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User Manual Rev. 2.0

2 Port ISDN Simulator

2 Port ISDN Simulator
P/N: BRI-2ST, BRI-2UST

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Chapter 1:   Important Information

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Important Safeguards

Read and understand the following instructions before using the system:

Close supervision is necessary when the system is used by or near children. Do not leave unattended while in use.
Always disconnect the system from power before cleaning and servicing and when not in use.
Do not spray liquids directly onto the system when cleaning. Always apply the liquid first to a static free cloth.
Do not place this product onto unstable desk, cart or table. The product may fall causing serious damage to the product.
Do not immerse the system in any liquid or place any liquids on it.
Do not disassemble this system (except as instructed in the manufacturer's instructions). To reduce the risk of shock and to maintain the warranty on the system, a qualified technician must perform service or repair work.
Connect this appliance to a grounded outlet.
Connect the system only to surge protected power outlets.
Keep ventilation openings free of any obstructions.

Unplug this product from the wall outlet and refer servicing to qualified service personnel under the following conditions:

1. When the power supply adapter or plug is damaged or frayed.

2. If liquid has been spilled into the product.

3. If the product has been exposed to rain or water.

8. If the product has been dropped or the enclosure has been damaged.

9. If the product exhibits a distinct change in performance.

SAVE THESE INSTRUCTIONS

Regulatory Compliance

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference in which case the user will be required to correct the interference at his own expense.

Chapter 2: Introduction

ISDN Simulator is a two port ISDN switch which was designed to ease testing, demonstration and development of ISDN Basic Rate CPE (TE) equipment. It simulates two ISDN BRI lines reducing installation and monthly charges from Telephone Company and provides full featured BRI lines for Voice, Data and Video communications.
ISDN simulator is equipped with "U" (2 wire) and "S/T" (4 wire) interfaces, allowing to connect two devices with either interface type, including mixed connection between "U" and "S/T" interfaces.

Unpacking

Carefully unpack the items in the shipping box and verify that you have received the following:

1. ISDN Simulator unit
2. Wall mount power adapter
3. ISDN Manager Configuration Diskette
4. DB9F-DB9M 6-ft RS-232 cable for connection to a PC.

Fast Start for Advanced Users

1. Plug the power adapter into a 120 VAC outlet, and connect the DC power cable to the power jack on your simulator.

2. Make the physical connection(s) between the device(s) for which you want ISDN connections with the ISDN simulator.

3. Connect the terminal port to a terminal, or a PC with a terminal emulator.

4. Issue commands or use ISDN Manager GUI interface to configure the switch type that you need to simulate, and any options appropriate for that switch type.

About your ISDN Simulator

Virtual Console's ISDN simulator is a two port ISDN switch that provides call switching services for Basic Rate Interface (BRI) terminal equipment. All our ISDN simulators conform to the ISDN architecture and to individually programmable switch types (Table 1). Our products are extensively used with Cisco equipment and are tested for compatibility with most of the ISDN-capable Cisco routers, including the 1600, 1700, 2500, 2600 and 3600 series.

Table 1: Switch Types Emulated

Switch Type	Cisco configuration command	SPID required
National ISDN-1	isdn switch-type basic-ni1	Yes
NET3	isdn switch-type basic-net3	No
AT&T 5ESS	isdn switch-type basic-5ess	Optional
Nortel DMS-100	isdn switch-type basic-dms100	Yes

Figure 1: ISDN Functional Architecture
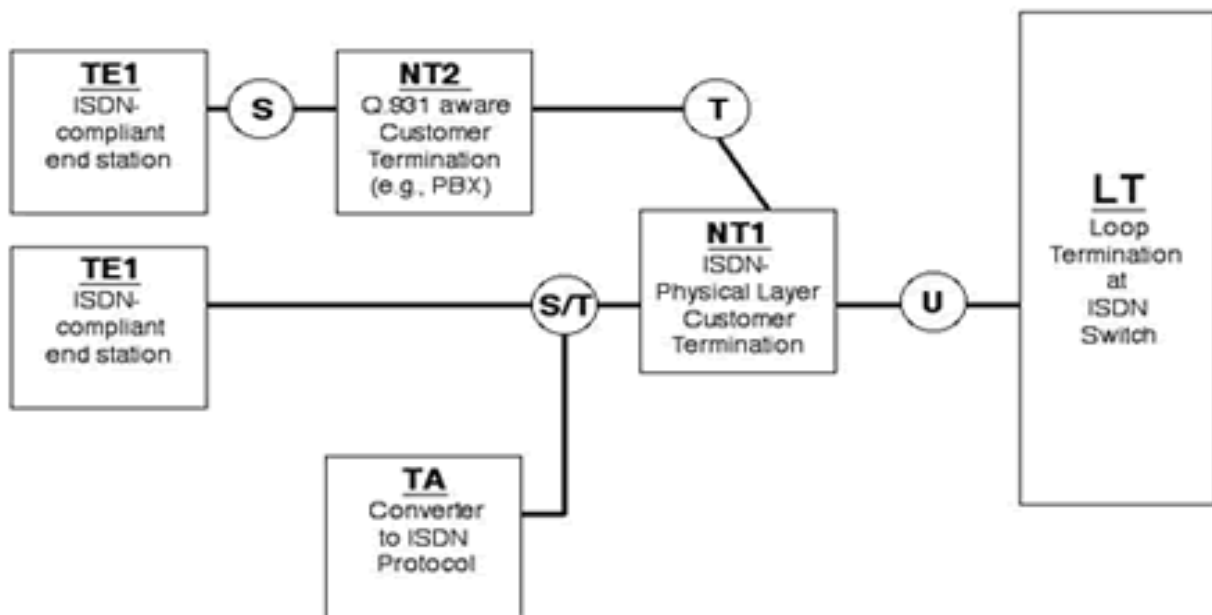
The ISDN simulator appears to the customer-side Functional Groupings as the Loop Termination (LT) at the telephone central office. These Functional Groupings, examples of which are shown in, include ISDN-compliant Terminal Equipment (TE1), Network Terminations (NT1 and NT1) and Terminal Adapters (TA).

