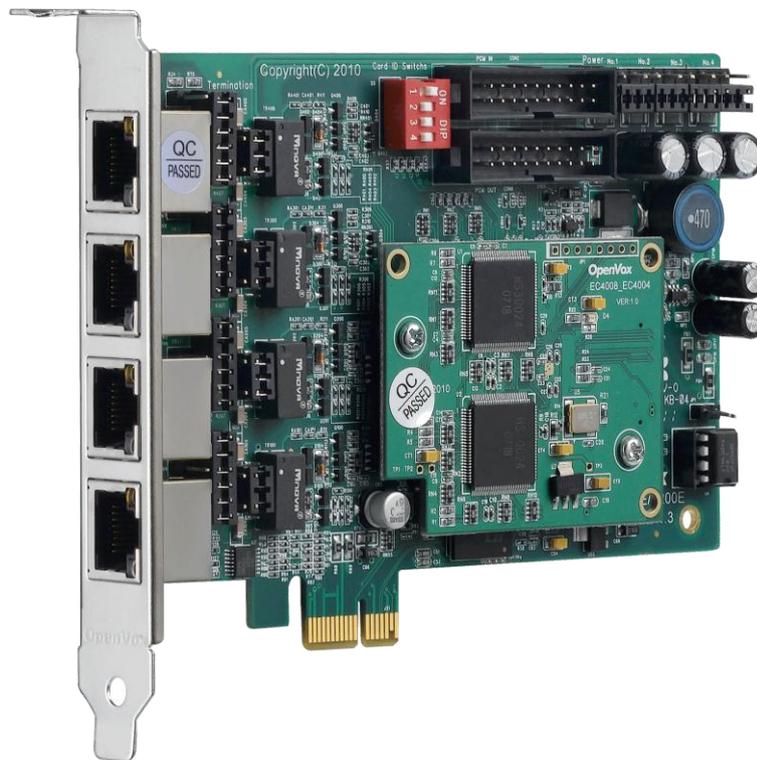




OpenVox Communication Co.Ltd



B400E/BE400E on DAHDI User Manual

Version: 2.2





OpenVox Communication Co.Ltd

Most Advanced Asterisk Cards

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General Safety Instructions



CAUTION

1. The computers that have B400E/BE400E card installed must comply with the country's specific safety regulations.
2. Only service personnel should install B400E/BE400E card.
3. Before you install B400E/BE400E card, please unplug the power cord from the computer and remove the cover from your PC.
4. For avoiding personal injuries and damage to your computer and B400E/BE400E card, make sure bracket of the card is secured to the PC's chassis ground by fastening the card with screws.
5. Electrical Surges, ESD are very destructive to the equipment. To avoid it, make sure there is a low impedance discharge path from your computer to chassis ground.
6. To reduce the risk of damage or injury, please follow all steps or procedures as instructed.

Test Environments

CentOS-5.6

Kernel version: 2.6.18-238.12.1.el5

DAHDI: dahdi-linux-complete-current

Asterisk: 1.8.5.0

Libpri: 1.4.11.5

Hardware: OpenVox B400E/BE400E

Chapter 1 Overview

1.1 What is Asterisk

The Definition of Asterisk is described as follows:

Asterisk is a complete PBX in software. It runs on Linux, BSD, Windows (emulated) and provides all of the features you would expect from a PBX and more. Asterisk does voice over IP in four protocols, and can interoperate with almost all standard-based telephony equipments using relatively cost-effective hardware. Asterisk provides Voicemail services with Directory, Call Conferencing, Interactive Voice Response, and Call Queuing. It supports three-way calling, caller ID services, ADSI, IAX, SIP, H323 (as both client and gateway), MGCP (call manager only) and SCCP/Skinny (voip-info.org).

