface of Asterisk.

5.Additional Sources of Information

www.digium.com
Digium website, the sponsor of the Asterisk project

www.beronet.com
Website of beroNet GmbH, download chan_misdn

www.misdn.org
beroNet Website for mISDN

www.asterisk.org
Official site of the Asterisk project

www.voip-info.org
A very comprehensive info portal on VoIP and Asterisk

www.ip-phone-forum.de
German language forum on VoIP with special Asterisk section

www.isdn4linux.de
Official site of the mISDN project

www.jolly.de
Website of Andreas Eversberg, the developer of PBX4Linux

www.freshmeat.net
Portal and hosting for open source projects

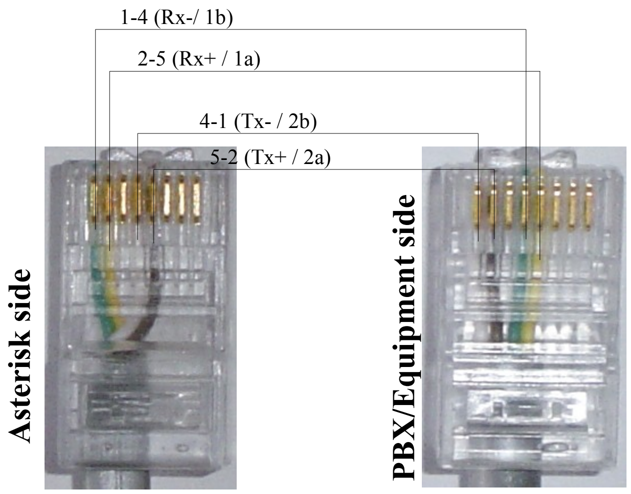
6.Sample Configurations

The following sample configurations are available for download at www.beronet.com:

TDM11B	http://www.beronet.com/downloads/config-samples/conf_TDM11B.zip
TDM40B	http://www.beronet.com/downloads/config-samples/conf_TDM40B.zip
TDM04B	http://www.beronet.com/downloads/config-samples/conf_TDM04B.zip
TE110P	http://www.beronet.com/downloads/config-samples/conf_TE110P.zip
TE4xxP	http://www.beronet.com/downloads/config-samples/conf_TE4xxP.zip
BN4S0	http://www.beronet.com/downloads/config-samples/conf_BN4S0.zip
BN8S0	http://www.beronet.com/downloads/config-samples/conf_BN8S0.zip

7.E1 Cable Selection for Connection to PRI Circuits or other Telephony Devices

Usual connection between a Digium PRI card and a telcom-device:



pic 7.1.

When connecting a NTPM, it is possible the wires are crossed inside the NTPM. In this case, use a simple patch cable (pin 1 to pin 1).