To a TE1 or TA, the simulator provides the S/T interface. To an NT1, it provides the U interface. Over these physical interfaces (Figure 2) flow the protocols described in Figure 3.
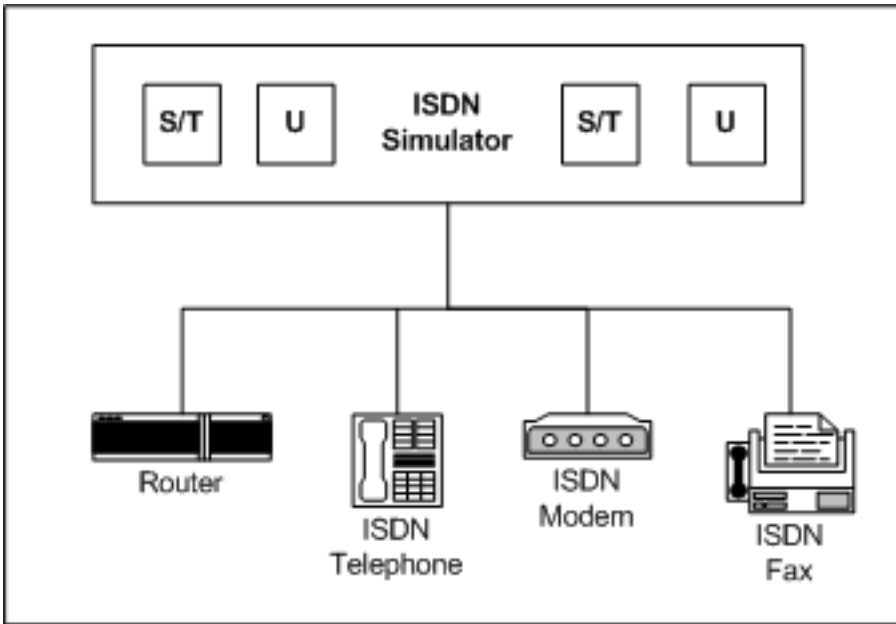
Figure 3: ISDN Protocol Stack

While Q.931, the ISDN primary "dialing" protocol, usually is used to set up dynamic ISDN calls, ISDN simulator also supports semi-permanent "nailed up" B channels that act like private leased lines.


Signaling for the D Channel

Before you configure signaling, you must have set the switch type. Once that is done, you will always need to set the phone numbers (i.e., DN) and, if the configured switch type requires it, the SPIDs.

"Caller ID", or, in formal ISDN terminology, "calling number identification presentation", is always enabled.

Chapter 3: Product Description

The Virtual Consoles ISDN simulator provides a "telco in a box" for a variety of device testing scenarios.

Figure 4: Functional Applications of the Virtual Console Simulator
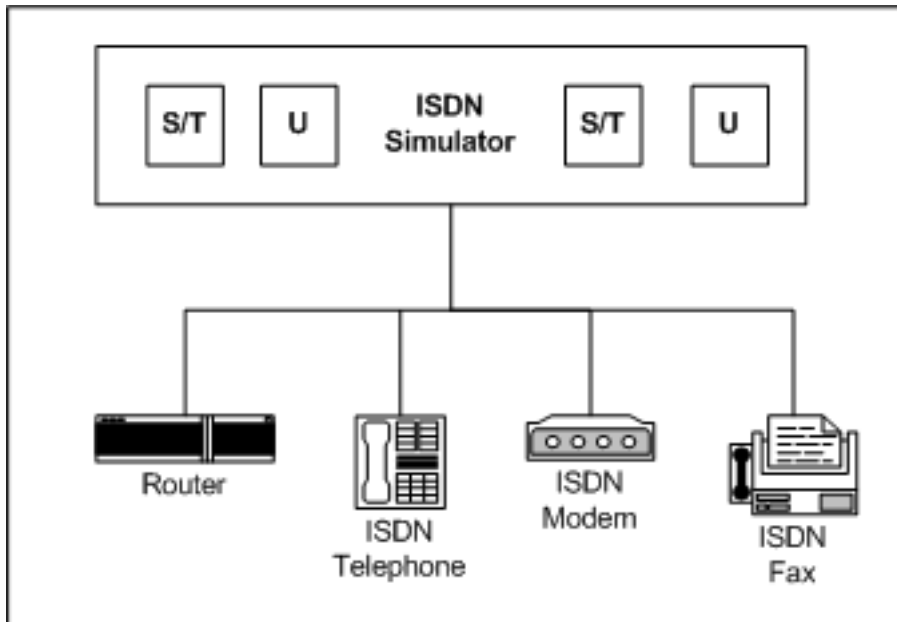
The device has the most common connectors and indicators on its front panel. In a rack installation with routers, you would typically want the front panel on the same side as the router interface connectors. Less frequently used connectors and switches are on the back. Do note that the "Reboot" button function can be invoked remotely through the ISDN Manager interface.