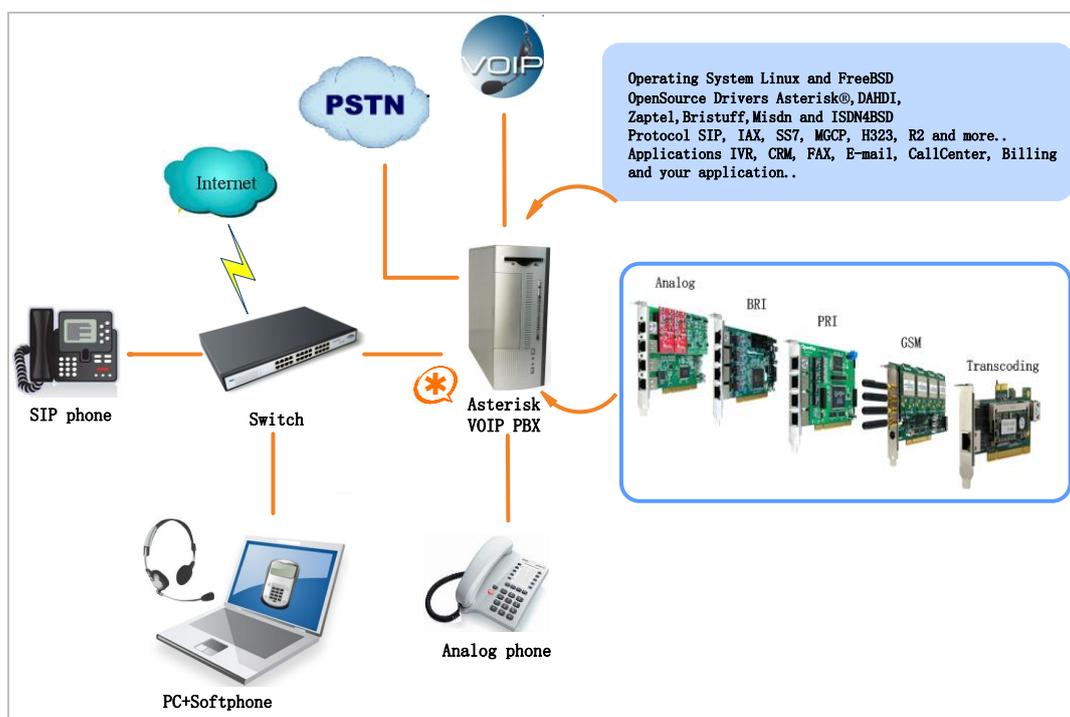


Figure 1 Topology

1.2 What is B400E/BE400E

OpenVox B400E/BE400E is a PCI Express 1.0 compliant card which supports 4 BRI S/T interface, and BE400E is B400E with a hardware echo cancellation module. It takes full advantage of Siemens® technology based Hardware Echo Cancellation Module to deliver the superior voice quality over the 4 BRI ports that can be configured for TE or NT mode individually by jumpers. This port configuration is detected by the driver automatically.

B400E/BE400E S/T BRI interface card delivers superior voice quality in the telephony systems with advanced Siemens® technology based hardware echo canceller. It can provide 8 simultaneous voices calls over 4 ISDN BRI line, turns your legacy ISDN BRI equipments into powerful Voice over IP devices and provides a soft migration path from ISDN technology to the new Voice over IP world. B400E/BE400E is designed for building Open Source systems based on Asterisk such as ISDN PBX and VoIP gateway.

The B400E/BE400E and drivers comply with fully GPLed for the Linux kernel bring powerful ISDN BRI connectivity to your Linux machine.

B400E/BE400E works well with Asterisk®, Elastix®, FreeSWITCH™, PBX in a Flash, trixbox®, Yate™ and IPPBX/IVR projects as well as other Open Source and proprietary PBX, Switch, IVR, and VoIP gateway applications.

Target applications

- High Performance ISDN PC Cards
- ISDN PABX for BRI
- VoIP Gateways
- ISDN LAN Routers for BRI
- ISDN Least Cost Routers for BRI
- ISDN Test Equipment for BRI

Main features

- Up to 4 ports of S/T interfaces
- Supports PCI Express 1.0 or above
- ITU-T I.430 and TBR 3 certified and S/T ISDN supporting TE/NT mode
- 32 bit bus master DMA data exchanges across PCI interface at 132Mbytes/sec for minimum host processor intervention
- DTMF detection on all B-channels
- Multiparty audio conferences bridge
- Full software and hardware compatible with Junghanns.NET ISDN, mISDN driver, DADHI and so on.
- RoHS compliant
- Certificates: CE, FCC, A-Tick
- trixbox™ Officially Certified
- Elastix® Officially Certified

Chapter 2 Hardware Setup

There are some points should be paid attention to when setting up B400E/BE400E.

2.1 Power supply

The board is powered by PCI Express 1.0 or above slot, provides +3.3V or 12V on PCI-E slots.

2.2 Slot compatibility

B400E/BE400E is compatible with PCI-E $\times 1$, $\times 2$, $\times 4$, $\times 8$ and $\times 16$ slot.