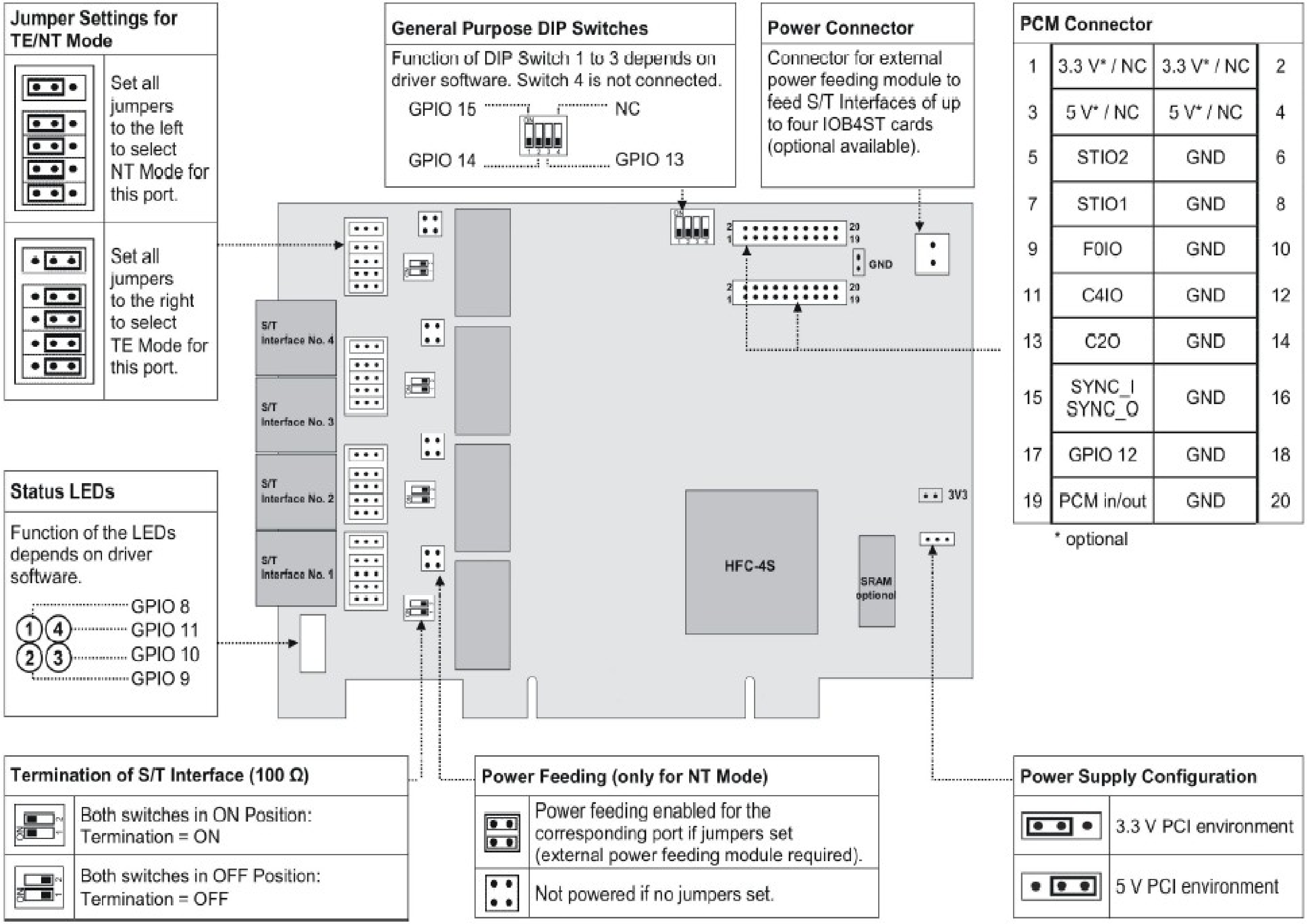
There is no standard pinout for PRI circuits, some manufacturers' pinouts differ from the image above. When connecting to LSA blocks of your provider, the wiring is installation specific. You should request a particular setting from your provider or identify the circuits before connecting to them. This applies to most telecommunications devices.

8.Technical Data

8.1.BN4S0 Board

- **S/T Interface**
  4 BRI ports (TE/NT mode; fed by external power supply;
- selectable, 100 Ohm line termination
  ISDN short circuit protection through fuses
- **PCI Interface**
  PCI interface is switch selectable to operate on 3.3V or on 5V PCI 2.2
- **PCM Bus**
  Daisy chain two or more cards
  2/4/8 Mbit/s data transfer rate
- **Chipset**
  Cologne Chip HFC-4S ISDN IC
  Highly stable 49.152 MHz quartz oscillator
  512 bit x 8 serial EEPROM (PCI configuration information)
- **General Purpose I/O**
  4 dual LEDs on the slot bracket (status: *green, red, off)*
  3-DIP switches, can be checked by software
- **ISDN Conformity**
  The BN4S0 board family is hardware compliant with the specifications of the ISDN standard (I.430, CTR3).
- Board Dimensions
  15.5 x 10.5 x 1.3 (cm)

8.1.1.technical overview of BN4S0 rev. 1



PCM Connector

1	3.3 V* / NC	3.3 V* / NC	2
3	5 V* / NC	5 V* / NC	4
5	STIO2	GND	6
7	STIO1	GND	8
9	F0IO	GND	10
11	C4IO	GND	12
13	C2O	GND	14
15	SYNC_I SYNC_O	GND	16
17	GPIO 12	GND	18
19	PCM in/out	GND	20

* optional

Jumper Settings for TE/NT Mode

Set all jumpers to the left to select NT Mode for this port.