Figure 5: Front and Rear Views of the ISDN Simulator
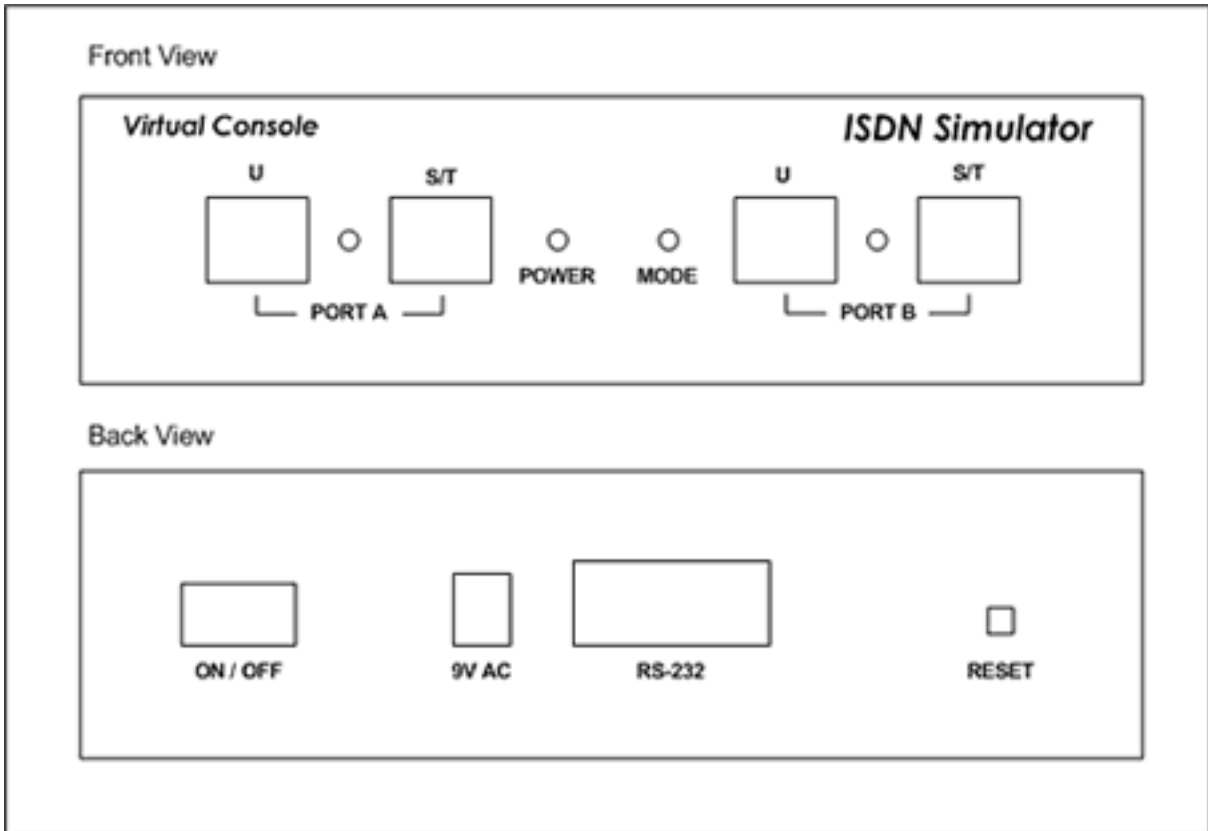
Ports / Interfaces

There are both S/T and U interfaces for each port of the simulator, but only one interface type can be active for each port. Again, remember that a TE1 or TA device plugs into the S/T interface jack, while a NT device plugs into the U interface jack.

