ZyXEL Limited Warranty

ZyXEL warrants to the original end user (purchaser) that this product is free from any defects in materials or workmanship for a period of up to five (5) years from the date of purchase. During the warranty period, and upon proof of purchase, should the product have indications of failure due to faulty workmanship and/or materials, ZyXEL will, at its option, repair or replace the defective products or components without charge for either parts or labor, and to whatever extent it shall deem necessary to restore the product or components to proper operating condition. Any replacement will consist of a new or remanufactured functionally equivalent product of equal value, and will be solely at the option of ZyXEL. This warranty shall not apply if the product is modified, misused, tampered with, damaged by an act of God, or subjected to abnormal working conditions.

Note: Repair or replacement, as provided under this warranty, is the exclusive remedy of the purchaser. This warranty is in lieu of all other warranties, express or implied, including any implied warranty of merchantability or fitness for a particular use or purpose. ZyXEL shall in no event be held liable for indirect or consequential damages of any kind or character to the purchaser.

To obtain the services of this warranty, please contact ZyXEL's Service Center, refer to the separate Warranty Card for your Return Material Authorization number (RMA). Products must be returned Postage Prepaid. It is recommended that the unit be insured when shipped. Any returned products without proof of purchase or those with an out-dated warranty will be repaired or replaced (at the option of ZyXEL) and the customer will be billed for parts and labor. All repaired or replaced products will be shipped by ZyXEL to the corresponding return address, Postage Paid (USA and territories only). If the customer desires some other return destination beyond U.S. borders, the customer shall bear the cost of the return shipment. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

FCC Part 15 Information

This device complies with Part 15 of FCC rules. Operation is subject to the following two conditions:

1) This device may not cause harmful interference.

2) This device must accept any interference received, including interference that may cause undesired operations.

This equipment has been tested and found to comply with the limits for a CLASS B digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy, and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio/television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and the receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. Shielded RS-232 cables are required to be used to ensure compliance with FCC Part 15, and it is the responsibility of the user to provide and use shielded RS-232 cables.

Elite 2864I: FCC ID# I88Elite2864I

The Industry Canada (IC, formerly DOC) label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational, and safety requirements. IC does not guarantee that the equipment will operate to a user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension card). The customer should be aware that the compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

For their own protection, users should ensure that the electrical ground connections of the power utility, telephone lines, and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electrical inspection authority, or electrician, as appropriate.

The Load Number (LN) assigned to each terminal device denotes the percentage of the total load to be connected to the telephone loop used by the device without overloading. The termination on a loop may consist of any combination of devices, subject only to the requirement that the total of the Load Numbers of all the devices not exceed 100.

This digital apparatus does not exceed the class B limits for radio noise emissions from digital apparatus set out in the radio interference regulations of Industry Canada (formerly Canadian DOC).

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Chapter 1

Introduction To ISDN

If you are already familiar with ISDN, you may skip this chapter.

ISDN, or Integrated Services Digital Network, is a global system that provides a variety of high speed digital communication solutions, while maintaining the compatibility of the existing analog voice, modem, data and fax communication protocols.

ISDN is based on various standards that define communications between switches and the equipment that connects to them. These standards allow most types of equipment to communicate across different types of switches in every part of the world.

The implementation of "network switches" by telephone companies differs from country to country. We will focus our discussions on the North American continent. If you plan to use the Elite 2864I in an area other than North America, please contact ZyXEL's local distributor for specific documentation and firmware upgrades to ensure proper operation of the ZyXEL Elite 2864I with your local ISDN switch and network.

In North America, a separate ISDN standard called National ISDN (NI-1) is currently being adopted by network providers and equipment manufacturers. When fully deployed, NI-1 will make the installation of ISDN equipment much easier. Currently, many different types of custom signaling protocols are used. Therefore, you will need to configure your ZyXEL Elite 2864I for the type of signaling that is used by the network it is connected to.

Basic Rate Interface (BRI)

When you order a Basic Rate Interface (BRI) ISDN line, you receive what is known as the 2B+D service. This provides two B channels that can transmit at 64Kbps per channel and a D channel that can transmit at 16Kbps. The B channels generally transmit data while the D channel monitors and controls the transmission or network signals.

The D channel is used to manage communication between the equipment and the switch. It is used mainly to exchange signal messages with the switch, setting up calls and releasing calls. In most cases, if there is any incompatibility issue raised, it is the D channel signaling protocol that is causing the problem. Currently, the Elite 2864I does not allow the user to utilize the D channel to send and receive data.

Out-of-band signaling - Some switches transmit all the network signals through the D channel, allowing both B channels to be used exclusively for your communication. This allows a throughput of 128Kbps (64Kbps per channel). However, not all switches support out-of-band signaling at this time. For the switches that do not support out-of-band signaling, network signals are transmitted through the B-channels only, which reduces the bandwidth to 56Kbps. This happens most frequently when you are making a call across different types of switches.

The Elite 2864I currently supports the following switch types and D-channel protocols:

❖   AT&T 5ESS Custol and National ISDN-1 protocol

❖   Northern Telecom DMS-100 Customl and National ISDN-1 protocol

❖   Siemens EWSD

In the following section, you will learn how to configure your Elite 2864I to work with each one of these switches. We will also provide you with the information you will need when ordering your ISDN line for the Elite 2864I.

Rate Adaptation

The ZyXEL Elite 2864I modem currently supports the following rate adaptation protocols:

❖   V.120

❖   X.75

❖   V.110

The B channels are used for carrying user communication information. This information could be data, voice or fax. Voice and analog data must be sent on the B channels. Unlike the asynchronous communications between most PC computers and your Elite 2864I, the B channel operates in synchronous mode. In order to convert the asynchronous communication to synchronous communication, it is necessary to use a rate adaptation protocol.

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In North America, V.120 is the most popular rate adaptation protocol used. V.120 is an ITU-T protocol that supports synchronous and asynchronous rate adaptation and provides link-layer error control. ZyXEL also implements V.42bis data compression and/or channel bundling on top of V.120, allowing the user to achieve even higher data communication throughput. Channel bundling combines two B channel's bandwidth for one communication session. This combination establishes a 128Kbps or 112Kbps communication link.

The Elite 2864I also supports HDLC asynchronous to synchronous conversion for Point-to-Point Protocol (PPP) and Serial Line Internet Protocol (SLIP). These protocols are very popular for Internet access and Remote Access applications.

X.75, V.110 and CAPI (Common ISDN API) are also supported.

Currently, most of us still use Plain Old Telephone Service (POTS) for our regular communication needs. The ZyXEL Elite 2864I provides a POTS port for you to connect regular analog devices. This lets you continue to use analog communications. You can connect phones, fax machines, or modems to the POTS port, while using one of the idle B channels (even if the Elite 2864I is busy doing data communications). The POTS port is fully functional, with one limitation, which we will cover in the analog adapter section.

The ZyXEL Elite 2864I comes equipped with a built-in V.34 (28,800bps) modem and V.17 (14,400bps) fax function. This allows you to use one of the B channels to communicate with remote modems or with remote fax machines.

Terminal Adapter

A Terminal Adapter (TA) allows users to send and receive data over the ISDN network. The Elite 2864I is more than a Terminal Adapter. With the Elite, users can send and receive both data and voice simultaneously by using both B channels. The analog adaptor in the Elite 2864I allows users to connect an analog device to the TA to make out-going calls as well as receive in-coming calls. With its auto detect feature, the Elite 2864I monitors incoming calls from both analog or digital devices. It monitors these calls without user intervention and makes connections accordingly.

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For example, you can set up the 2864I to receive analog calls via the built-in V.34 modem/fax or route the calls to the POTS port allowing your analog device to receive the call.
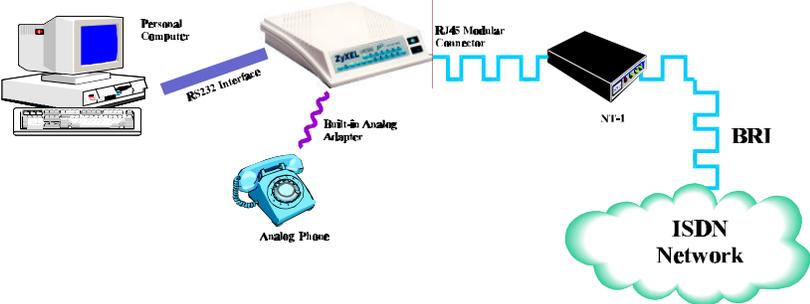
Figure 1-2

The Elite 2864I, with the NT-1 optional adapter, offers the ability to transmit data and voice through digital devices, such as an ISDN phone.
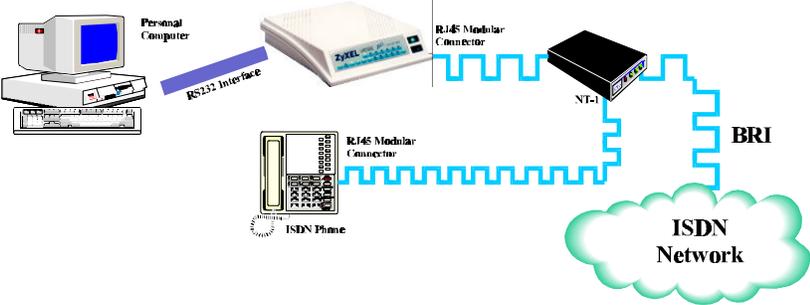
Figure 1-1

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The Elite 2864I comes with two different types of interfaces:

❖   The Elite 2864I-S/T comes with a S/T interface

❖   The Elite 2864I-U comes with a U interface

You can connect Elite 2864I-U direct to the ISDN jack installed by the phone company. Elite 2864I-S/T requires an NT-1 interface in between. The following section explains this in detail.