You should confirm your slot type firstly and then insert B400E/BE400E into the PCI-E slot as previously described. Some slots are described like that.



Figure 2 PCI-E and PCI slots

2.3 Setting Card ID

If want to install more than one card of B400E/BE400E in a PC, you should take care of the card ID switch. The state of ON stands for "1" in binary, OFF represents "0", and Card ID is calculated by binary. For instance, the four switches should be all set to OFF if there is only one card, which means their corresponding binary value is "0000" and the decimal number is "0". There two pieces of rules you must obey to set Card ID:

- The ID of the first card must be set to 0, the second should be set to 1, and so on.
- The first Card is a card that will be initialized (i.e. installing driver) firstly once the system boot up. At most cases, Linux will initialize PCI devices according to their slot order. The slot nearest to the CPU will be initialized firstly and the farthest end slot will be initialized at last. That is to say, the card which is nearest to the CPU ID should be set to 0 if there are more than one B400E/BE400E on your machine.

2.4 Adjusting Termination of S/T Interface (100 ohm)

You are able to set a port to NT or TE mode, please refer to figure 3 for visualized information.

- If a port works on NT mode, you should set jumper to CONNECT (ON).

- If a port works on TE mode, theoretically it should be set to OPEN (OFF), but it might connect to some non-standard ISDN terminal equipments that do not have terminal resistors, for such equipments, you should set it to CONNECT(ON).

2.5 Power Feeding Connector

These jumpers control whether supply power for the external ISDN terminals. You should adjust accordingly as follows:

- If the port works on TE mode, you **MUST** set the jumper to OPEN(OFF)
- There are two aspects when ports work on NT mode. If the ISDN terminal has the function of power supply, you should set the jumper to OPEN (OFF); If ISDN terminal isn't self- powered, you should set the jumper to CONNECT (ON).

2.6 Power Supply

- Power Feeding Input

If one of the eight power feeding connectors is CONNECT (ON), you should connect a D-type connector from PC power supply to this jack, the D-type connector is used to provide power to CDROM and 3.5" HDD.

- Power Supply Selection

Some latest model PCs do not provide +5V on the PCI slots. If you use

this kind of PC, it is need to set the jumper to 3.3V.

➤ PCM IN/PCM OUT

The above point is applied to connect two BRI cards.