Figure 6: Connectivity Options
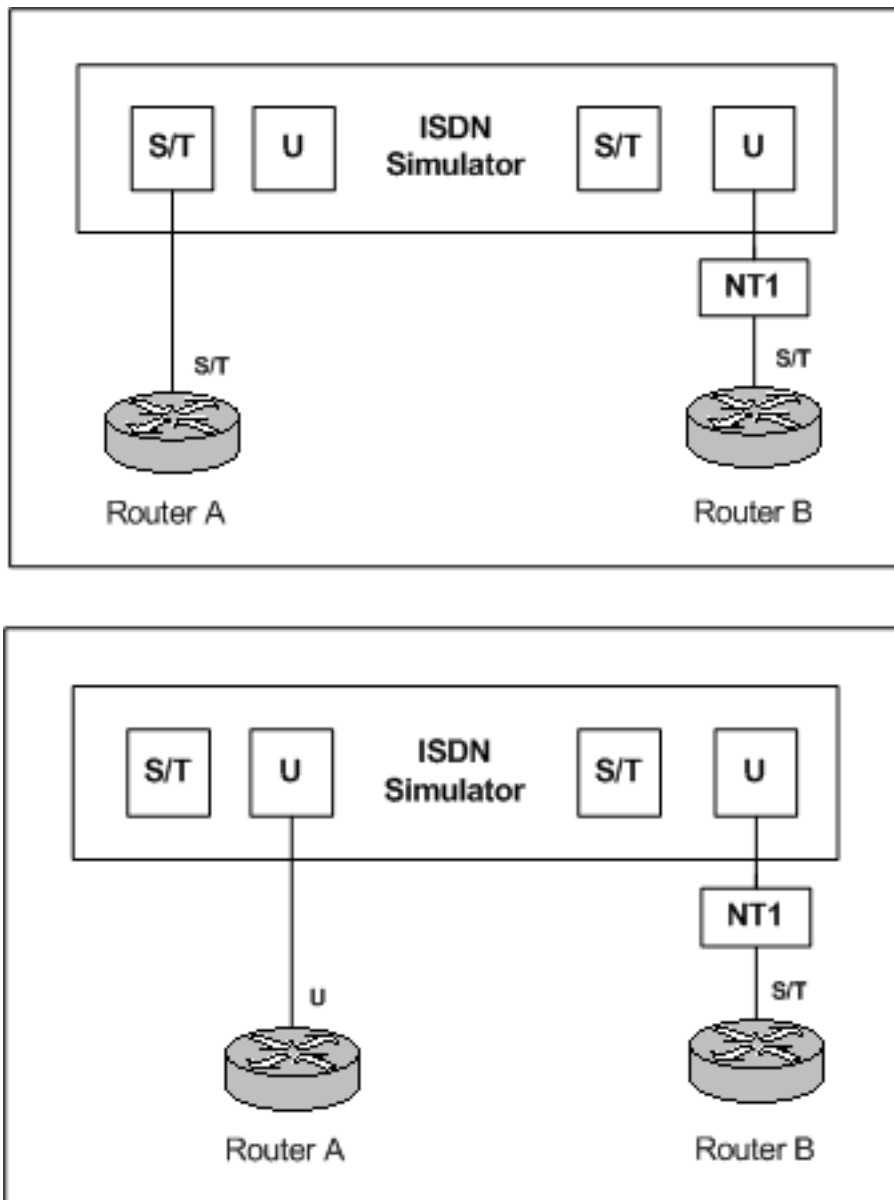
Power

ISDN Console simulator is powered from a 9 DC or AC, 500 mA supply that plugs into a standard 120 VAC household outlet. Equivalent supplies are available if you need to use the device in a country with 220 VAC. The power supply may be slightly warm when operating.

The simulator does not provide inline power to connected ISDN devices. They will need independent power sources.

Cabling

Straight-through RS-232 cable with DB9 connectors is supplied with each ISDN Simulator for the ISDN Manager or console management. To connect ISDN devices to the simulator, also use a straight-through CAT3 or CAT5 cable with RJ45 connectors.

Controls

A hardware Reset button is on the back panel of the ISDN Simulator. You can also Reboot ISDN Simulator remotely using ISDN Manager or AT commands sent via console port.

LEDs

Your simulator has four status LEDs (Table 2), numbered from left to right. Two are global to the simulator and two are specific for ports.

Table 2: LED Definitions

LED number	Function
1	Port A Status
2	Power Indicator
3	Device Mode
4	Port B Status

LED status indications are the fastest way to tell the status of the device.

Table 3: Interpreting the ISDN Simulator LEDs

LED Color	LED 1 & 4 (Port)	LED 2 (Power)	LED 3 (Mode)
Off	No connection	No power	No Calls in Progress or established
Red	Physical handshaking on the U interface	Hardware Failure	N/A
Yellow	Physical link established, data link not active	N/A	Call negotiation in progress
Green	Data link active	Power ON	Call in progress
Blinking green	SPID received, not matching	N/A	N/A
Green / Red	N/A	N/A	Data transfer in progress

Chapter 4: Configuring ISDN Simulator

Your simulator is controlled by ISDN Manager Win32 application. We recommend that you use ISDN Manager, which provides a graphic interface with several convenient click buttons. In test racks, you may find it more convenient to control the simulator with a reverse Telnet server by issuing AT-style configuration commands.

Configuring the ISDN Simulator with ISDN Manager

Virtual Console's ISDN Manager is the principal means of configuring and controlling ISDN simulators. It is a Windows application supported for Windows 2000 and Windows XP. ISDN Manager application is provided with each ISDN simulator or can be downloaded from
http://www.vconsole.com/client/?page=software