ISDN Basic Rate Interface Points

In the interest of supporting deregulated Customer Premises Equipment (CPE), the Exchange Carrier Standard Association in the United States established a basic rate transmission standard for CPE. Standards are defined for equipment to connect to different reference points of the ISDN link. Some of these reference points are S, T, and U. They have very specific definitions and provide standard interfaces for equipment connected to them. The following diagram shows these interface points.
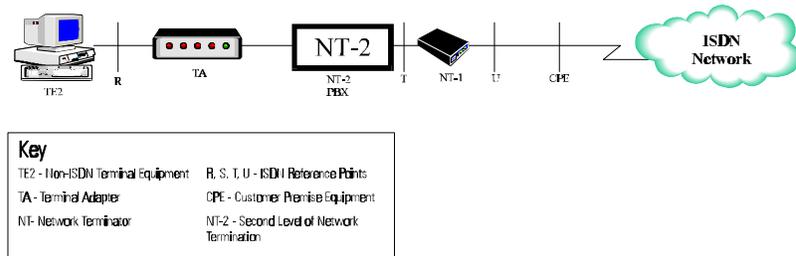
Figure 1-3
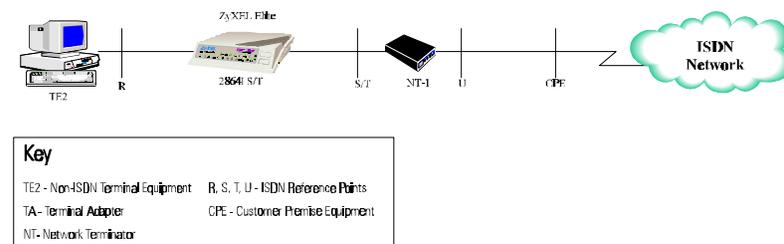
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 Not all the interfaces must exist in actual implementations. For example, not all the houses are equipped with a PBX (NT2), in this case, the U interface is provided by the NT-1. The ZyXEL Elite 2864I-S/T connects to the NT-1.

An ISDN terminal adapter could be constructed with the functionality of a NT-1. In this case, the terminal adapter will connect directly to the U-interface. The Elite 2864I-U lets you connect directly to a U-interface without a NT-1 equipment which sometimes could be quite expensive:
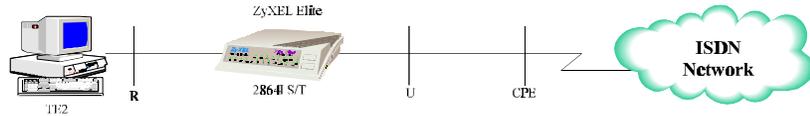
Figure 1-5

Elite 2864I

Automatic Protocol Detection

In the previous section, we have explained that the ISDN B channel can support all different types communications protocols. In the ISDN data communication, the user information could be:

- ❖ V.120
- ❖ HDLC PPP or SLIP
- ❖ X.75
- ❖ X.75 with CAPI
- ❖ V.110

For analog communication, the user information could be:

- ❖ V.34 data
- ❖ V.17 fax
- ❖ Voice

The ZyXEL Elite 2864I has the ability to handle almost all of the various types of ISDN data information and almost all of the different types of analog data communication information. However, the Elite 2864I might not be able to detect the exact protocol used in the incoming call.

For example, the Elite 2864I is able to tell the difference between a V.120 ISDN call and an V.110 ISDN call. But it is not able to tell the difference between a V.120 ISDN call and a HDLC PPP or HDLC SLIP ISDN call.

The ZyXEL Elite 2864I can distinguish between an ISDN call and an analog call. But it is unable to detect whether an analog call originates from a modem, fax or voice line before it picks up the call. You have a couple of options as to how you want the Elite 2864I to route your call. You can have the Elite 2864I answer the call, or you can also have the call sent to the POTS port.

All of these combinations make the configuration of the Elite 2864I a little more complicated than a regular modem/fax device. We are doing our best to simplify the setup procedure. The preset defaults allow most of the setup decisions to be made for you.

If you expect more than one type of call to come in, please go through the section on how to configure the device to answer different types of calls.

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Chapter 2

Introduction to Elite 2864I

This chapter will tell you everything you need to know to properly install your Elite 2864I. It includes all the graphics and tables you'll need to get properly connected. We will provide you with descriptions of Power On and Self Diagnostics, and we will help you configure your ISDN line. We'll even take the guess-work out of setting up ISDN communications with your local telephone company.

Multiple Logical DTE Channels

In order to meet your personal communication needs, the Elite 2864I has 4 major communication channels built-in.

❖   Two ISDN data channels

❖   One analog data (modem/fax) channel

❖   One POTS port communication channel

The 2864I has two physical DTE ports, only one can be active at any one time. In order to communicate with multiple channels, a special set of AT commands was created. The AT command set allows users to select the channel they need in order to communicate with the DTE.

Aside from some of the more common setup parameters, which are applicable to all channels, ISDN data communication is quite different from modem/fax data communications.   Therefore, ISDN requires different setup parameters.   The channels are also used to setup specific communication settings for different types of communication. For example, if you are in channel 0, you will be able to change setup parameters for specific modem/fax settings. But you will not be able to change the ISDN setup parameters.

Description of each channel

❖   Channel 0 Modem/fax and common parameters

❖   Channel 1 ISDN data (B1) and common parameters

❖   Channel 2 ISDN data (B2) and common parameters

❖   Channel 3 POTS port and common parameters

In order to make a successful connection, you need to be certain that you have correctly setup the proper channels before a call is made. In order to correctly setup a certain channel, you need to select that channel before you can configure it. There are simple commands used to perform the logical channel switching.   These commands are:

Issue   AT&O0 if you want to switch to channel 0, to setup or use modem/fax channel

Issue   AT&O1 if you want to switch to channel 1, to setup or use ISDN data

Issue   AT&O2 if you want to switch to channel 2, to setup or use ISDN data (default)

Issue   AT&O3 if you want to switch to channel 3, to setup or use POTS port

The standard AT command set is used to force the Elite 2864I to switch channels. In addition, the Elite 2864I can perform automatic logical channel switching when some specific commands are issued.

Auto Channel Switching

Outgoing Calls

When an outgoing call is made, the Elite 2864I will assume the call type in the current channel being used.

If you are in:

Channel 0 you are making a modem/fax call

Channel 1you are making an ISDN data B1 call

Channel 2 you are making an ISDN data B2 call

The ZyXEL Elite 2864I has built-in automatic channel mechanisms which will help you switch channels automatically. For example if you use:

❖   "ATDI" as your dialing string, switching to channel 2 (ISDN data) will take place automatically

❖   "ATDM" as your dialing string, switching to channel 0 (modem/fax) will take place automatically

Without the proper switching command, the Elite 2864I is not able to tell exactly what kind of call you are going to make. It will rely on you to make the channel switch decision (AT&On command) before an outgoing call can be made. For a detailed explanation please refer to chapter 4.

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Modem/Fax

Computer

DTE
Channel 0

Fax/Modem

B1

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Figure 2-4

ISDN Data

Computer

DTE
Channel 2

B1   ISDN

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Figure 2-1

Bundling ISDN Data

Computer

DTE
Channel 1 & 2

ISDN ISDN

B1   B2

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Figure 2-2

Phone

POTS

DTE
Channel 3

Analog
Adapter

B1
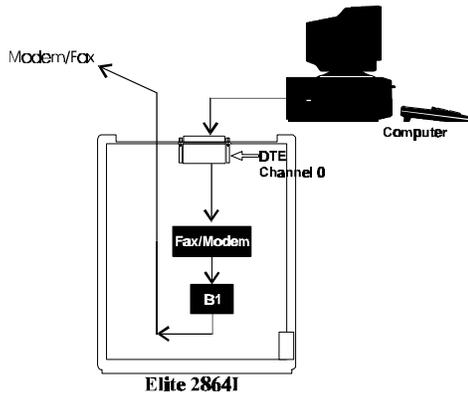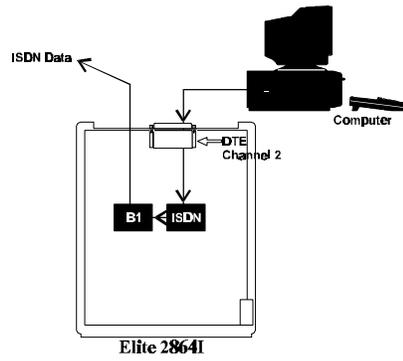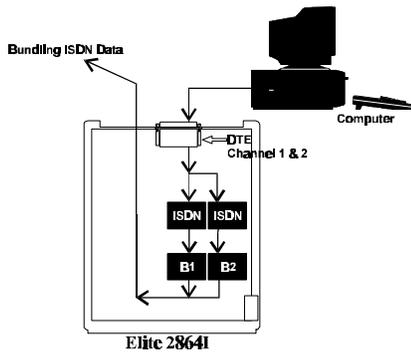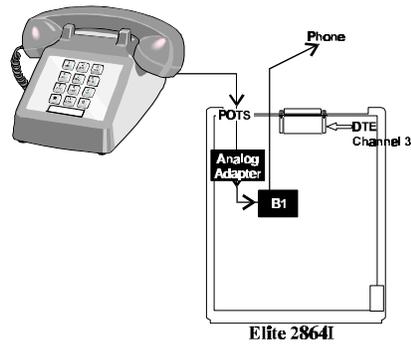
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Figure 2-3

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Incoming Calls

When a call comes in, as we have explained, it can fit into one of the following categories:

In ISDN data communication, the user information could be carried by:

❖   V.120

❖   HDLC PPP or SLIP

❖   X.75

❖   X.75 with CAPI

❖   V.110

In analog communication, the user information could be carried by:

❖   V.34 data

❖   V.17 fax

❖   Voice

The factory default used to answer the call is V.120 protocol. If an ISDN data call comes in and you have not configured it properly, the Elite 2864I will use the protocol already defined in channel 2 to pick up the call.