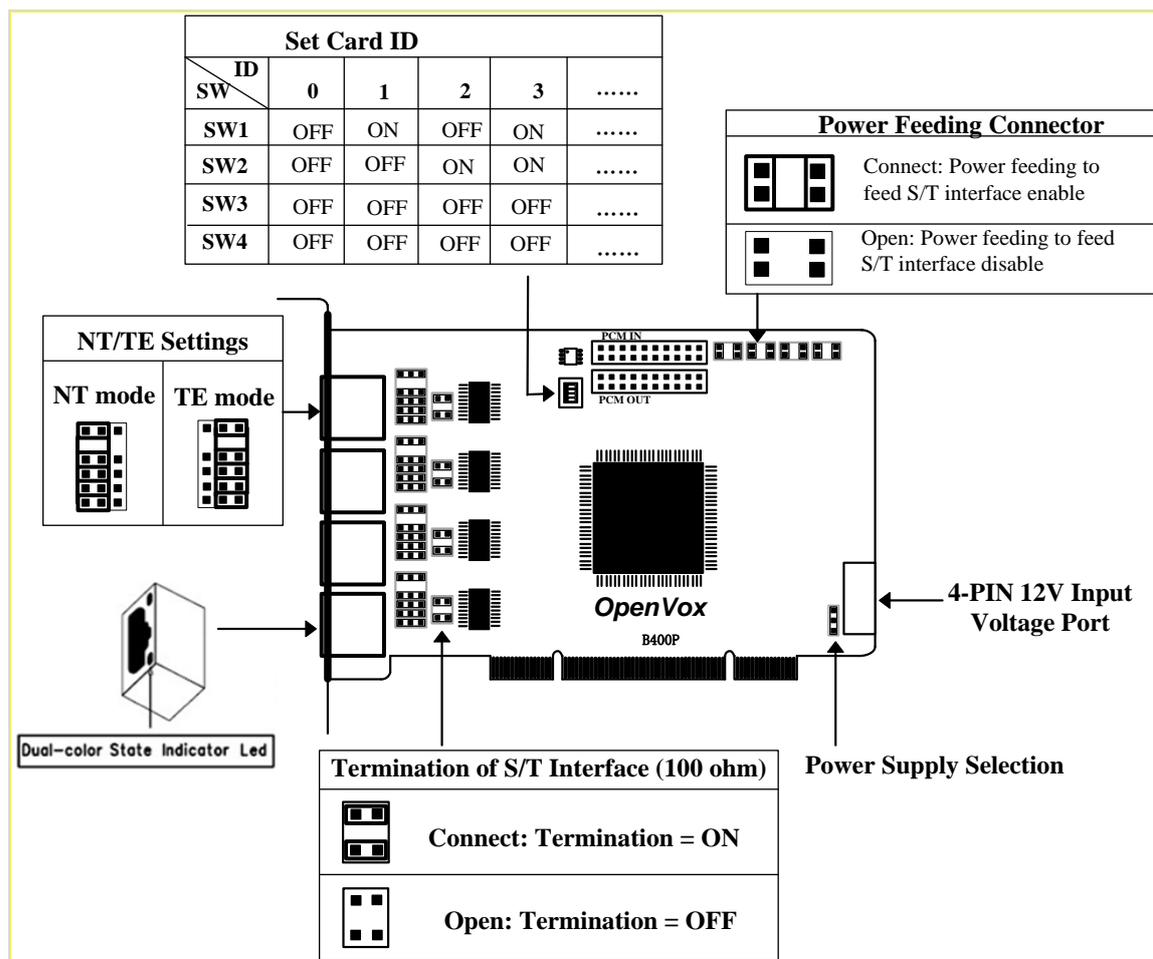


Figure 3 Jumper setting

2.7 Hardware setup procedure

- Power off your PC, remember to unplug the AC power cable
- Set card ID as previously stated if there is more than one BRI card.
- Insert B400E/BE400E into a PCI-E slot vertically

- Plug the hard disk power supply cable (D style) to power feeding input jack if need to provide power by external equipments, please refer jumper setting section for more details.
- Plug ISDN lines into RJ-45 interfaces which sets as TE mode and ISDN phone lines into RJ-45 interface which sets as NT mode
- Fix the board by a screw
- Plug back the AC power cable, and power on PC



Caution: During the above processes, an ESD wrist strap is needed. Once power is on, you must not attempt to install or take down the board. After hardware setup appropriately, it is time to install software.



Chapter 3 Software Installation and Configuration

B400E/BE400E supports DAHDI software driver on Linux. To make full use of B400E/BE400E, you should download, compile, install and configure DAHDI, Libpri and Asterisk. Let's make specific versions for an example to state how to install software.

3.1 Download

DAHDI software packages are available on OpenVox official website or Digium. Some patches should be applied when the driver source is from Digium. Therefore, it is recommended that downloading the DAHDI driver package from OpenVox official website.

Gain DAHDI source package from OpenVox:

http://downloads.openvox.cn/pub/drivers/dahdi-linux-complete/openvox_dahdi-linux-complete-current.tar.gz

Get Libpri and Asterisk software packages from Digium official website:

<http://downloads.asterisk.org/pub/telephony/libpri/releases/libpri-1.4.11.5.tar.gz>

<http://downloads.asterisk.org/pub/telephony/asterisk/releases/asterisk-1.8.5.0.tar.gz>

Execute the following commands under the directory of /usr/src/ in generally to download and decompress these packages:

```
# wget http://downloads.asterisk.org/pub/telephony/libpri/releases/libpri-1.4.11.5.tar.gz
# tar -zxvf libpri-1.4.11.5.tar.gz
# wget http://downloads.openvox.cn/pub/drivers/dahdi-linux-complete/openvox_dahdi-linux-complete-current.tar.gz
# tar -xvzf openvox_dahdi-linux-complete-current.tar.gz
# wget http://downloads.asterisk.org/pub/telephony/asterisk/releases/asterisk-1.8.5.0.tar.gz
# tar -zxvf asterisk-1.8.5.0.tar.gz
```

- If using Asterisk 1.8, it is not need to make any patches more.
- If using Asterisk 1.6, please modify the file asterisk-1.6.xx/channels/chan_dahdi.c like that as the following introduction.