Set all jumpers to the right to select TE Mode for this port.

General Purpose DIP Switches

Function of DIP Switch 1 to 3 depends on driver software. Switch 4 is not connected.

Power Connector

Connector for external power feeding module to feed S/T Interfaces of up to four IOB4ST cards (optional available).

Status LEDs

Function of the LEDs depends on driver software.

Termination of S/T Interface (100 Ω)

Both switches in ON Position: Termination = ON

Both switches in OFF Position: Termination = OFF

Power Feeding (only for NT Mode)

Power feeding enabled for the corresponding port if jumpers set (external power feeding module required).

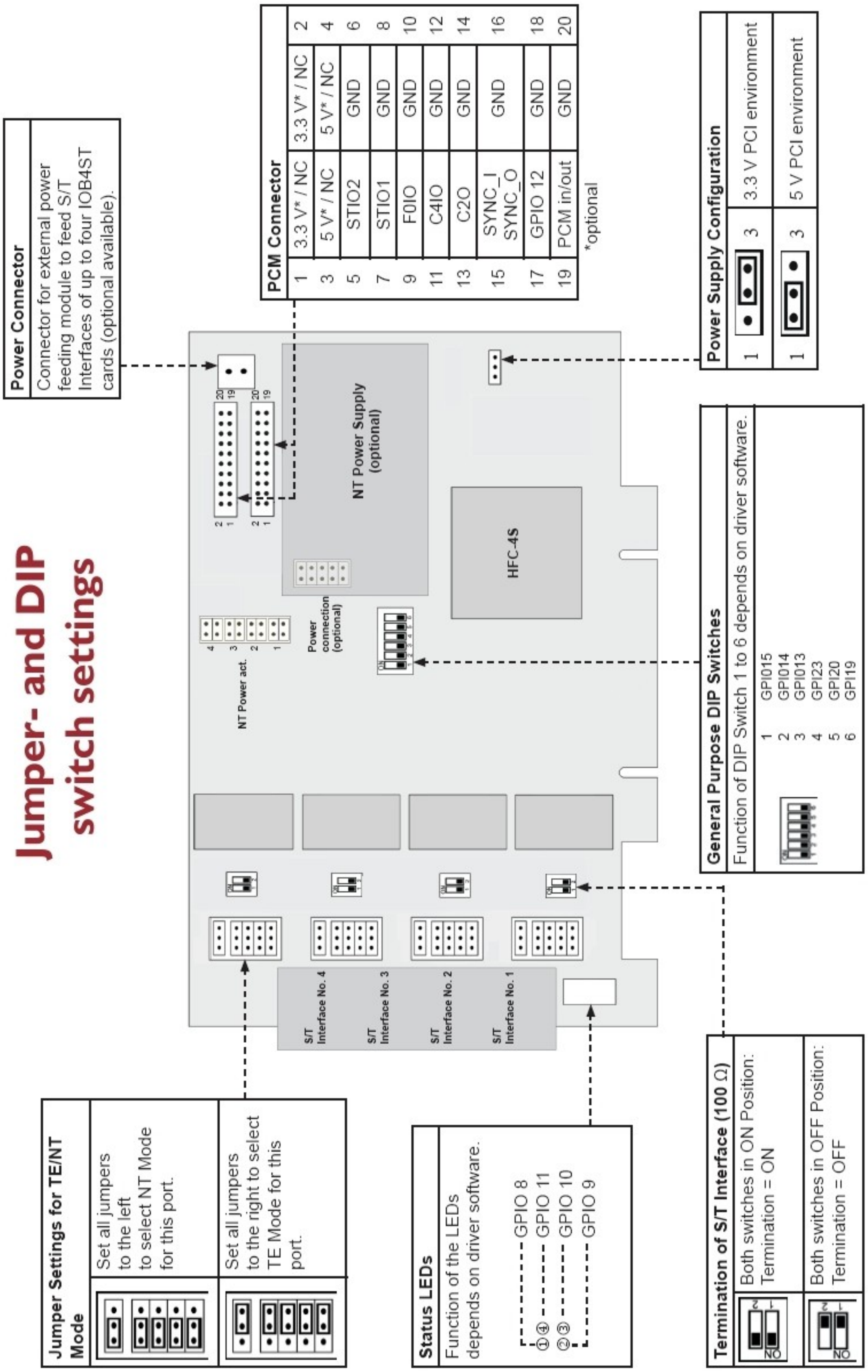
Not powered if no jumpers set.