When the Elite 2864I receives an incoming analog call, the Elite 2864I will automatically send the call to the factory default, POTS port.

You have several different options available that allow you to configure the Elite 2864I to perform to your exact specifications when answering a call. In order to better understand your options, we will divide the configuration options into two different types of communication: ISDN and analog. Both ISDN and analog will be divided into two categories: general setup and specific setup:

The Elite 2864I is able to detect whether the incoming call is ISDN data or an Analog (voice) call before it picks up. The information is exchanged when the call is setup through the signaling protocol.

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Incoming Call Type	General Setup	Specific Setup
ISDN Data	Configure Channel 2 to the expected protocol for incoming (ATBnn in channel 2). Channel 2 outgoing protocol will be used as the default protocol to answer an incoming ISDN data call whenever the protocol used by the remote TA is not recognizable	Lookup Called-Party-Number and matching protocol on the AT&ZIn table. Use a specific protocol to answer a specific call (recognized by the number the remote caller dialed)
Analog Calls	Set the priority parameter. Either the POTS port has a higher priority or the built-in modem/fax has a higher priority, when an analog call comes in (AT&Ln in any channel it is a common parameter)	Lookup Called-Party-Number and matching protocol on the AT&ZIn table. Use the specific protocol to answer a specific call (recognized by the number that caller dialed)

```
CALL ──▶  Look at called      If the number    YES   If call type      ──▶  Do the handshake
          party number   ──▶  matches what is  ────▶  matches                according to what
          (What number did     set in AT & ZIN                               is assigned
          remote dial)                           NO    If call type
                                              ────▶   does not match

                                        NO
                              ◀───────────────┘

          ISDN Data call   Analog   What is set in    "0"    Generate
          or analog call  ──────▶   "&L"           ──────▶  a ring on
                                                             the analog
                                                             adapter

                                                     "1"              NO    Generate
                                                    ──────▶  S 0 > 0  ────▶  ring on
             │ ISDN                                                          channel 0

             ▼                                                        YES    Answer
          Is channel 2     NO     Generate ring                      ──────▶ according
          S 0 > 0        ──────▶  on channel 2                                to "&N" or
                                                                             "+FCLASS"
             │ YES                                                            setting

             ▼
          What is set as   YES    Use it to answer
          default outgoing ──────▶
          protocol
          Channel 2
```
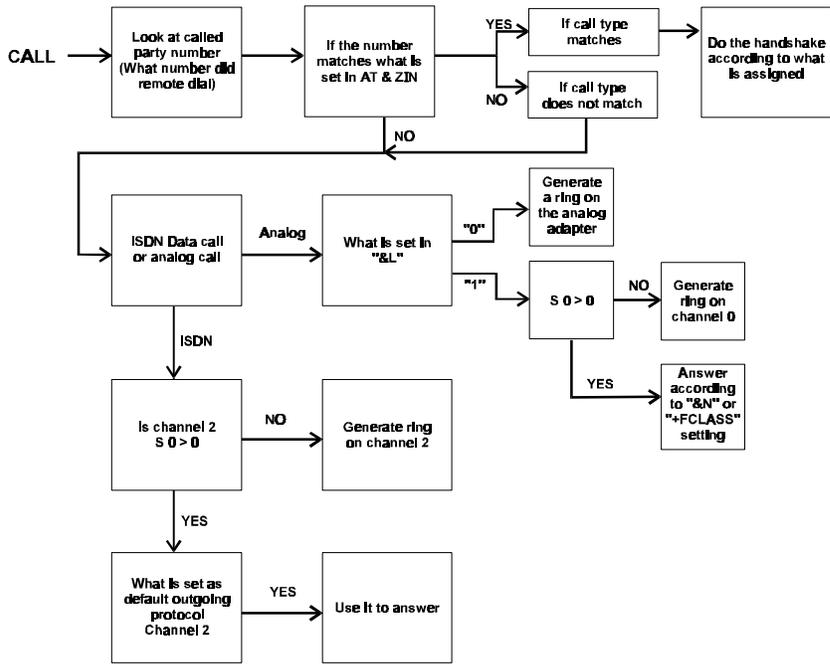
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When to Use a Serial or a Parallel Port

To satisfy the need for increased speeds between a computer and the Elite 2864I, ZyXEL adopts two advanced DTE interfaces:·

❖   RS-232 with throughput up to 460.8 Kbps·

❖   ZyXEL Parallel Port Interface (ZYPPI) (connects to the PC's printer port and runs under DOS or Windows)

You can choose to use either the RS-232 serial connection or the parallel port connection to connect the Elite 2864I to your computer. You should base your selection on your computer system, operating system, and the applications you are using. Since most PCs only support DTE speeds up to 115,200bps, (supporting 16550 UART/ utilizing Elite 2864I's high speed serial port), we recommend that you obtain an enhanced (high speed) serial card that can support DTE speeds of up to 460,800bps. If you do not upgrade your serial card, it will continue to be the source of all of your future communication bottlenecks. If you are using the Elite 2864I with Windows 3.1/3.11, Windows for Workgroup, or DOS, the ZyXEL Parallel Port Interface drivers are available for connection between the Elite 2864I and your PC parallel port. (Other drivers for various types of operating systems are currently under development).

Advantages of using a Serial (RS232C) connection to the Elite 2864I:

1.   It provides the most compatibility, and it should work with all different types of computer systems, operating systems or applications.

2.   It allows you to free up the parallel port on your Elite 2864I for a more convenient use.

3.   Faxes can be received and sent directly to print on your local HP laser printer (a printer connector is shipped with your Elite 2864I).

Advantages of using a parallel port connection:

1.   It provides higher throughput than a regular serial port connection.

2.   It consumes less CPU overhead than regular serial connections when heavy data communication is taking place.

Note: *Please read through the installation portion of this manual. Make sure that you **never** connect the modem's serial connector to your computer parallel port, or connect*

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your modem's parallel connector to your computer's serial port.   *This could damage your computer or your modem.*

Understanding AT Commands

The Elite 2864I communicates asynchronously with a computer using AT commands (V.25bis for synchronous mode is also supported, and is the topic covered in the Elite 2864 User's Manual). AT commands are used to configure and control the Elite 2864I. A command statement is usually sent to the modem by being typed from the computer keyboard.

Command statements must be written in a specific form in order for the Elite 2864I to recognize them. A command statement begins with the letters "AT" or "at", It is then followed by one or more commands and finally by a return.

AT commands can only be issued when the Elite 2864I is in "command" or is in "off-line" mode.

Once the Elite 2864I has established a connection with the remote device, it goes into "on-line" mode, and the characters sent from your computer (through the Elite 2864I) are transmitted to the remote device.

In order to issue an AT command statement, you first need to run your communications software and configure it to the port connected to the Elite 2864I. Please refer to your communications software manual if this is not the case.

Once the communication terminal program is running and the Elite 2864I is connected:

Type "AT" and press ENTER (or RETURN key on your keyboard)

You should see the Elite 2864I respond with an "OK" on your screen. This confirms that the modem and your computer are communicating correctly.

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Quick Tips when issuing AT commands:

The ENTER or RETURN key must be pressed to execute a command.

Multiple AT commands can be combined into one line. For example, AT&O2 and ATB02 can be combined into one line AT&O2B02.

The Elite 2864I processes commands from left to right. The AT command that appears to the right might over-write the command to the left. For example, ATB1B0 will result in ATB0 since both B1 and B0 can not coexist.

You need to make sure that the channel switching command (&On) is on the left-most side of the command string (the Elite 2864I executes the commands from left to right).

You can use the backspace or delete key to erase the last character. This also depends on your terminal program.

If you see two characters for each one you type, it means your Elite 2864I and software both have their echo feature turned on (the Elite 2864I defaults to enable command echo). To eliminate the double characters, you should turn off software command echo.

The Elite 2864I supports either verbose result code (i.e. "OK") or numerical result code (i.e. "0"). You can use ATV commands to set it to one code or the other. Use "ATV0" to select numerical result code and "ATV1" to select verbose result code.

Use "A/" to repeat the last command.

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The ZyXEL Elite 2864I supports several groups of AT commands:

Basic AT (Hayes compatible) command	example ATB0
Basic AT$ (on line help) command	example AT$
Extended AT& command	example AT&N0
Extended AT* command	example AT*I1
Extended ATn$ (on line help) command	example AT&$
AT+ fax command	example AT+FCLASS=2
S-Register command	example ATS0=1
S-Register bit-mapped command (set S-Register bit 1 equal to 1)	example ATS13.1=1
S-Register inquiry command	example ATS0? or ATS13.1?

Please refer to Appendix E for a complete command set table.

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Chapter 3

INSTALLATION

Ordering Your ISDN Line

Installing an ISDN line through your local phone company will take10 to 15 working days.

ISDN Service Ordering Information

The following guidelines can be used to order basic ISDN service from the telephone company.

The Elite 2864I series includes two models:

1. Elite 2864I-S/T : This model comes with the S/T interface and requires an external NT-1 device to provide the U-interface.

2. Elite 2864I-U : This model comes with a built-in NT-1(U-interface).

ISDN Physical Line Requirement:
     2B+D Service - Basic Rate Interface (BRI)
     U Interface (ANSI T1.601) - Elite 2864I-U

The Elite 2864I series supports the following switch types and protocols:
AT&T 5ESS	Custom and National ISDN-1
Northern Telecom DMS-100	Custom and National ISDN-1
Siemens EWSD	National ISDN-1 only

Features	Value
B1 Service	On Demand (DMD)
B2 Service	On Demand (DMD)
Access Date	64Kbps*
Data Line Class	Point-to-Point(PP) or Multi-point*
Maximum B channels	2
D channel packet	No
Electronic Key telephone sets (EKTS)	No
Circuit Switched Voice/Data (CSV/CSD)	Any
Intercom Groups	No
Message Waiting	No
Terminal Type	Type A

* Please note that your Central Office (CO) may still use in-band signaling between CO switches, which allows for speeds of up to 56Kbps on the B channel. After the line is installed, the telephone service provider should provide the following information:

1.   Confirm the switch that has been installed. If it is an AT&T 5ESS switch, then the phone company must inform you whether it is Point-to-Point or Multi-point; either option must then be programmed into the Elite 2864I modem. The configuration will be explained in the "Connecting your Elite 2864I" chapter.