Please comment out the following line:

```
/*ast_log(LOG_WARNING, "How cool would it be if someone Implemented this mode!For now, sucks for you.(line %d)\n", v->lineno);*/
```

Then add the following two lines after the above action:

```
confp->chan.sig = SIG_BRI_PTMP;  
confp->pri.nodetype = PRI_NETWORK
```

3.2 Installation

1. Hardware detection

```
# lspci -vvvv
```

Check the outcome and confirm your system has recognized

B400E/BE400E. If it has been recognized, "ISDN controller" will be displayed in the output information like that:

```
02:0a.0 ISDN controller: Cologne Chip Designs GmbH ISDN network Controller  
[HFC-4S] (rev 01)  
    Subsystem: Cologne Chip Designs GmbH HFC-4S [OpenVox B200P / B400P]  
    Control: I/O+ Mem+ BusMaster- SpecCycle- MemWINV- VGASnoop- ParErr-  
Stepping- SERR+ FastB2B- DisINTx-  
    Status: Cap+ 66MHz- UDF- FastB2B- ParErr- DEVSEL=medium >TAbort-  
<TAbort- <MAbort- >SERR- <PERR- INTx-  
    Interrupt: pin A routed to IRQ 209  
    Region 0: I/O ports at dff0 [size=8]  
    Region 1: Memory at feafb000 (32-bit, non-prefetchable) [size=4K]  
    Capabilities: [40] Power Management version 2  
        Flags: PMEClk- DSI+ D1+ D2+ AuxCurrent=0mA  
PME(D0+,D1+,D2+,D3hot+,D3cold-)  
    Status: D0 NoSoftRst- PME-Enable- DSel=0 DScale=0 PME+  
    Kernel driver in use: wcb4xxp  
    Kernel modules: wcb4xxp
```

Figure 4 Hardware detection

If B400E/BE400E is not recognized by the system, you have to power off and take out the card to insert it into another PCI slot.

2. Software installation

Some dependencies are crucial. If any of them is absent, the software installation process would not go through successfully. Let's run "yum install XX" (XX stands for the dependency's name) to check the availability of dependencies.

```
# yum install bison
# yum install bison-devel
# yum install ncurses
# yum install ncurses-devel
# yum install zlib
# yum install zlib-devel
# yum install openssl
# yum install openssl-devel
# yum install gnutls-devel
# yum install gcc
# yum install gcc-c++
# yum install libxml2
# yum install libxml2-devel
```



If there is no kernel-devel source in the system, users should run the following command to install the kernel-devel to peer current kernel:

```
# yum install kernel-devel-`uname -r`
```

While if there is no matched kernel-devel found, you should download matched RPM package to install it, or execute the following command to update to the latest and stable kernel version:

```
# yum install kernel kernel-devel
```

After installed, please reboot your machine to apply the new kernel and install the dependencies. If the dependency has been installed, system indicates that nothing to do which means you could go to next one directly. Otherwise, the system will keep on installing it.

Change to the directory of dahdi-linux-complete-XX (XX represents DAHDI version), then perform commands one by one to install DAHDI.

```
# cd /usr/src/dahdi-linux-complete-current
```

```
# make
```

```
# make install
```

```
# make config
```

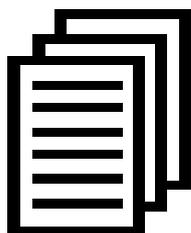


Caution: If there is something wrong after "make", please refer to [HERE](#). In the url link, the moderator introduces you a method how to patch. After patching, save your changes and exit. Then run "make" again, if successfully done, it is time for you to install Libpri and Asterisk.

Please execute those commands to install Libpri and Asterisk:

```
# cd libpri-1.4.11.5
# make
# make install

# cd asterisk-1.8.5.0
# ./configure
# make
# make install
# make samples
```



"make samples" will install the standard sample configuration file in the directory /etc/asterisk. As a freshman, you should perform "make samples", that is

to say, it is unnecessary to perform "make samples" every time. Because once performed, it will cover the old sample configuration files you have installed.