Power Supply Configuration

3.3 V PCI environment

5 V PCI environment

8.1.2.technical overview of BN4S0 rev. 2



Jumper- and DIP switch settings

Power Connector

Connector for external power feeding module to feed S/T interfaces of up to to four IOB4ST cards (optional available).

PCM Connector

1	3.3 V* / NC	3.3 V* / NC	2
3	5 V* / NC	5 V* / NC	4
5	STIO2	GND	6
7	STIO1	GND	8
9	F0IO	GND	10
11	C4IO	GND	12
13	C2O	GND	14
15	SYNC_I SYNC_O	GND	16
17	GPIO 12	GND	18
19	PCM in/out	GND	20

*optional

Power Supply Configuration

1 ● ▣ 3		3.3 V PCI environment
1 ▣ ● 3		5 V PCI environment

General Purpose DIP Switches

Function of DIP Switch 1 to 6 depends on driver software.

1	GPI015
2	GPI014
3	GPI013
4	GPI23
5	GPI20
6	GPI19

Jumper Settings for TE/NT Mode

Set all jumpers to the left to select NT Mode for this port.

Set all jumpers to the right to select TE Mode for this port.

Status LEDs

Function of the LEDs depends on driver software.

①④ ②③ GPIO 8 GPIO 11 GPIO 10 GPIO 9

Termination of S/T Interface (100 Ω)

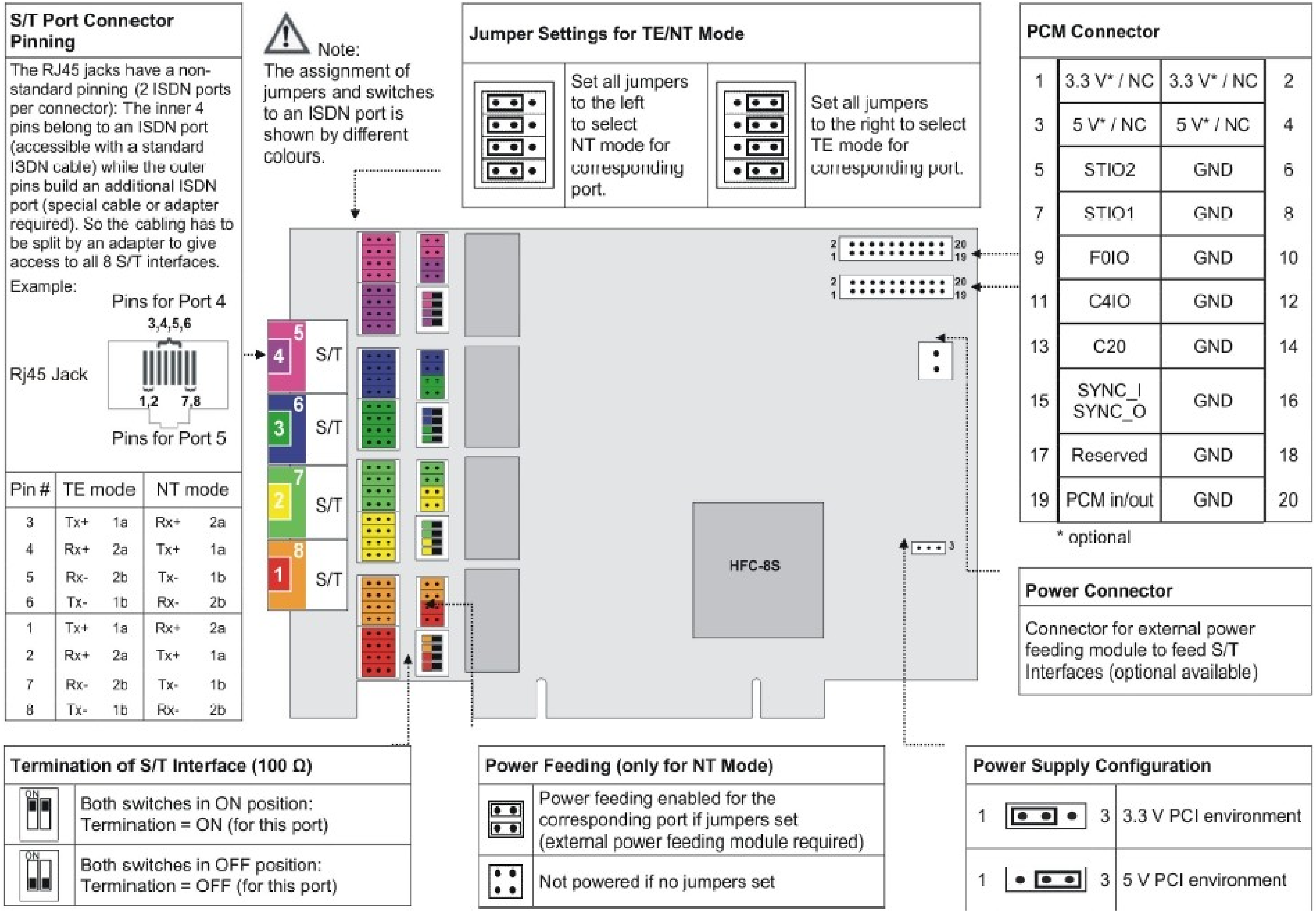
Both switches in ON Position: Termination = ON