2.   The protocol version of the switch. Please note whether the switch is using a Custom protocol or National ISDN-1 (NI-1).

3.   If the line is not an AT&T Point-to-Point, you should receive a unique SPID number for each of the B channels. Then both SPID numbers must then be programmed into the Elite 2864I modem. The TA configuration will be explained in the following chapters. Please take careful note of the prefixes and suffixes.

4.   Confirm the 7-digit Local Directory Number (LDN) for each of the B channels.

Note: *Use the above information as a check list. These parameters are very important in installing the Elite 2864I modem. They will allow the Elite 2864I to perform to its true potential.*

Elite 2864I

What are SPIDs?

The Service Profile Identifier (SPID), is a string of 3 to 20 numeric digits that is assigned to the user by the telephone company. The user must program the SPID into the terminal. The terminal will send this information (SPID) to the central office before it is initialized. When the switch receives the SPID, it will then allow the user to begin to dial out and receive calls.

Unpacking Your Elite 2864I

Packing List

Packed along with your Elite 2864I modem:

1.	A modular telephone cable	1 piece
2.	AC power adapter, with power cable	1 piece
3.	Serial/Parallel cable	1 piece
4.	ZyXEL's ZFAX software	1 disk
5.	ZyXEL ZFAX electronic manual	1 disk
6.	Voice/fax/data software	3 disks
7.	ZyXEL Drivers disk	1 disk

8. Gender Changer: *(Note it may already be attached to your parallel port.)*

9. Elite 2864I User Manual

10. Elite 2864 User Manual *(For analog function reference only)*

If any item is missing or damaged, contact your dealer or ZyXEL customer service immediately.

Connecting Your Elite 2864I

Connecting Your Elite 2864I to the Power Supply

The following steps are required to install your modem.

Turn off your computer. Make sure the power switch on the supplied power adapter is in the "O" (OFF) position. Connect the round end of the power adapter to the POWER JACK on the modem's back panel (see Figure *3*-1). Make sure when you plug in the power adapter that you hear a "click". If you do not hear the "click", the power supply has not been inserted properly.
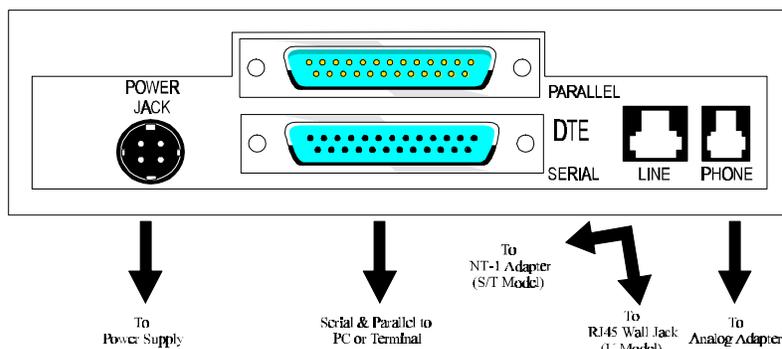
Figure 3-1

Note: *Only use the power adapter supplied with your modem. Never use a power adapter designed for a different product.*

Connect the power cable to a wall jack and power switch on (the switch is located on the power adapter). Observe the LED light status on the front panel of your Elite 2864I (without the modem cable and phone line connected to the Elite 2864I). You should see a series of LED lights blinking. Then you should observe the PWR, DSR, CTS, & SP lights remaining on. This is when you'll know your Elite 2864I has passed all self tests.

You can turn the power off now and continue connecting your serial cable and phone line.

Elite 2864I

Connecting the Elite 2864I to Your Computer

Your Elite 2864I comes with both a serial port (RS232C port) and a parallel port. The parallel port is a 25 pin male connector and it might be mounted with a 25 pin female to female gender changer. When you first install the Elite 2864I, we recommend you use the serial port to setup the device. Then you may try to establish a connection via the parallel port.

The gender changer (included in the box) is intended for connection of the Elite 2864I parallel port to your HP PCLII compatible laser printer, for the purpose of direct fax printing. You will not need to use this adapter for your data communication needs.

Your Elite 2864I comes with a 25 pin, male to female cable, which can be used as either a serial (RS232C) cable or a parallel cable. Please see diagrams below:
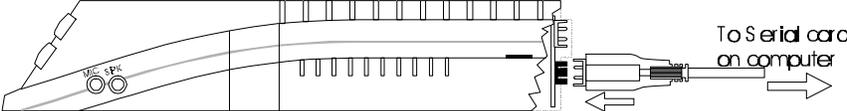
Figure 3-2

Elite 2864I

To connect your Elite 2864I to your computer serial port:
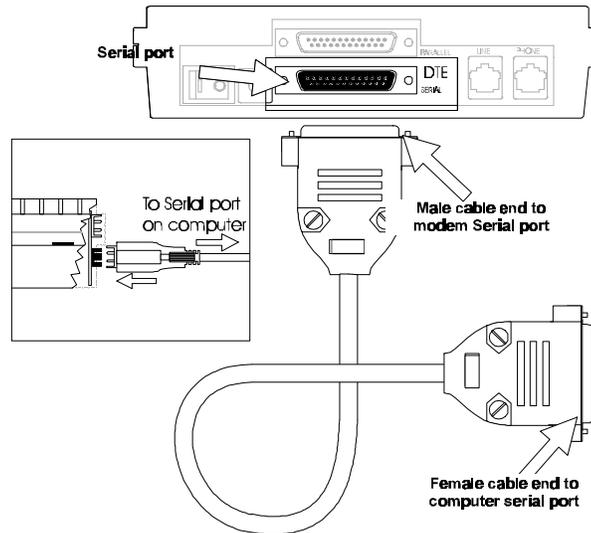
Figure 3-3

First, find the male end of your cable.

Find the serial port of your Elite 2864I. It is close to the bottom of the device, and is marked, "serial". Connect the male end of the 25 pin cable to the serial port of the Elite 2864I. Connect the other end of the cable (female end) to your computer's serial port. In case your computer only supplies a 9 pin serial connector, you will need to obtain a 25 pin to 9 pin converter (a 9 pin female to 25 pin male adapter).

Once the connection is made you can turn the power back on.

Elite 2864I

When you are ready to use the parallel port for your communication needs, then you will need the following instructions:
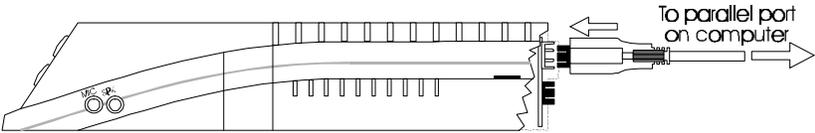
Figure 3-4

Connect the female end of the 25 pin cable to your Elite 2864I.

Connect the other end of the cable (male in this case) to your computer's parallel port (it is always a 25 pin female).
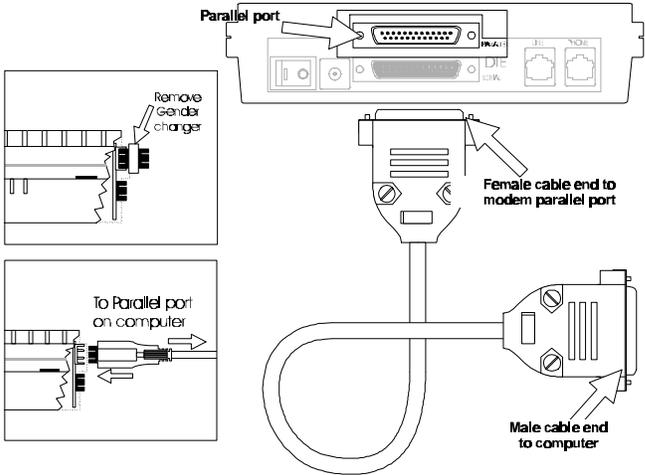
Elite 2864I

To connect your HP laser printer to the Elite 2864I, please read thefollowing:

The Elite 2864I does not come with a printer cable. So, you will need to either use your existing cable or obtain an extra printer cable for this application.

A printer cable has one end with a 25 pin male connector and a 25 pin Centronics connector which always connects to your printer.

Find your 25 pin parallel port on your Elite 2864I. When you receive the Elite 2864I from the factory, there should be a female to female gender changer either connected to it or included in the Elite 2864I. In case you remove the gender changer, then please put it back on, so the port has a 25 pin female connector. This way, it can be connected to the 25 pin male connector of your printer cable.

Find the 25 pin male end of the cable.

Connect the male end of the printer cable to the parallel port of your Elite 2864I.

Connect the Centronics connector to your HP PCL II compatible laser printer.

Figure 3-5

Elite 2864I
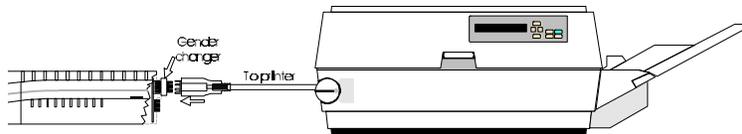
This configuration will allow you to perform regular communications through the serial port of the device.

You can then set it up so that when a fax call is received it will send the received fax directly to your printer.

In case you want to be able to connect your printer to both your computer and the Elite 2864I, you should get a printer sharing device. This way, the device can do the automatic switching for you.

If you do have a printer sharing device connected, the printer might be busy when a fax is in-coming. In this case, you should upgrade the Elite 2864I to have DRAM installed. This way, the received fax will be stored automatically in the Elite 2864I, while the printer is busy, and it will send the fax to the printer once the printer is free. With DRAM installed, the fax/modem receives faxes and can dowload them to your PC for storage.