Figure 7: ISDN Manager Screens
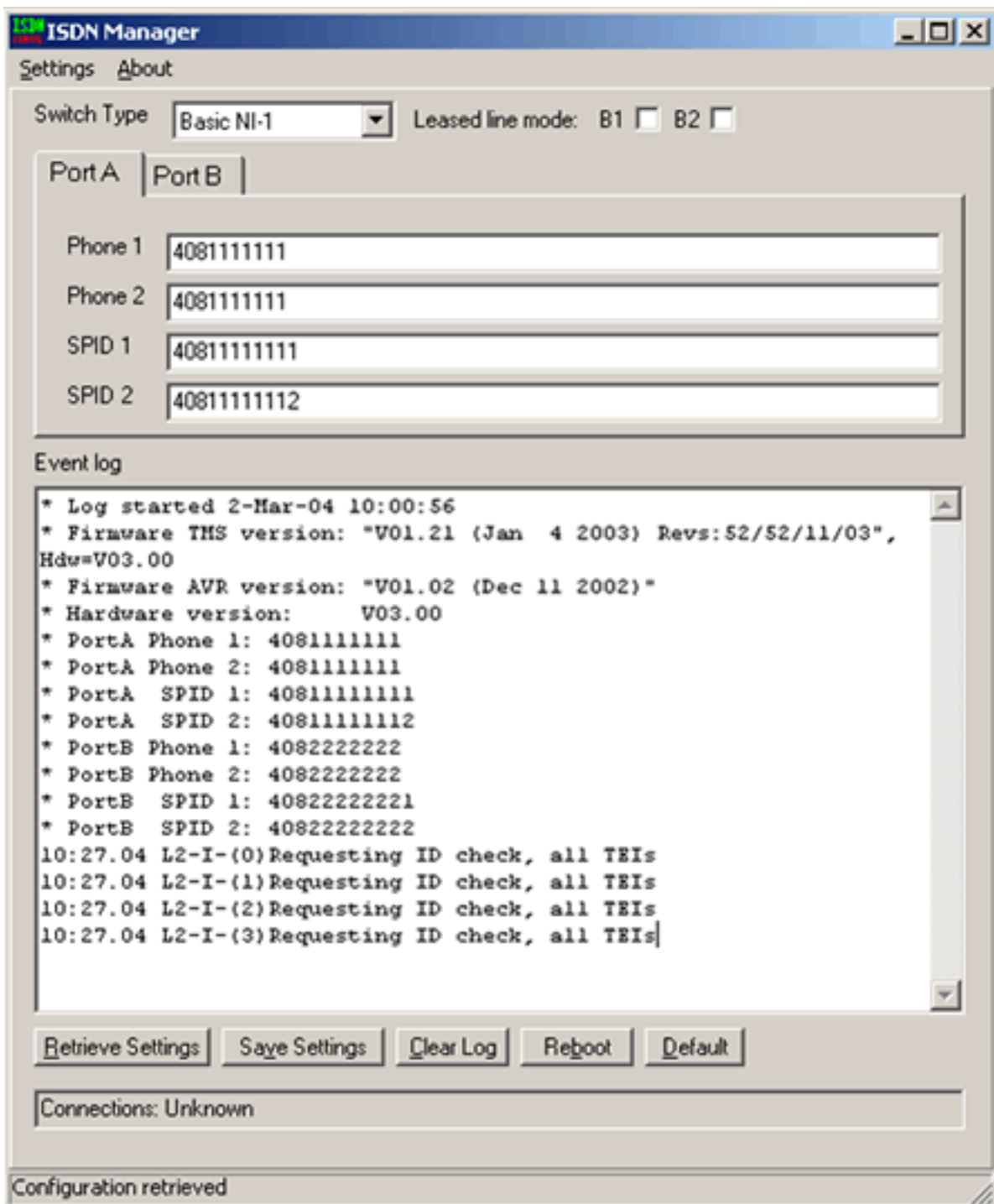
When you bring up ISDN Manager, you can set the appropriate COM port for it to communicate with the simulator with the settings" tab (Figure 8). The "gather low-level diagnostics" is used only when working with the technical support.

Figure 8: Setting the COM port for ISDN Manager
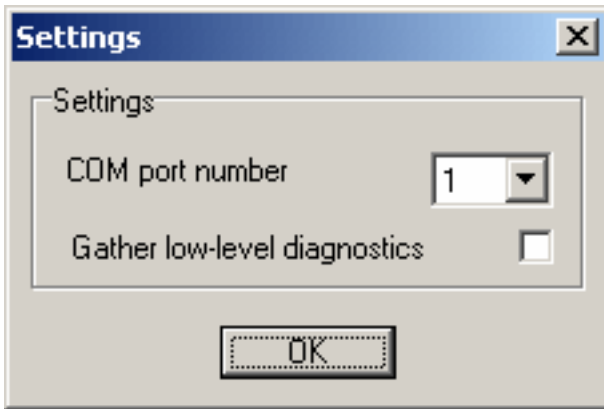
Your PC COM port must be configured with the settings in Table 4

Table 4: COM port settings for ISDN Manager

Parameter	Value
Baud rate	115200 bps
Data bits	8
Parity	None
Stop bits	1
Flow Control	Hardware

Once you are in communications with the ISDN simulator, you can click the "About" tab to check firmware and software versions (Figure 9).   See "Upgrading Firmware" for the upgrade procedure, which will give you a new version of the TMS code. The AVR and Hardware fields in the figure are for factory use.