Both switches in OFF Position: Termination = OFF

8.2.BN8S0 Board

- **S/T Interface**
- **8 S/T interfaces**: 4 RJ45 jacks using non-standard pin-outs (2 ISDN ports per connector); TE/NT mode; fed by external power supply;
- selectable, 100 Ohm line termination
- **ISDN short circuit protection** through fuses
- **PCI Interface**
  PCI interface is switch selectable to operate on 3.3V or on 5V PCI 2.2
- PCM Bus
  Daisy chain two or more cards
  2/4/8 Mbit/s data transfer rate
- **Chipset**
  Cologne Chip HFC-4S ISDN IC
  Highly stable 49.152 MHz quartz oscillator
  512 bit x 8 serial EEPROM (PCI configuration information)
- **ISDN Conformity**
  The BN8SO board is hardware compliant with the specifications of the ISDN standard (I.430, CTR3).
- **Board Dimensions**
  16 x 10.5 x 2 cm (exceeds standard PCI dimensions)

8.2.1.technical overview of BN8S0 rev. 1



S/T Port Connector Pinning

The RJ45 jacks have a non-standard pinning (2 ISDN ports per connector): The inner 4 pins belong to an ISDN port (accessible with a standard ISDN cable) while the outer pins build an additional ISDN port (special cable or adapter required). So the cabling has to be split by an adapter to give access to all 8 S/T interfaces.

Example:

Pins for Port 4

3,4,5,6

Rj45 Jack

1,2 7,8

Pins for Port 5

Pin #	TE mode		NT mode	
3	Tx+	1a	Rx+	2a
4	Rx+	2a	Tx+	1a
5	Rx-	2b	Tx-	1b
6	Tx-	1b	Rx-	2b
1	Tx+	1a	Rx+	2a
2	Rx+	2a	Tx+	1a
7	Rx-	2b	Tx-	1b
8	Tx-	1b	Rx-	2b

⚠ Note:
The assignment of jumpers and switches to an ISDN port is shown by different colours.

Jumper Settings for TE/NT Mode

Set all jumpers to the left to select NT mode for corresponding port.	Set all jumpers to the right to select TE mode for corresponding port.