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Connecting the Elite 2864I to Your ISDN Line

The Elite 2864I comes with two different types of interfaces:

❖   Elite 2864I-S/T comes with a S/T interface

❖   Elite 2864I-U comes with an U interface
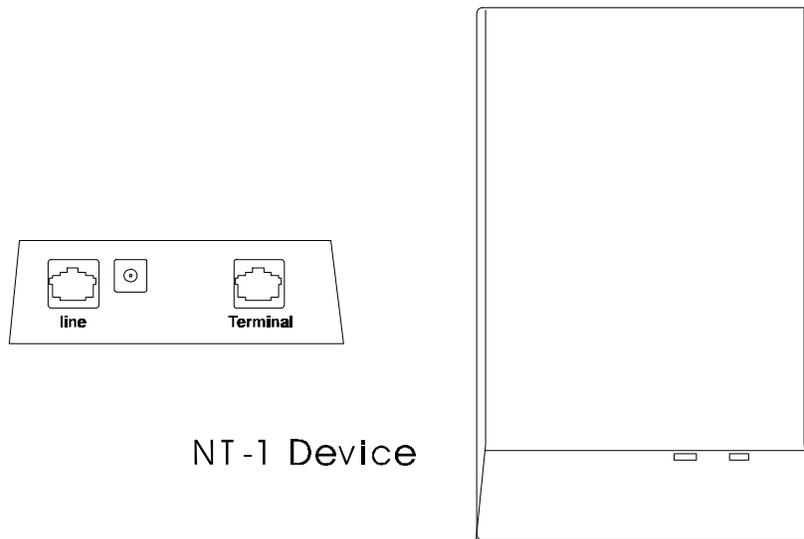
Figure 3-6

S/T Interface - The Elite 2864I-S/T can only connect to your NT-1 (Network Termination) device. U Interface - The Elite 2864-U allows you to connect directly to your wall jack.

Elite 2864I

Connecting the ISDN Line

S/T Interface

If you have purchased the Elite 2864I-S/T model, you will need an NT-1 device to connect to the ISDN network.
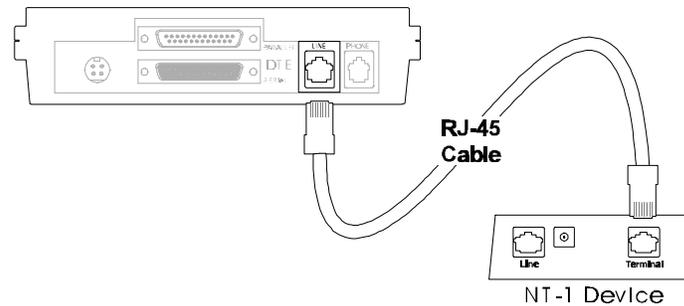
Figure 3-7

Although there are a lot of NT-1's on the market, in most cases an NT-1 has two sets of RJ-11 or RJ-45 jacks:

One set should be marked "Line", "ISDN", "Wall" or "U", and it should be a single RJ-11 or RJ-45 jack.

The other set should be marked "Terminal" or "S/T", and it can be either a single or multiple RJ-45 jack(s).

Before making the connection, you should also make sure the termination is set up properly. The termination setup depends on the number of devices connected to the

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NT-1 device, and how the devices are connected. It also depends on the distance from the device(s) and the NT-1. Please refer to NT-1 manual for more information.

When the telephone company installs your line, you can specify the type of jack you want installed. You should order the jack that is recommended by the NT-1 device. In most cases, RJ-45 jacks will be installed unless you specified otherwise. If a RJ-11 jack is installed, then you will need an RJ-11 to RJ-45 cable. The RJ-11 goes to the wall and the RJ-45 connects on to NT-1. If nothing is mentioned in the NT-1 manual, and no cable is supplied, you can order a jack, similar to the U interface jack on your NT-1 (RJ-45 is one size larger than a regular RJ-11 telephone connector). It is much easier to get an RJ-45 to RJ-45 or RJ-11 to RJ-11 phone cable, than to find a cable with an RJ-45 on one end and an RJ-11 on the other. (You have the option to experiment by plugging in an RJ-11 connector to an RJ-45 jack. This may work, but we do not recommend you try it, since it would provide an insecure connection.)

No matter what kind of wall jack you have installed, only the center two pins are connected. We call them Tip and Ring.

The cable connecting the NT-1 device to the Elite 2864I is provided for you. It is an RJ-45 to RJ-45 cable with four conductors running through it.

Once you have everything set up, you can connect them together.

Use the phone cable (RJ-45) that is included, connect the Elite 2864I "ISDN S" jack to your NT-1 "Terminal" or "S/T" jack.

Using the proper cable, connect your NT-1 "Line" or your "U" jack to the wall jack installed by your phone company. Make sure all the connectors are properly inserted.

If you are using the ISDN line for all your communications, we recommend that you use a UPS (Uninterruptable Power Supply) to provide backup power for the NT-1 and the Elite 2864I. Otherwise, these units as well as any devices attached to the POTS port will not function in the event of a power loss at your location.

U Interface

If you have purchased the Elite 2864I-U, you can connect the U-Interface directly to the wall jack.

In most cases, the ISDN jack installed by the phone company is a RJ- 45 jack and the U-Interface jack on the back of the Elite 2864I-U is a RJ-45 jack. A RJ- 45 to RJ-45 phone cable is included with your Elite Elite 2864I-U.

If you have a RJ-11 jack (the smaller connector jack) installed for your ISDN line, please call our customer service department for an alternate cable.

To connect your ISDN line to the Elite 2864I-U:

Connect the RJ-45 connector to the "ISDN U" jack on the back of the Elite 2864I-U. Connect the other end of the RJ-45 cable to your wall jack.
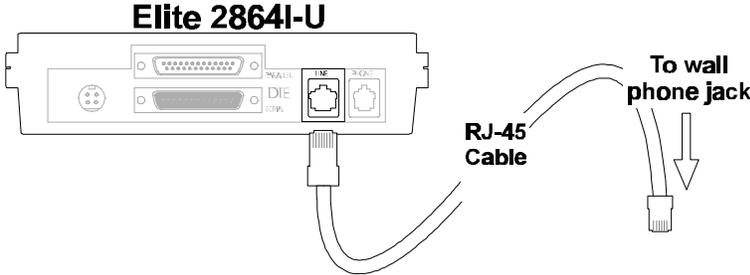
Elite 2864I

Power On and Self Diagnostics

Once you have completely connected your Elite 2864I to your computer and to the power supply, you should plug the power cord in to your wall jack and turn on the Elite 2864I modem.

The Elite 2864I modem should cycle through a self test sequence, where you should see a series of LED lights blinking.   After this cycle is complete, the PWR, SP, DSR, and CTS lights should stay on.

If you have a communication program loaded and active (connected to the same serial port that the Elite 2864I is connected to), you should see the DTR and RTS lights go ON after the self test. Sometimes the TXD light might stay on after the self test; however, if you type anything from your terminal, the TXD light should go away.   If you are using the serial port connection, the SP light will stay on.

If the test routine fails, the LNK LED flashes. The number of times the indicator flashes indicates the error number according to the following table:

# of Flashes	Error Description
1	ROM code checksum error
2	System RAM fail
3	EEPROM checksum error. The factory default settings will be downloaded to the EEPROM and the self-test will be re-initiated. This is not a real error
4	The testing of DSP RAM fails - Condition A
5	The testing of DSP RAM fails - Condition B
6	Analog circuit calibration error. (VO calibration fail)
7	Analog circuit calibration error. (VR calibration fail)
8	Analog circuit calibration error. (FR calibration fail)
9	Communications between controller and DSP fail - Condition A
10	Communications between controller and DSP fail - Condition B

Once the first test routine is complete without error, the Elite 2864I will then begin to test both the ISDN daughter board and its interface with the main-board. There are

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six items for this test, each test takes about half-a-second. The following table is a summary of the ISDN daughter-board self-test:

The LNK LED will light up for half-a-second to indicate the success of the Elite 2864I's power-on self test.

Test Seq.	LED B1	LED B2	LED AA	**Test Description**
1	on*	off*	off	Siemens 2086 chip's address/data bus test
2	off	on*	off	Siemens 2086 chip's functional test
3	off	off	on*	Siemens 2160 chip's functional test
4	on*	off	off	Interface test 1 with Siemens 2086
5	off	on*	off	Interface test 2 with Siemens 2086 chip
6	off	off	on*	Interface test 3 with Siemens 2086 chip

After this, the LNK LED will become the normal physical layer (layer 1) active indicator.

If the B2 light blinks while the Elite 2864I is powered on, it might be because the connection between your Elite 2864I and the NT-1 device is not properly made. Another reason may be related to an improper phone line set up. You should either check the connection between the Elite 2864I and your NT-1, or you should disconnect the ISDN line from the Elite 2864I and power it off. Wait 5 seconds, then power it back on. We will cover the connection between the line jack and the NT-1 in greater detail later in this manual.

Before you setup the switch, the LNK line should be off.

Please note that the Elite 2864I takes longer to initialize than a regular modem. This is because it requires that communication first be established with your local switch when you power on.

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Front Panel and LED Lights

This section describes the functions of the ZyXEL Elite 2864I front and back panels.
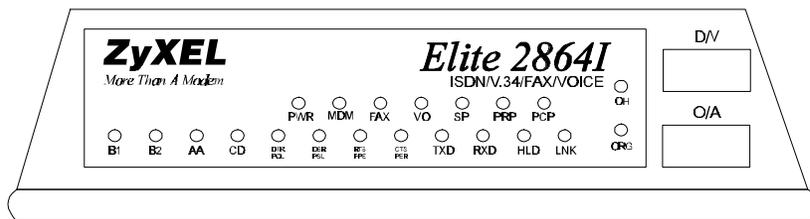
PWR   Power on indicator; lights up when the Elite 2864I is turned ON.