3.3 Configuration

1. Driver loading

After compiling and installing DAHDI, Libpri and Asterisk, please load the driver by running commands:

```
# modprobe dahdi
# modprobe wcb4xxp
# dahdi_genconf
# dahdi_cfg -vvv
```



OpenVox B400E/BE400E has great adaptive ability that it can be set as TE/NT mode automatically without any parameters. When the driver module "wcb4xxp" loaded, B400E/BE400E card can be configured for TE or NT mode individually by jumpers. This port configuration is detected by the driver automatically. You can see following outcome when execute the command below:

dmesg|grep wcb4xxp

```
[root@localhost Dahdi]# dmesg|grep wcb4xxp
wcb4xxp 0000:02:0a.0: probe called for b4xx...
wcb4xxp 0000:02:0a.0: Identified OpenVox B400P (controller rev 1)
at 0001dffb, IRQ 209
<6>wcb4xxp 0000:02:0a.0: Hardware echo cancellation disabled.
wcb4xxp 0000:02:0a.0: Port 1: TE mode
wcb4xxp 0000:02:0a.0: Port 2: TE mode
wcb4xxp 0000:02:0a.0: Port 3: NT mode
wcb4xxp 0000:02:0a.0: Port 4: NT mode
wcb4xxp 0000:02:0a.0: Did not do the highestorder stuff
wcb4xxp 0000:02:0a.0: new card sync source: port 2
wcb4xxp 0000:02:0a.0: new card sync source: port 2
wcb4xxp 0000:02:0a.0: new card sync source: port 2
wcb4xxp 0000:02:0a.0: Failed to create device attributes.
wcb4xxp 0000:02:0a.0: Driver unloaded.
wcb4xxp 0000:02:0a.0: probe called for b4xx...
```

Figure 5 dmesg information

Meanwhile, if the patch is applied correctly, you can see the message "Hardware echo cancellation enabled" which means the Hardware Echo Cancellation Module is working fine.



After running "modprobe dahdi" or "modprobe wcb4xxp", there is not any information displayed if loaded normally and successfully. "wcb4xxp" is the driver module name of B400E/BE400E.

If there is any error, please trace the cause. Until all errors are clear up, you could execute "dahdi_genconf" again, and then go to the next step. By running "dahdi_genconf", it will generate /etc/dahdi/system.conf and etc/asterisk/dahdi-channels.conf automatically.

Checking whether the generated files information agrees with your hardware setup, if not, you should modify to your specific requirements.

Do not forget to confirm that dahdi-channels.conf is included in chan_dahdi.conf, if not, run command:

```
# echo "#include dahdi-channels.conf" >>  
/etc/asterisk/chan_dahdi.conf
```

A part of system.conf which is one of the basic configuration files is displayed as follows:

```
# Autogenerated by /usr/sbin/dahdi_genconf on Thu Sep 29 15:01:02 2011
# If you edit this file and execute /usr/sbin/dahdi_genconf again,
# your manual changes will be LOST.
# Dahdi Configuration File
#
# This file is parsed by the Dahdi Configurator, dahdi_cfg
#
# Span 1: B4/0/1 "B4XXP (PCI) Card 0 Span 1" (MASTER) RED
span=1,1,0,ccs,ami
# termtype: te
bchan=1-2
hardhdlc=3

# Span 2: B4/0/2 "B4XXP (PCI) Card 0 Span 2" RED
span=2,2,0,ccs,ami
# termtype: te
bchan=4-5
hardhdlc=6

# Span 3: B4/0/3 "B4XXP (PCI) Card 0 Span 3" RED
span=3,3,0,ccs,ami
# termtype: te
bchan=7-8
hardhdlc=9

# Span 4: B4/0/4 "B4XXP (PCI) Card 0 Span 4" RED
span=4,4,0,ccs,ami
# termtype: te
bchan=10-11
hardhdlc=12

# Global data

loadzone          = us
defaultzone       = us
```

Figure 5 A part of system.conf

2. Country mode modification

In order to match your country mode, it is need to change parameters loadzone and defaultzone to your country. For example, your system is in CHINA, you would like them change to:

```
loadzone = cn
```

```
defaultzone = cn
```



Some zonedata is available in the file

../dahdi-XX/tools/zonedata.c, you can refer to it to match

your country mode. Meanwhile, you also need to modify

another parameter which is in file /etc/asterisk/indications.conf.

country=cn

A part of file /etc/asterisk/dahdi-channels.conf is showed as below.