Figure 9: Version information from ISDN Manager "About" tab
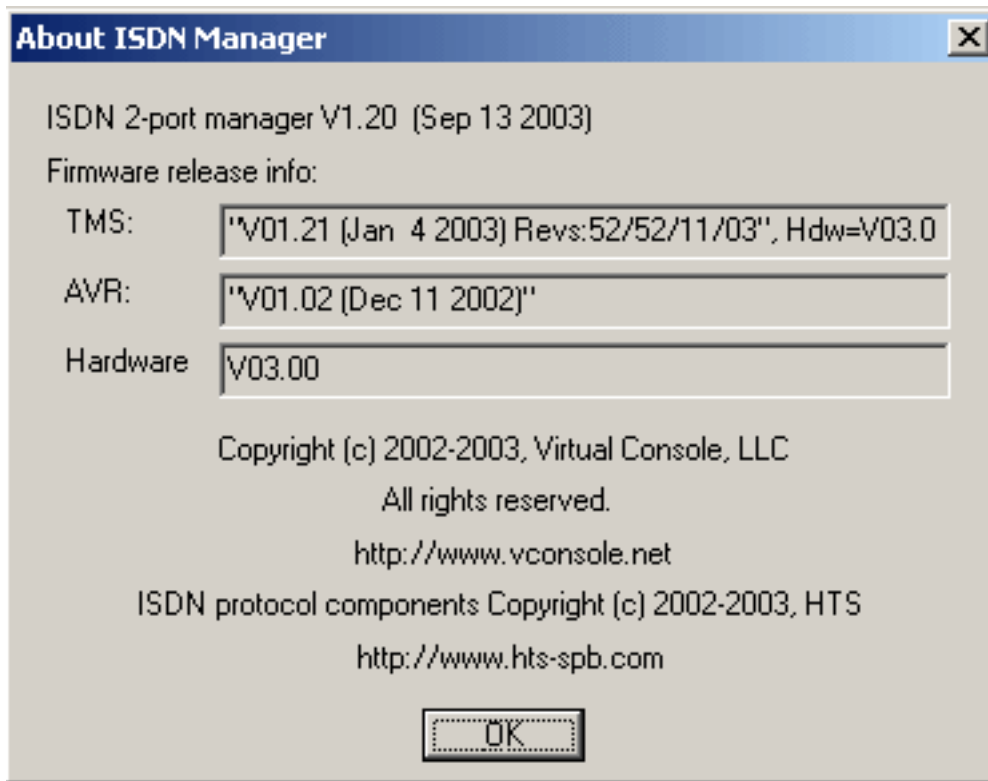
On the main screen, you set the "switch-type" (see Table 1).

To set individual port characteristics, click on the appropriate "Port" tab. The screen will then show the current phone number and, when applicable, SPID settings (see Table 7) for each B channel on the port. You can then set the values as required.

If you need to configure a B channel in "nailed up", "semi-permanent", or "dedicated line" mode, check the appropriate box at the top of the ISDN Manager screen.

Configuring ISDN Simulator via Terminal Server

Many test environments control all devices from a single point, using a reverse Telnet server to connect to all devices at a remote site. You can control the ISDN simulator in this manner. You must set the asynchronous interface on the reverse Telnet server to the values in Table 5, and send the codes in Table 6.

Table 5: Interface Settings for Reverse Telnet

Parameter	Value
Baud rate	115200 bps
Data bits	8
Parity	None
Stop bits	1
Flow Control	Hardware

From a terminal server, since you cannot press display buttons, modem-style AT commands must be issued for all functions.

Table 6: Configuring the ISDN Simulator via Terminal Interface

Function	Command Example
Reboot	ATZ
Save current configuration	AT&W
Display firmware version	ATI7
Assign Phone 1 for port A	ATN0="1234567"
Assign Phone 2 for port A	ATN4="1234567"
Assign SPID1 for port A	ATP0="1234567"
Assign SPID2 for port A	ATP4="1234567"
Assign Phone 1 for port B	ATN1="1234567"
Assign Phone 2 for port B	ATN5="1234567"
Assign SPID1 for port B	ATP1="1234567"
Assign SPID2 for port B	ATP5="1234567"

SPID assignments

Some ISDN switches, or provider implementations of switches, require Service Provider Identifiers (SPID). You need to know the type required for your reference configuration, and, if you are using a Cisco device, the Cisco device must be configured to match the switch being simulated.

You can use any SPID numbering scheme that matches your requirement. We support three types of SPID numbering (Table 7). Whenever you change the SPID, reboot the simulator and preferably the TE device.

Table 7: SPID Formats

SPID format	Switch type	Comment
All SPIDs are "0" Matches any SPID on the TE side	Supported by NI-1, DMS-100, 5ESS	Troubleshooting use
All SPID are empty	Supported by NET3 only	Standard
Any sequence of 40 digits.	Supported by NI-1, DMS-100, 5ESS	Standard

Upgrading Firmware

Virtual Consoles will periodically publish software upgrades. Check the website for new versions of the upgradable TMS file shown in Figure 9. When you download new firmware, check if there is a newer version of ISDN Manager and upgrade that as well.

Clicking the "upgrade" tab for your product will download a ZIP file containing three files (Table 8). XLOAD is the actual loader.

Table 8: Firmware Upgrade

File	Function & comments
XLOAD.EXE	Firmware loader
XXXXX.XMD	Firmware, where XXXXXX is a platform specific designation.
DEV.CFG	Device default configuration file

To load new firmware with the XLOAD program, connect a COM port of a PC to the console port of the simulator. The XLOAD program must have exclusive use of the COM port; no other application may use it while the upgrade program is running.

Example:
XLOAD.EXE P2US.XMD /Com:1 /Cfg:DEV.CFG

at the Windows DOS command prompt. In this example, the Virtual Console device is connected to COM1 port and loads the default settings from the DEV.CFG file.

Chapter 5: ISDN Simulator and Cisco Routers

Since many simulator users intend to use their product with Cisco routers, we will illustrate practical setup and troubleshooting with Cisco examples. The simulator supports physical connectivity for the two Basic Rate Interface types, the S/T Reference Point used inside customer premises, and the U Reference Point between the customer premises and the provider end office.

A good starting point is to remember that the isdn switch-type configured, as a global command in the router, must match one of the types in Table 1 if you are to have any success in operations.

Obviously, you can look at the Cisco configuration for switch-type commands, but, in a lengthy configuration, it can sometimes be hard to find the right line.

An alternative is to use the "show isdn status" command. This is a good command to check for success at each successive stage of configuration: global, layer 1, layer 2 and layer 3. The switch type is set globally for the entire router. Layer 1

Figure 10 for an example of "show isdn status" output before the switch type is set.