PCM Connector

1	3.3 V* / NC	3.3 V* / NC	2
3	5 V* / NC	5 V* / NC	4
5	STIO2	GND	6
7	STIO1	GND	8
9	F0IO	GND	10
11	C4IO	GND	12
13	C20	GND	14
15	SYNC_I SYNC_O	GND	16
17	Reserved	GND	18
19	PCM in/out	GND	20

* optional

Power Connector

Connector for external power feeding module to feed S/T Interfaces (optional available)

Termination of S/T Interface (100 Ω)

ON	Both switches in ON position: Termination = ON (for this port)
ON	Both switches in OFF position: Termination = OFF (for this port)

Power Feeding (only for NT Mode)

	Power feeding enabled for the corresponding port if jumpers set (external power feeding module required)
	Not powered if no jumpers set

Power Supply Configuration

1	3	3.3 V PCI environment
1	3	5 V PCI environment

8.3.BN2E1 Board

- **E1 Interface**
  - 2 PRI port
  - can be configured to TE/NT mode by jumpers
  - TE/NT mode setting can be detected by software
  - line termination (120 Ω default / 75 Ω optional) is selectable by DIP switch

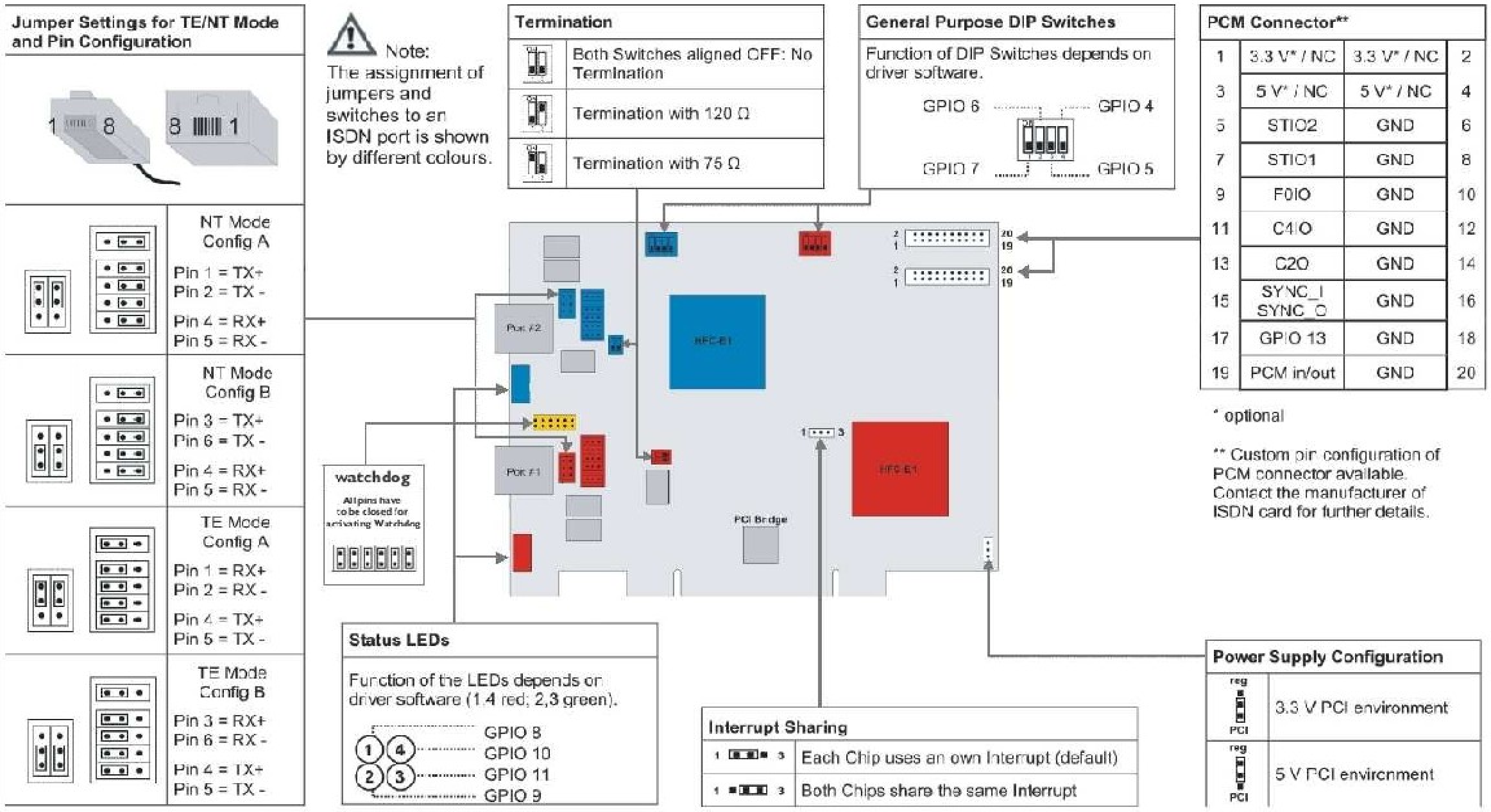
- **PCI Interface**
  - PCI interface is suitable for 3.3V as well as 5V PCI 2.2 slots (5V to 3.3V regulator on board)