MDM   Modem active indicator; lights up when the Elite 2864I operates
                  in modem mode.

FAX   Fax active indicator; lights up when the Elite 2864I is in fax
                  transmission or receiving mode.

VO   Voice mode indicator; lights up when the Elite 2864I operates in
                  voice mode.

SP   Serial port active indicator; lights up when the Elite 2864I is using
                  the serial port for DTE communication.

PRP   Printer parallel port active indicator; lights up when the Elite 2864I
                  is using the parallel port to drive a printer for fax printing.

PCP   PC parallel port active indicator; lights up when the Elite 2864I is
                  using the parallel port to communicate with a PC's bi-directional
                  parallel port.

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B1	B1 channel connection indicator; lights up when B1 channel is in use. A single blinking LED indicates data transmission is protected by Data Encryption Standard (DES).
B2	B2 channel connection indicator; lights up when a B2 channel is in use. A single blinking LED indicates data transmission is protected by Data Encryption Standard (DES).
AA	Auto-answer indicator; lights up when the Elite 2864I is in the Auto Answer mode; it flashes when it rings.
CD	Carrier detect indicator; lights up when a valid carrier is present on the line for fax/modem operation. For ISDN data calls, the LED lights up when a B channel protocol has been established and is ready for data transmission.

DTR/POL

DTE mode:
Data terminal ready indicator; lights up when the DTE or Computer indicates it is ready for communication by raising the corresponding RS232 signal.

Printer mode:
Printer on-line indicator; indicates the signal status of "Select" from the printer. It lights up when the printer is selected and is available for data transfer.

DSR/PSL

DTE mode:
Data set ready indicator; lights up when the Elite 2864I is ready for communication.

Printer mode :
Printer select signal; indicates the signal status of "Select-In" from the Elite 2864I to the printer. It lights up when printer is enabled to input data.

RTS/PPE

DTE mode:
Request to send indicator; indicates the signal status of the RS-232 signal RTS from DTE. RTS is used for hardware flow control in asynchronous data transmission.

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Printer mode:
Printer paper end indicator; lights up when the printer runs out of paper. It indicates the signal status of PE from the printer.

CTS/PER

DTE mode:
Clear to send indicator; lights up when the Elite 2864I can accept data for transmission.

Printer mode:
Printer error indicator; lights up when an error condition exists in the printer, e.g., paper empty or not on-line. It indicates the signal status of "Error" from the printer.

TXD	Transmit data indicator; flashes when the DTE/Computer is transmitting data to the Elite 2864I.
RXD	Receive data indicator; lights up when the DTE/Computer is receiving data from the Elite 2864I.
HLD	Call hold indicator; lights up when the telephone (connected to the a/b adaptor) is in Hold condition.
LNK	Physical layer (layer 1) active indicator; lights up when Layer 1 of the S interface is active; flashes when the data link layer of the D channel is in multiple frame mode. LNK is also used as a self test indicator for internal fax/modem initialization. In this case, the Elite 2864I's LED LNK behaves just like the Elite 2864's LED SQ. It lights up when signal quality is good and flashes when it is marginal
OH	Hook status of the A/B adaptor; lights up when the telephone handset is picked up (off-hook); flashes when the analog telephone set (connected to the A/B adaptor) is used for local voice mode operation (play back and record).
ORG	Modem Originate mode indicator; lights up when the modem is in originate mode. Otherwise it is in answer mode.

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Elite 2864I Front Panel Switches

D/V   A toggle switch that allows you to answer a call manually when
                   the Elite 2864I is not set up to automatically pick up a call. Press
                   the button once, it will connect the call. Press it again, the call will
                   be disconnected.

O/A   A toggle switch that determines the Fax/Modem is in originate
                   mode or answer mode when the Fax/Modem goes off-hook by
                   pushing the D/V switch.

Configuring Your ISDN Line and Network

You are now ready to setup your network.   In our experience, most problems are
traced back to two factors: either the line was not ordered correctly, or the line was
ordered correctly, but it was not programmed correctly.

It would be wise to have your digital modem ready to use before your phone company
comes to install your line. This way your can enter the SPID to your line and confirm
that the ISDN network is responding properly, before the phone installation people
leave.

There is a simple DOS utility provided by ZyXEL to help you setup the network.
This setup procedure needs to be done only once. The network information will be
stored in the NVRAM of the Elite 2864I, power on-off will not erase the information.
The only time you will need to reconfigure your line is when you upgrade the
firmware code or when you change options on your ISDN line. We will explain how
to setup up your switch using the DOS utility, ISDN101.exe, which comes with the
Elite 2864I.

If your Elite 2864I is not going to be setup by a computer running MS-DOS, you will
need some type of terminal program that allows you to send and receive commands
to the modem. This will be required to setup the network according to the
instructions.

We are currently developing a network setup program to run under Windows. Please
check the README file that came with your Elite 2864I to see if it is shipped with
your device.

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Network Setup, Configuring Your ISDN Line Using the DOS Setup Utility

When you are running MS-DOS with your computer, a utility will help you setup the switch that comes with the Elite 2864I. The name of the program is "ISDN101.EXE". We will use the README file called "README.101" for the most up-to-date information.

To run the program, simply type "ISDN101" at the DOS prompt where the program is located. Once the program is executed, the COM port setup screen will appear:

Select the appropriate COM port. If you are not using a standard COM port, select the "custom COM port" setting and enter your information in the fields provided to the right. If you select a standard COM port, all information in those fields will be ignored.

```
+-[_]----------ZyXEL-ISDN-Configuration---------------------------+
|................................................................|
|-Con-Port-------------------------------Custom-Con-Port----------|
|--(·)·COM1:·0x3f8h,·IRQ··············Con·*······2···············|
|--(·)·COM2:·0x2f8h,·IRQ··············IRQ·······3···············|
|--(·)·COM3:·0x3e8h,·IRQ··············Interrupt·11···············|
|--(·)·COM4:·0x2e8h,·IRQ··············Base-Addr··0x2f8···········|
|--(·)·Custom·····················································|
|................................................................|
|·Switch·Type····················································|
|--(·)·AT&T·5ESS··················································|
|--(·)·Northern·Telecom·DMS-100····································|
|--(·)·Siemens·EWSD·(NI-1·Only)····································|
|·············Ok···_·················Cancel·_···············|
+----------------------------------------------------------------+
```

The phone company must provide the switch information when you order the line. ZyXEL's entire line of ISDN modem products support AT&T, Northern Telecom DMS-100 and Siemens EWSD switches. The AT&T and DMS-100 switches support NI-1 as well as Custom protocols.

Select the switch type. If you do not have this information, you will need to contact your phone company again.

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After you have selected the proper settings, click on the "OK" button, and another screen will prompt you for your Protocol Type and SPID (Service Profile ID). The SPID must be provided by your phone company.

```
+-[_]------------ZyXEL·ISDN·Configuration------------------+¶
|---------------------------------------------------------|¶
|-----------------------------------AT&T·Protocol·Type----|¶
|-SPID·#1----------------------------(·)·Point·To·Point---|¶
|-----------------------------------(·)·Multipoint--------|¶
|-----------------------------------(·)·NI-1-------------|¶
|---------------------------------------------------------|¶
|-NOTE·:·No·SPID·is·needed·for·Point·To·Point-------------|¶
|---------------------------------------------------------|¶
|-----------------Ok---_-------------Cancel·_-------------|¶
|---------------------------------------------------------|¶
+---------------------------------------------------------+¶
```

```
+-[_]------------ZyXEL·ISDN·Configuration------------------+¶
|---------------------------------------------------------|¶
|-----------------------------------DMS-100·Protocol·Type·|¶
|·SPID·#1-----------------------------(·)·PVC-0·(Custom)···|¶
|·SPID·#2-----------------------------(·)·PVC-1·(Custom)···|¶
|-----------------------------------(·)·NI-1·(PVC-2)·····|¶
|---------------------------------------------------------|¶
|---------------------------------------------------------|¶
|---------------------------------------------------------|¶
|-----------------Ok···_-------------Cancel·_·············|¶
|---------------------------------------------------------|¶
+---------------------------------------------------------+¶
```

If you did not receive it, please call your phone company and get it. If you make the wrong selection, use F1 key to go back to the first screen.

When AT&T 5ESS Switch Is Selected

AT&T point to point does not need a SPID:

For AT&T Multipoint, you will need one SPID provided by your phone company number, the format:
01+(ISDN Local Number)+0

For AT&T NI-1, you will also need one SPID provided by your phone company number, the format (for reference only):
01+(ISDN Local Number)+TID
The TID is a 2-digit number and the value is from 00 to 62.
The default value for TID is "00"

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When Northern Telecom DMS-100 Switch Is Selected

You will need two SPID numbers for the Northern Telecom Switch, the SPID should be provided by your phone company, format is (for reference only):

(Your Area Code)+(ISDN Local Number)+(Suffix)

The suffix is supplied by your telephone company, in most cases it is "1" for the first phone number and "2" for the second number.

If NI-1 is selected, you need to add two digit TID (Terminal Identifier) after the above number. (Similar to the TID for AT&T)

When the Siemens EWSD Switch Is Selected

Please use the SPID information you receive from your phone company.

After you have entered the appropriate information, click on the "OK" button again.

The information you entered will be listed for confirmation.

If the information is not correct, select "cancel" and hit 'F1' to re-enter the information.

If the information is correct, select one of the following options:

Setup Only   This option will only setup the Elite 2864I, but it will not test it for you. It will provide you with very little feedback, if the information is incorrect.

Setup & Test   This option will setup the Elite 2864I modem, then it will dial a test number (note: we have already set up a sample number), and it will automatically make a connection and hang up. This will assure that your setup is correct (note: you are calling Anaheim, California; it may be a long distance call).