Layer 1

Figure 10: Show ISDN Status with undefined Switch Type

Router#sh isdn stat
 **** No ISDN Switchtype currently defined ****
ISDN BRI0 interface
   Layer 1 Status:
    DEACTIVATED
   Layer 2 Status:
     Layer 2 NOT Activated
   Layer 3 Status:
     0 Active Layer 3 Call(s)
   Activated dsl 0 CCBs = 0
   The Free Channel Mask: 0x80000003
 Total Allocated ISDN CCBs = 0

Once you have the switch type defined, you should see the Yellow LED light and the following output from the show isdn status command.

Figure 11: Cisco display for active physical layer

Router#sh isdn stat
The current ISDN Switchtype = basic-ni1
ISDN BRI0 interface
 Layer 1 Status:
  ACTIVE

Spid Status:
  TEI Not Assigned, ces = 1, state = 1(terminal down)
   spid1 configured, spid1 NOT sent, spid1 NOT valid
  TEI Not Assigned, ces = 2, state = 1(terminal down)
   spid2 configured, spid2 NOT sent, spid2 NOT valid
 Layer 3 Status:
  0 Active Layer 3 Call(s)
 Activated dsl 0 CCBs = 0

See Table 9 for other possible states following setting the switch type.

Table 9: Cisco Layer 1 States

Layer 1 Status	General Meaning
DEACTIVATED	No Layer 1 connection has been established
ACTIVE	A Layer 1 connection is up and running
GOING DOWN	Normally a transient state. If it persists, try a clear interface BRI number command. If it still persists, check cabling, then reload the router and the simulator
INIT	
TESTING	
REBOOT	
DELEATED (sic)	
SHUTDOWN	
ACTIVATING	
ACTIVE_ErrorInd	

Layer 2

 After TEI negotiation is complete, you will see a Cisco display like that in Figure 12.

Figure 12: Status display after Layer 2 Initialization

Router#show isdn status
The current ISDN Switchtype = basic-ni1
ISDN BRI0 interface
     Layer 1 Status:

```
        ACTIVE
    Layer 2 Status:
         TEI = 64, SAPI = 0, State = MULTIPLE_FRAME_ESTABLISHED
                 TEI = 66, SAPI = 1, State = MULTIPLE_FRAME_ESTABLISHED

    Layer 3 Status:
         0 Active Layer 3 calls
Activated dsl 0 CCBs = 0
Total Allocated ISDN CCBs = 0
```

While the Virtual Console simulator will stay up, some DMS implementations may shut down ISDN layer 1 or 2 if there are no active calls. With the actual switch, rather than the simulator, it may be necessary to dial out, or arrange to receive a call, for the lower layers to activate.

In operation with the real switch, rather than the simulator, if you are operating in DMS mode and the switch is implemented in this manner, you may need to configure the Cisco interface subcommand

"isdn tei-negotiation first-call" This is most commonly seen in European switch implementations where the switch initiates TEI negotiation as part of power-up handshaking.

Troubleshooting

Be systematic in your troubleshooting, from the environmental and then bottom-up from layer 1 upwards.

Environmental

Table 10: Symptoms and Recommended Actions

Power LED (2) does not light	Check power cabling, and the power supply. Verify the outlet has power
Port LED (1 or 4) does not light	1. Check power LED. If it is OFF, check power cabling, and the power supply 2. Check that the NT or TE are enabled 3. Check device cabling. Verify interface type. 3. Try the other port. If the other LED does not light, contact technical support

Layer 1 Troubleshooting with Cisco routers

If the connected router fails to enter the ACTIVE state, as shown in Figure 13, you will need to troubleshoot.

Figure 13: Show isdn status output immediately after setting the switch type

Router#show isdn status
The current ISDN Switchtype = basic-ni1
ISDN BRI0 interface
    Layer 1 Status:
        ACTIVE
    Layer 2 Status:
        TEI = 64, SAPI = 0, State = **TEI_ASSIGNED**
    Layer 3 Status:
        0 Active Layer 3 calls
Activated dsl 0 CCBs = 0
Total Allocated ISDN CCBs = 0

Try the following troubleshooting steps:

1. Verify the switch types are set and consistent. If you change from the current settings, reboot the simulator and preferably the router.

2. Issue a "**shutdown"** followed by a "**no shutdown"** command

3. Issue a "**clear interface bri number"** command.

4. Reboot the router.

5. Check that the BRI interface does not have a "**backup interface"** subcommand; remove it if present.

6. Be sure that the physical interface (i.e., S/T or U) on the device under test matches the Simulator jack to which it is connected. On a Cisco router, use **"show version"** or "**show controllers"** to confirm the interface type.

Layer 2 Troubleshooting with Cisco routers

Once you have confirmed layer 2 is working but layer 2 either is down or cannot stay up, you need to debug Q.921, the layer 2 protocol used for ISDN signaling on the D channel.