- **PCM Bus**
  - daisy chaining possible by two connectors (2x10 pins, 2.54cm pin pitch) on the card
  - flat ribbon cable for connection of several cards optional available
  - 2/4/8 Mbit/s data transfer rate

- **Chipset**
  - 2 Cologne Chip HFC-E1 ISDN IC
  - high precision 32.768 MHz quartz oscillator
  - 512 bit x 8 serial EEPROM for the storing of PCI configuration
  - 512k x 8 SRAM for enlarging FIFO buffer (soldering option)

- **General Purpose I/O**
  - 4-DIP switch can be checked by software for e.g. identification of the card (controllable via GPI – general purpose input)
  - 4 monochrome LEDs (2 red and 2 green LEDs) on board that can be controlled by software (controllable via GPIO – general purpose input/output)
- **Board Dimensions**
  - 15 x 10.6 x 1.5 (cm)

8.3.1.technicel overview of BN2E1



Jumper Settings for TE/NT Mode and Pin Configuration

NT Mode Config A	Pin 1 = TX+ Pin 2 = TX - Pin 4 = RX+ Pin 5 = RX -
NT Mode Config B	Pin 3 = TX+ Pin 6 = TX - Pin 4 = RX+ Pin 5 = RX -
TE Mode Config A	Pin 1 = RX+ Pin 2 = RX - Pin 4 = TX+ Pin 5 = TX -
TE Mode Config B	Pin 3 = RX+ Pin 6 = RX - Pin 4 = TX+ Pin 5 = TX -

Note:
The assignment of jumpers and switches to an ISDN port is shown by different colours.

Termination

Both Switches aligned OFF: No Termination

Termination with 120 Ω

Termination with 75 Ω

General Purpose DIP Switches

Function of DIP Switches depends on driver software.

GPIO 6 GPIO 4
GPIO 7 GPIO 5

PCM Connector**

1	3.3 V* / NC	3.3 V* / NC	2
3	5 V* / NC	5 V* / NC	4
5	STIO2	GND	6
7	STIO1	GND	8
9	F0IO	GND	10
11	C4IO	GND	12
13	C2O	GND	14
15	SYNC_I SYNC_O	GND	16
17	GPIO 13	GND	18
19	PCM in/out	GND	20

* optional

** Custom pin configuration of PCM connector available. Contact the manufacturer of ISDN card for further details.

watchdog

All pins have to be closed for activating Watchdog

Status LEDs

Function of the LEDs depends on driver software (1,4 red; 2,3 green).

1 4 2 3
GPIO 8
GPIO 10
GPIO 11
GPIO 9

Interrupt Sharing

1 3	Each Chip uses an own Interrupt (default)
1 3	Both Chips share the same Interrupt