(Modification, if it is not agree with the hardware setup. Here is an

example that assumes port 1& 2 are set to TE mode, port 3& 4 are set to

NT mode.)

```
; Autogenerated by /usr/sbin/dahdi_genconf on Thu Sep 29 15:01:02 2011
; If you edit this file and execute /usr/sbin/dahdi_genconf again,
; your manual changes will be LOST.
; Dahdi Channels Configurations (chan_dahdi.conf)
;
; This is not intended to be a complete chan_dahdi.conf. Rather, it is intended
; to be #include-d by /etc/chan_dahdi.conf that will include the global settings
;

; Span 1: B4/0/1 "B4XXP (PCI) Card 0 Span 1" (MASTER) RED
group=0,11
context=from-isdn
switchtype = euroisdn
signalling = bri_cpe_ptmp
channel => 1-2
context = default
group = 63

; Span 2: B4/0/2 "B4XXP (PCI) Card 0 Span 2" RED
group=0,12
context=from-isdn
switchtype = euroisdn
signalling = bri_cpe_ptmp
channel => 4-5
context = default
group = 63

; Span 3: B4/0/3 "B4XXP (PCI) Card 0 Span 3" RED
group=0,13
context=from-internal
switchtype = euroisdn
signalling = bri_net_ptmp
channel => 7-8
context = default
group = 63

; Span 4: B4/0/4 "B4XXP (PCI) Card 0 Span 4" RED
group=0,14
context=from-internal
switchtype = euroisdn
signalling = bri_net_ptmp
channel => 10-11
context = default
group = 63
```

Figure 6 A part of dahdi-channels.conf

3. Asterisk initiation

Execute a command to start Asterisk:

```
# asterisk -vvvvvvgc
```

If Asterisk is already activate, run "asterisk -r" instead.

In the CLI, please run the following commands

"dahdi show channels" and "pri show spans":

```
*CLI> dahdi show channels
Chan Extension Context Language MOH Interpret Blocked State
pseudo default default default In Service
1 from-isdn default default In Service
2 from-isdn default default In Service
4 from-isdn default default In Service
5 from-isdn default default In Service
7 from-internal default default In Service
8 from-internal default default In Service
10 from-internal default default In Service
11 from-internal default default In Service
*CLI> pri show spans
PRI span 1/0: Up, Active
PRI span 2/0: In Alarm, Down, Active
PRI span 3/0: Up, Active
PRI span 4/0: In Alarm, Up, Active
```

Figure 7 channels and spans show

If the span is up and active and not "In Alarm", it means successfully installation. Otherwise, please check the setting files and physical connections.

4. Dialplan edit

You should make sure that the context "from-isdn" and "from-internal" are in extensions.conf, here a simple example is given:

```
# vim /etc/asterisk/extensions.conf
```

```
[from-isdn]
exten => s,1,Dial(SIP/100,,r)
exten => s,n,Hangup()

[from-internal]
exten => _X.,1,Dial(dahdi/1/${EXTEN},,r)
exten => _X.,n,Hangup()

exten => _0XX,1,Dial(dahdi/${EXTEN:1},,r)
exten => _0XX,n,Hangup()
```

Figure 8 dial plan

After saving your dialplan, please run "asterisk -r", then execute "reload" in the CLI. Now you are able to make calls. The above dialplan achieves that:

- If there is a call from ISDN line, Asterisk will transfer to SIP extension 100, then it rings;
- If SIP extension 100 dials any phone number, Asterisk will transfer to the destination phone through the first channel.
- If SIP extension 100 dials a channel number, Asterisk will transfer to the destination ISDN phone which connects the channel. For example, if the SIP phone dials 001, Asterisk will get through to the ISDN phone which connects the first DAHDI channel.

When calls are running, you can check the status of Hardware Echo Cancellation Module. The status of EC looks like the following, EC status of active channel should be ON, and otherwise it's OFF.

```
*CLI> dahdi show channel 1
Channel: 1
File Descriptor: 9
Span: 1
Extension:
Dialing: no
Context: from-isdn
Caller ID: 10086
Calling TON: 33
Caller ID subaddress:
Caller ID name: 10086
Mailbox: none
Destroy: 0
InAlarm: 0
Signalling Type: ISDN BRI Point to MultiPoint
Radio: 0
Owner: DAHDI/i1/10086-1
Real: DAHDI/i1/10086-1
Callwait: <None>
Threeway: <None>
Confno: -1
Propagated Conference: -1
Real in conference: 0
DSP: yes
Busy Detection: no
TDD: no
Relax DTMF: no
Dialing/CallwaitCAS: 0/0
Default law: alaw
Fax Handled: no
Pulse phone: no
Gains (RX/TX): 0.00/0.00
Dynamic Range Compression (RX/TX): 0.00/0.00
DND: no
Echo Cancellation:
    128 taps
    currently ON
Wait for dialtone: 0ms
PRI Flags: Call
PRI Logical Span: Implicit
Actual Confinfo: Num/0, Mode/0x0000
Actual Confmute: No
Hookstate (FXS only): Onhook
```