Figure 14: Example of Layer 2 Debugging

router#debug isdn q921
ISDN Q921 packets debugging is on
router#conf t
r2(config)#
r2(config)#int bri 0
r2(config-if)# no shut
%LINK-3-UPDOWN: Interface BRI0, changed state to up
ISDN BR0: TX -> IDREQ ri = 33114 ai = 127
ISDN BR0: RX <- IDDENY ri = 33114 ai = 127
ISDN BR0: RX <- IDCKRQ ri = 0 ai = 127
ISDN BR0: RX <- IDCKRQ ri = 0 ai = 127
ISDN BR0: TX -> IDREQ ri = 38651 ai = 127
ISDN BR0: RX <- IDREM ri = 0 ai = 82
ISDN BR0: RX <- IDREM ri = 0 ai = 83

ISDN BR0: TX -> IDREQ ri = 1708 ai = 127
ISDN BR0: RX <- IDASSN ri = 1708 ai = 85
ISDN BR0: TX -> SABMEp sapi = 0 tei = 85
ISDN BR0: RX <- UAf sapi = 0 tei = 85
ISDN BR0: TX -> INFOc sapi = 0 tei = 85 ns = 0 nr = 0 i = 0x08007B3A0A30383335383636323031
ISDN BR0: RX <- INFOc sapi = 0 tei = 85 ns = 0 nr = 1 i = 0x08007B080382E43A
ISDN BR0: TX -> RRr sapi = 0 tei = 85 nr = 1
ISDN BR0: TX -> IDREQ ri = 29037 ai = 127
ISDN BR0: RX <- IDASSN ri = 29037 ai = 86
ISDN BR0: TX -> SABMEp sapi = 0 tei = 86
ISDN BR0: RX <- UAf sapi = 0 tei = 86
ISDN BR0: TX -> INFOc sapi = 0 tei = 86 ns = 0 nr = 0 i = 0x08007B3A0A30383335383636343031
ISDN BR0: RX <- INFOc sapi = 0 tei = 86 ns = 0 nr = 1 i = 0x08007B080382E43A
ISDN BR0: TX -> RRr sapi = 0 tei = 86 nr = 1

Layer 3 Troubleshooting with Cisco routers

One of the most important Cisco tools for debugging ISDN layer 3 problems is:

"debug isdn q931"

As with any use of debug, be careful when using it on a production router.

When you are interconnecting two routers through the Simulator, you might encounter problems because the called router is not configured correctly.

See Figure 15 for a representative "debug isdn q931" output associated with a failed call. The call is initiated by the ping to the remote router.

Figure 15: Layer 3 failure due to called router misconfiguration.

router#debug isdn q931
ISDN Q931 packets debugging is on
router#ping 192.168.0.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echoes to 192.168.0.1, timeout is 2 seconds:

ISDN BR0: TX -> SETUP pd = 8 callref = 0x10
    Bearer Capability i = 0x8890
    Channel ID i = 0x83
    Called Party Number i = 0x80, '8358661
ISDN BR0: RX <- RELEASE_COMP pd = 8 callref = 0x90
    Cause i = 0x82EF - Protocol error, unspecified
ISDN BR0: Event: incoming ces value = 1.

Chapter 6: Cisco Routers Configuration Examples

The following configurations can be used as a typical implementation of ISDN Simulator with two Cisco routers.

Basic-Net3 Switch Type Example

Note: **NET3 does not use SPID numbers**

Router 1

```
hostname R1
isdn switch-type basic-net3
!
interface BRI0
! this interface should be in the simulator Port A
no shutdown
ip address 10.10.10.1 255.255.255.0
dialer map ip 10.10.10.2 broadcast 4082222222
dialer-group 1
isdn switch-type basic-net3
!
dialer-list 1 protocol ip permit
!
end
```

Router 2

```
hostname Router2
!
isdn switch-type basic-net3

interface BRI0
! this interface should be in the simulator Port B
no shutdown
ip address 10.10.10.2 255.255.255.0
dialer map ip 10.10.10.1 broadcast 4081111111
dialer-group 1
isdn switch-type basic-net3
!
dialer-list 1 protocol ip permit
```

Basic-NI1 Switch Type Example

Note: This common switch type require SPID numbers.

Router 1

```
hostname R1
!
isdn switch-type basic-ni1
!
interface BRI0
! this interface should be in the simulator Port A
no shutdown
isdn spid1 408111111101
isdn spid2 408111111102
ip address 10.10.10.1 255.255.255.0
dialer map ip 10.10.10.2 broadcast 4082222222
dialer-group 1
isdn switch-type basic-ni1
!
dialer-list 1 protocol ip permit
!
end
```

Router 2

```
hostname Router2
!
isdn switch-type basic-ni1
!
!
interface BRI0
! this interface should be in the simulator Port B
no shutdown
isdn spid1 408222222201
isdn spid2 408222222202
ip address 10.10.10.2 255.255.255.0
dialer map ip 10.10.10.1 broadcast 4081111111
dialer-group 1
isdn switch-type basic-ni1
!
dialer-list 1 protocol ip permit
```

Chapter 7: Specifications

Power Adapter:	**Input: 110/220 VAC Output: 9 VDC, 600mA. 2.5mm jack**
U Interface:	**RJ-45, 8-pin modular jack**
U Interface protocol:	**2B1Q (2 Binary 1 Quaternary)**
S/T Interface:	**RJ-45, 8-pin modular jack**
S/T Interface protocol:	**ASI (Alternate Space Inversion)**
Maximum cable drop:	**1600 meters (U Interface), 100 meters (S/T interface)**
RS-232 Interface:	**DB-9 Female**
Storage Temperature:	**-40 to +55C**
Operating Temperature:	**0 to 50 C**
Humidity Max:	**75%**
Dimensions:	**1.5"H x 5"D x 7"W**
Weight:	**1 lb (500g)**