Power Supply Configuration

reg PCI	3.3 V PCI environment
reg PCI	5 V PCI environment

8.4.TE410P / TE405P

- **Applications**
  Legacy PBX/IVR services
  Voice-over Internet protocol (VoIP) services
  Complex IVR trees
  "Meet-Me-Bridge" conference calls
  VoIP Gateways (SIP, H.323 and IAX support)
  Calling card platforms
  Voice/Data router (replaces expensive routers)
- **PRI Switch Compatibility**
  Euro-ISDN (PRI or PRA) - Q.931/Q.921
  AT&T 4ESS
  DMS 100
  Lucent 5E
  Network or CPE
  National ISDN 2
- **CAS Voice Modes**
  Feature Group D
  E&M Wink
  A-Law, µ-Law, and linear mode support
- **Data Modes**
  SyncPPP (both fixed and dial up)
  Frame Relay
  Cisco HDLC
  Multi-link PPP
- **PCI**
  The TE410P is only for use in a 3.3 volt PCI slot.
  The TE405P is only for use in a "normal" 5 volt PCI slot.

8.5.TE407P / TE412P

Same features as in 8.3, with the addition of:

- **Echo Cancellation**
  G.168 compliant
  128 taps over 128 channels
  (16ms over 128 channels)

8.6.TDMxxP / TDM400P

- **Target Applications**
  Small Office Home Office (SOHO) applications
  Gateway termination to analog telephones
  Add inexpensive analog phones to existing PBX systems
  Wireless point-to-point applications between Asterisk servers
- **Services and Features**
  Caller ID and Call Waiting ID
  ADSI telephones
  PCI half-length slot
  RJ-11C connector
- **Environmental Conditions**
  Operating temperature: 0° to 50°C, 32° to 122° F
  Storage temperature: -20° to 65°C, 4° to 149° F
  Humidity: 10-90% non-condensing
- **Standard Configurations**
  TDM10B: 1-port FXS bundle
  TDM40B: 4-port FXS bundle
  TDM01B: 1-port FXO bundle
  TDM04B: 4-port FXO bundle
  TDM11B: 1-port FXS &1-port FXO bundle
  TDM22B: 2-port FXS &2-port FXO bundle
  TDM31B: 3-port FXS &1-port FXO bundle
  *Other configurations available on request
- **Hardware and Software Requirements**
  500 MHz Pentium III or better with 64MB RAM
  Available PCI slot

8.7.TE110P

- **Target Applications**
  Packet voice gateways and switches
  Calling card services
  One number services
  Message services
  Conference calls
  Customized and Web telephony
  Voice/Data integration
  Future-proof PBX
  ISDN remote access servers
- **PRI Switch Capability**
  AT&T 4ESS
  DMS 100
  Lucent 5E
  National ISDN 2
  Euro ISDN
  Network or CPE
  NFAS
- **RBS Voice Modes**
  GR-303
  A-law, µ-law, and linear
  mode support
  E&M
  E&M Wink
  Feature group D
  Ground start (FXO and FXS)
  Loop start (FXO and FXS) with
  optional disconnect supervision
- **Data Modes**
  SyncPPP (both fixed and dial up)
  Frame Relay
  Cisco HDLC

8.8.S101I (IAXy)

- **Applications**
  - Internet telephony service providers
  - Remote PBX extensions
  - Wireless phone service with
  - External bridge
- **Features**
  - Auto upgrade
  - Remote provisioning
  - Caller ID
  - Call waiting
  - Cancel call waiting (*70)
  - Call waiting ID
  - Caller ID disable,
  - Caller ID enable (*67, *82)
  - Three-way calling
  - Call transfer
  - Blind transfer
  - Call parking
  - VMWI (Voice Mail Waiting indicator)
  - Mute Rx on-Hook
  - Pulse dial
  - Call hold
- **VoIP codecs**
  - µlaw (G.711)
  - ADPCM
- **VoIP control**
  - Inter-Asterisk eXchange (IAX)
- **Telephone**
  - Connector: RJ11
  - Ringer Equivalence Number (REN):5 at 1500 ft.
- **Power requirements**
  - 6V DC, 1000mA Regulated switching power supply
  - Tip positive 3–3.8mm outer diameter,
  - 1–1.3mm inner diameter connector, 11.5mm length
- **Environmental Conditions**
  - Operating temperature: 0° to 50° C,
  - 32° to 122° F
  - Storage temperature: -20° to 65° C,
  - 4° to 149° F
  - Humidity: 10-90% non-condensing