Figure 9 EC status

Chapter 4 Reference

www.OpenVox.cn

www.digium.com

www.asterisk.org

www.voip-info.org

www.asteriskguru.com

Tips

Any questions during installation please consult in our forum or look up for answers from the following websites:

[Forum](#)

[wiki](#)

Appendix A Specifications

• Weight and size

Weight: 125g (4.41oz)

Size: 14.0×9.9×1.8cm (5.51×3.90×0.71 inch)

• Interfaces

PCI Express 1.0 or above

Local Loop Access: RJ-45 ports used on certain ISDN S/T/U interfaces

• Environment

Temperature: 0 ~ 50 °C (Operation)

- 40 ~ 125 °C (Storage)

Humidity: 10 ~ 90% NON-CONDENSING

• Power consumption

Voltage: 3.3V/38V (NT only)

Power Dissipation: 1.53W Minimum, 9.4W Maximum

• Hardware and software requirements

RAM 128 + MB

Linux kernel 2.4.X or 2.6.X

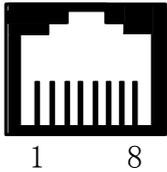
CPU 800+ MHZ

Appendix B PIN Assignments

Basic Rate ISDN lines can use straight ("flat") modular cable if necessary.

However, twisted-pair are more common.

- ISDN U-interface

8-pin RJ45 port	PIN	Color	Description
	1	White/Orange	N/A
	2	Orange	N/A
	3	White/Green	N/A
	4	Blue	U interface
	5	White/Blue	U interface
	6	Green	N/A
	7	White/Brown	-48VDC Power (optional)
	8	Brown	-48VDC Return (optional)

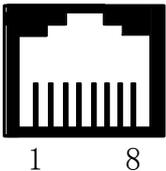
The U-Interface is most commonly used in North American Basic Rate ISDN systems. The U-Interface is an 8-conductor, modular, RJ-45 jack.

The center two pins (pin 4 and 5) are used for the 2-wire loop. The wiring of pin 4 and pin 5 **are not** polarity sensitive (e.g. 4 and 5 may be crossed).

Optional -48 VDC power may be utilized on RJ-45 pins 7 and 8. This can be used to power the NT-1 and TE equipments if sufficient power is

available. In most cases, power is **not provided** from the telephone company.

- BRI S-Interface

8-pin RJ45 port	PIN	Color	Description
	1	White/Orange	N/A
	2	Orange	N/A
	3	White/Green	Receive+
	4	Blue	Transmit +
	5	White/Blue	Transmit -
	6	Green	Receive -
	7	White/Brown	-48VDC Power(optional)
	8	Brown	-48VDC Return (optional)

The BRI S-Interface is a 4-wire interface, with separate Transmit and Receive pairs. It can be operated in four modes:

- Point-to-Point Mode allows one logical terminal that may be up to 1 KM from the NT-1
- Short Passive Bus Mode allows connection of up to 8 terminals in parallel on the S/T bus. The terminals can be within 100 to 200 meters from the NT-1.

- Extended Passive Bus Mode allows connection to 8 terminals at distances of up to 500 meters from the NT-1.
- Star Bus Mode allows interconnection of up to 8 terminals to a central NT-1. Each terminal can be up to 1 KM from the NT-1.
 - ✧ The NT-1 unit has configurable jumpers to apply a 100-ohm termination to the S-Interface signal pairs. Usually, these jumpers will be in. Rules of termination is similar to that of the SCSI-bus: the NT-1 will have 100-ohm terminators applied, and the farthest TE1/TA device will have 100-ohm terminators.
 - ✧ Optional power to the NT-1 can be applied from pins 7 and 8 of the S-Interface RJ-45 jack. This is usually not used.
 - ✧ Many NT-1 units provide "phantom-power" (sealing current) between the transmit (4,5) and receive (3,6) leads. In these cases, the Transmit (4,5) leads will be negative with respect to the Receive (3,6) leads. This is often selectable in the NT-1.

Whenever possible, it is recommended that this option be disabled.

As a general rule-of-thumb, most PC cards, routers, and other data communications equipment do not require power from the S/T interface. ISDN telephones usually require power from the S/T interface.
 - ✧ Most NT-1 units will ship with a wall-mount transformer power supply for the NT-1.