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Network Setup, Configuring the ISDN Line and Getting a Terminal Program Ready

If you are not using the ISDN configuration utility that is packaged with the Elite 2864I, you will need a terminal program to help you program your Elite 2864I. The Elite 2864I should work with any asynchronous terminal program that can communicate directly with one of the communication ports on your system. If you do not know how to use a terminal program, please refer to the instructions that come with the terminal program. Some basic AT command instructions are covered at beginning of this manual.

You will need to make sure the program is set up to communicate with the port (serial port) that the Elite 2864I is connected to. You can check to see if the DTR LED is on when the terminal program is active. In most cases, if the terminal program is active and ready to communicate (with the port that the Elite 2864I is connected to), it will activate the DTR signal. Then it will force the DTR LED light to ON. If DTR is not ON, you will need to check the program's setting again.

The communication speed should be set to anywhere between 1,200bps and 460,800bps. The Elite 2864I will automatically adjust its speed to match your communication program speed. To take advantage of the high speed communication features of the Elite 2864I, we recommend you set the speed to above 57,600 bps. If you are running the communication program under Windows, you should install a special communication port driver. Without a driver installed, reliable communications can only occur at speeds of 19,200 bps or lower. Serial and parallel port drivers are shipped with the Elite 2864I to improve the performance of Windows (for version 3.11 and 3.1). Before the driver is installed, you should set the port speed to 19,200 bps. To install the driver, please check installation instructions located on the driver diskette.

Once you have the terminal communication program ready, you can type a simple command to see if the Elite 2864I responds to it:

Type
```
AT [Enter]
```

Elite 2864I should respond
OK

Type

```
ATI [Enter]
```

Elite 2864I should respond

```
Elite 2864I   (Model number)
```

Type
```
ATI1 [Enter]
```

Elite 2864I should respond
36786   (Firmware checksum)
This number will change based on your firmware version

```
E2864 V 1.05a   (Firmware version number)
OK (Ready to accept more commands)
```

Once the Elite 2864I accepts the commands that you typed, it is ready to be programmed to operate with your ISDN network. If you do not see any response from the device, you will need to check the following table:

Check	Indicates	What is wrong, how to correct it
If DTR LED is on Elite 2864I is ON	This indicates that communication program is set up to the right port	The speed may not be set up correctly. Make sure the program speed is set between 1200 to 460,800 bps.
		If the TXD and RXD LEDs blink quickly when you type (the speed of the blink depends on the speed of your setup). If the light does not blink, set the communication speed to 9,600 bps and try again.

DTR is ON however, no sign of TXD or RXD blinks when you type. Changing the speed does not help	2864I might not initialize correctly	Power cycle Elite 2864I. When you turn off the power, please wait at least 5 seconds before you turn it back on. If you have NT-1 connected to it, remove the NT-1 cable when you try this. Improper communication between NT-1 and Elite 2864I might also cause the problem.
If DTR LED on Elite 2864I is not ON	Is PWR indicator of Elite 2864I on?	Turn the power of Elite 2864I on. The switch is located at the power adapter. There is no switch on the 2864I unit.
	The communication program is not setup correctly to the port that Elite 2864I is connected	Change the setup of the program
	The SP indicator is not ON	Elite 2864I is not setup to communicate with your serial port. You should do a Hardware Reset to Elite 2864I. Hardware Reset: Turn the power off, holding down the D/V button (the upper button on the right hand side of front panel) while you are turning on the power. Keep holding down the D/V button for 3 more seconds after the power is turned on. Wait 5 more seconds and power cycle it. the SP light should turn ON now.
	The cable between Elite 2864I and your computer is not connected correctly	Please refer to the earlier section for connection of the cables.

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Elite 2864I responded however, it shows strange characters	Elite 2864I is not able to detect communication speeds correctly	Change the communication software speed around to see if the situation will improve.
	The speed of the communication program is set too high. Your computer might not be supporting it correctly	Change the communication software to a lower speed.
Have no idea what is going on	Some help is needed	Call our tech support at 714-693-0808, we will be glad to help

Elite 2864I

Network Setup, Configuring Your ISDN Line Switch Type ans SPID

In North America there are three most popular types of switches, they are:

❖   AT&T 5ESS

❖   Northern Telecom DMS100

❖   Siemens EWSD

These switches are either running software that confirms to the National ISDN-1 standard, or a custom version. Currently, the Elite 2864 supports a total of 6 different combinations, listed in the table below.

You must have the switch type information available when you install your ISDN line. You need this information to program the Elite 2864I to work with your switch.

The ATPn command is used to program the D-channel protocol. This is to allow the Elite 2864I to work with the type of switch your ISDN line is connected to. "n" is a digit that indicates the type of switch. Please use the following table for the "n" value.

The Elite 2864I is shipped with a default value of ATP0, which is a custom command for NI-1 (Northern Telecom) DMS-100 switch.

ISDN Network Switch	Switch Version	AT Command
AT&T 5ESS	Point-to-Point	ATP4
	Multipoint (Point-to-Multipoint)	ATP5
	National ISDN-1	ATP1
Northern Telecom DMS 100	PVC IC-0	ATP0
	PVC IC-1	ATP0
	PVC IC-2	ATP0

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	National ISDN-1	ATP1
Siemens EWSD	National ISDN-1	ATP1
Other	National ISDN-1	ATP1

Enter the proper value for the switch you have: (for example, if Northern Telecom DMS 100 custom is selected).

You would enter
```
     ATP0 [ENTER]
```

```
     Elite 2864I will respond
     OK
```

You can verify the setting with AT&V command:

You would enter

```
AT&V [ENTER]
Elite 2864I will respond:
Switch Type : Northern Telecom DMS
DTE Channel : 2Outgoing Service : V.120 64K
Calling Party Number :()
...
```

followed by current modem settings.

Once you have verified the value correctly, you are ready to enter the SPID (Service Profile Identifier) number. Unless your switch type is AT&T 5ESS with Point-to-Point protocol, otherwise SPID(s) would be needed. The ISDN switches use Service Profile Identifier (SPID) to represent the network services to which the Elite 2864I has subscribed. Each SPID corresponds to one Terminal End point Identifier (TEI). Different switches may provide different rules for the SPID number format.

You should get the SPID number from your local phone company.

The command to enter the SPID number is:

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ATSPID0=n
and   ATSPID1=n   if 2 SPID numbers are required

"n" is the SPID number assigned. Use the following table for the general assignment
rule if it is not provided by your local phone company.

<DN>   A Directory Number or a subscriber number, that should be the
                    phone number assigned to your ISDN line excluding the area code.

<TID>   A Terminal Identifier, 2 digit number and the value is from 00 to 62.
                    The default value for TID is 00

<Area Code>   The area code for your area

<Suffix>   The suffix is supplied by your telephone company, in some cases it
                    is "1" for the first phone number and "2" for the second number.

ISDN Network Switch	Switch Version	Command to be Used
AT&T 5ESS	Point-to-Point	ATP4
	Multipoint (Point-to-Multipoint)	ATP5
	National ISDN-1	ATP1
Northern Telecom DMS-100	Custom	ATP0
	National ISDN-1	ATP1
Siemens EWSD	National ISDN-1	Please use the SPID information provided by your phone company.
Other	National ISDN-1	ATP1
ISDN Network Switch	Switch Version	# of SPID
AT&T 5ESS	Point-to-Point	None

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	Multipoint (Point-to-Multipoint)	1
	National ISDN-1	1
Northern Telecom DMS 100	Custom	2
	National ISDN-1	2
Siemens EWSD	National ISDN-1	2
Other	National ISDN-1	ID

When you program your ZyXEL Elite 2864I with a SPID number you can receive one of three responses:

1. Input   `ATSPID0=999-999-99999 [ENTER]`
    Type   `OK`
    `SPID Error!`

 - This indicates a wrong SPID number was entered

2. Type   `ATSPID0=999-999-99999 [ENTER]`
    Reply   `OK`
    `SPID correct!`

 - This indicates the SPID number was accepted

3. Type   `ATSPID0=999-999-99999 [ENTER]`
    Reply   `OK`

- General Error, SPID was not verified. For example your ISDN phone line is not connected to your Elite 2864I or your NT-1 is not functioning properly.

Once the SPID is entered and accepted, you can use your terminal program to dial ZyXEL V.120 number (714-939-7524 or 714-939-8563) and see if you can get a "CONNECT" message. The following instructions can be used to make your test call:

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```
Type   AT [ENTER]
Reply   OK

Type   AT&F [ENTER]
Reply   OK

Type   ATD7149397524 [ENTER]
Reply   CONNECT 115200/V.120 56000/LAPD
```

Note: *You may only get a "CONNECT" message and no other communication. This is OK.*
           In the next chapter you will learn how to setup your Elte Elite 2864I to connect and
           then communicate over the line.

For example, we have assigned two SPID numbers for one of our Northern Telecom
ISDN lines. The assigned SPID numbers are:

       714-935-1918-1
       714-935-1939-2

(Before you enter the SPID number, make sure the telephone line is connected, since
the Elite 2864I needs to communicate with your ISDN switch once the SPID is
entered.)

We will enter the following commands to set the SPIDs:

```
Type    ATSPID0=71493519181<Enter>
wait for:

OK
SPID correct!
OK

Type   ATSPID1=71493519392<Enter>
wait for

OK
SPID correct!
OK
```

The SPID number(s) will be stored in nonvolatile memory. This way you won't need
to enter the SPID again, even if the power is turned off. However, if you perform a

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firmware upgrade, you will need to re-enter the SPID number(s) and switch type again. Make sure you store all the relevant information so it can be retrieved at a later date.

Once the SPID number(s) are entered correctly, the LNK light should be ON. If the SPID(s) registration fails, the LNK light will not light up and an error message "SPID error!" will appear.

If you are not able to get the SPID(s) to accept correctly, verify the number with your phone company again. You should recheck all your cable connections, before calling your phone company. We may be able to help in this area. However, without your local phone company's assistance, we can only help you go through connection and Elite 2864I setup to help ensure that the problem is not in the device setup. If it still does not work, you will need your phone company's support to make sure the SPID(s) is correct and the line you ordered is setup correctly.

This is where most of the frustration occurs. This is why you should always make sure the cable connections are correct and securely in place. This will make it easier for you to isolate the problem area. We will provide some of our experience for you to refer to in the next section.

What Can Go Wrong?

ISDN is totally a different beast when compared to a POTS (Plain Old Telephone Service) installation. There is still a learning curve for all parties involved. This especially applies to those areas where ISDN lines are installed for the first time, or if switches are in the process of being upgraded. Below is what we would call a "hit-list" of things you should be aware of:

a)   Wiring issues

b)   Wrong SPID assignment

c)   Wrong switch assignment

d)   Line is provisioned incorrectly

e)   General issues

f)   The NT-1 device that you are using, for Elite 2864I-S/T model

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g)   The ISDN Elite 2864I itself

Wiring issues

Make sure that when the phone company representative visits, you ask where the POP (Point Of Presence) or demarcation point is installed. Unlike a POTS line, you will not hear a dial tone. Therefore, locating the line in the room where the phone is located may not be an easy task.

It is even more difficult when you are installing more than one line. Most local loops (the wire between your POP and the nearest phone company facility) in North America are able to support ISDN lines. So if you are experiencing particularly bad problems in your local loop, please let the phone company representative know about it immediately.

Wrong SPID assignment

Before the phone company representative leaves the premises, make sure that you receive the SPID information (number) for BOTH the B-channels. This is very IMPORTANT because without the SPID information, the ISDN modem is useless. You can do a quick check to verify that the information provided by the phone company is correct for the switch type. For example:

Switch Type

SPID
Northern Telecom DMS-100 (Custom)   area code-xxx-xxxx-suffix(optional)
Northern Telecom DMS-100 (NI-1)   area code-xxx-xxxx-suffix(optional)-00
AT&T 5ESS   (Custom)
01-xxx-xxxx-0
AT&T5ESS   (NI-1)
01-xxx-xxxx-0-00

Wrong switch assignment

The SPID information can be used to verify the switch type that you have. Please have a look at the table above to see if the switch type and SPID information you have been given is correct.

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If you have a Siemens switch, the only option you will have is NI-1. Please make a note that the Siemens switch provides different SPID information from the table shown above.

Line is provisioned incorrectly:

If you enter the SPID and the result code message is NOT "SPID CORRECT", this indicates that your line is not provisioned correctly.

The easiest way to get around this is to call the phone company, and get verification that the SPID(s) you are attempting to use is correct and the switch type you are using is also correct. Before calling, please make sure that the Elite 2864I is set up to the correct switch type, and that you have verified that the correct SPID information was entered into the Elite 2864I modem. If you cannot dial out from the analog adaptor to any destination, please make sure that the phone company has set the EKTS option to "NO".

When ordering the line, please make sure that you request CSV/CSD (Circuit Switch Voice/Circuit switch Data) on both B channels and request no packet data on the D channel. Be aware that due to some complexities involved in ISDN, it may take a few calls to the phone company to get the line provisioned correctly.

General Issues

In this section we will cover some of the basic problems you may encounter when dealing with public networks.

Q: I can no longer make outgoing calls to either ISDN destinations or to analog destinations.

A: Check if the LNK LED is high (ON). If not, then re-issue the SPIDs again and wait until the LNK is ON. If the LNK is ON, put a phone on the analog adapter and see if there is a dial tone. If there is no dial tone, then re-issue the SPIDs again and wait for a "SPID CORRECT" message. If you do not receive this message, then call the phone company. If you do get a dial tone, make sure that the line is provisioned for both CSV/CSD.

Q: No matter what SPID I enter I get back a "SPID CORRECT".

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A: The problem will rest most likely on the phone company's side, but Tech Support at ZyXEL can further   diagnose the problem. Be prepared to provide the EPA (Embedded Protocol Analyzer) output.

Q: If there is a power outage, can I use any of the B channels or do I use the phone hooked to the analog adaptor?

A: No, you are not able to use either the phone or any of the B channels. If this is the only line coming into your site, then having a battery back-up would be advisable on the NT-1 device and on the Elite 2864I.

The NT-1

Most of the NT-1's sold on the market today come with indicators.

Please make sure that the line indicator on the NT-1 (if there is one) is in the connect mode. You'll also want to ensure that there are no errors, when both the ISDN line and the Elite 2864I modem are plugged in.

Please note that the phone company's ISDN line should be plugged into the jack labeled "U". Also check to make sure the Elite 2864I is plugged into the jack labeled "S/T" interface.

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First you should receive verification from the phone company that the switch and SPID settings are correct and that you are not getting the "SPID CORRECT" message. Then in order to debug further, you will need to use the EPA function on the Elite 2864I. In order to know what information to log, please contact a ZyXEL Technical Support representative.

Making Your First ISDN Data Connection

Make sure that the LNK LED light is on. If the LED is low, check the "What Could Go Wrong?" section. Start your terminal program.

Type AT&V. You should see a screen similar to the following:

```
Switch Type : Northern Telecom DMS
DTE Channel : 2              Outgoing Service : V.120 56K
Calling Party Number :()
E1  L1  M1  N5  Q0  V1  X5

&B0 &C1 &D2 &G0 &H3 &J0 &K0 &L0 &M0 &N61 &R1 &S0 &X0 &Y1

*B0 *C0 *D0 *E0 *F0 *G0 *I0 *L0 *M0 *P9 *Q2 *S0

S0  =   0 S1  = 16 S2  = 43 S3  = 13 S4  = 10 S5  =  8 S6  =  3 S7 = 45 S8  =  2
S9  =   6 S10 =  7 S11 = 70 S12 =  0 S13 =  0 S14 =  2 S15 = 98 S16= 0 S17 = 18
S18 =   1 S19 = 61 S20 = 14 S21 =178 S22 =  0 S23 =105 S24 = 21 S25=  0 S26 =  0
S27 =152 S28 = 68 S29 =  0 S30 =  0 S31 = 17 S32 = 19 S33 =  0 S34 = 30 S35 = 34
S36 =   0 S37 =  0 S38 =  0 S39 =  0 S40 =  0 S41 =  0 S42 =  0 S43=  8 S44 =  0
S45 =100 S46 = 28 S47 = 64 S48 =  0 S49 =  6 S50 =  0 S51 =  0 S52 =  0 S53 =  0
```

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```
S126=  0 S127=  0
S54 = 0 S55 = 0 S56 = 0 S57 = 0 S58 = 0 S59 = 0 S60 = 0 S61= 0 S62 = 0
S63 = 0 S64 = 0 S65 = 0 S66 = 0 S67 = 0 S68 = 0 S69 = 0 S70= 0 S71 = 0
S72 = 0 S73 = 0 S74 = 0 S75 = 0 S76 = 0 S77 = 0 S78 = 0 S79= 0 S80 = 0
S81 = 0 S82 = 0 S83 = 0 S84 = 0 S85 = 0 S86 = 0 S87 = 0 S88= 0 S89 = 0
S90 = 0 S91 = 0 S92 = 0 S93 = 0 S94 = 0 S95 = 0 S96 = 0 S97= 0 S98 = 0
S99 = 0 S100= 2 S101= 0 S102= 0 S103= 61 S104= 72 S105= 0S106= 9 S107= 6
S108= 7 S109= 0 S110= 7 S111= 0 S112= 51 S113= 7 S114= 0 S115= 10 S116= 0
S117= 0 S118= 0 S119= 0 S120= 0 S121=252 S122= 0 S123= 0 S124= 0 S125= 0
```

Check to make sure that your DTE Channel is set to either 1 or 2.

Use AT&O1 or AT&O2 to change the DTE channel. Also check to make sure that you are using V.120 with a 56K channel. ATB2 switches to V.120 while AT&E1 tells the Elite 2864I to utilize the 56K bandwidth. (As of this writing, our phone company only allows a 56K link outside of our local switch.)

Now you are ready for your first call. As a test, you may dial our BBS line at 714-939-7524.

Type ATD17149397524<cr>.

You should now see the B1 LED go on.

If everything was set up correctly, you should see the following:

```
     CONNECT 460800/V120 5600/LAPD
  FrontDoor 2.20c.mL/OX000046; MultiLine

   Press <Esc> twice for ZyXEL BBS
```

From this screen, you can either continue the session or hang up.

We are now ready to try a bundled (2 B channels) connection.

To make a bundled connection, follow the above instructions, with one change:

You must let the Elite 2864I know that you want to make a bundled connection. Typing AT&J1 will tell the Elite 2864I to set up a bundled call. When dialing into an AT&T 5ESS or a Seimens EWSD switch, you would dial a normal ATD<number>. If you are dialing into a DMS switch, then tell the remote Elite 2864I that it needs to make 2 separate connections. This is accomplished by typing:

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ATD<number1>+<number2>. To dial our BBS, type AT&J1<cr>. Then type
ATD17149397524+17149398563<cr>. You should see the following:

```
 CONNECT 460800/V120 112000/LAPD
FrontDoor 2.20c.mL/OX000046; MultiLine

   Press <Esc> twice for ZyXEL BBS
```

From this screen, you can either continue or hang up.

Chapter 4

2864I COMMUNICATION
BASICS

In this chapter, you will learn the basics of ISDN communication as it relates to operating your Elite 2864I. With tables designed for easy reference, you'll understand how to make a call and establish a connection. You'll also learn how to answer a fax/modem call, and how to set up the Elite 2864I to accept calls going to more than one phone number. With the Multiple Subscriber Number table built-in, you can assign calls coming in to a certain number to be routed to a specfic function (eg. the fax function). You'll also learn about protocols relating to Internet access.

Logical Channel

Switching Logical Channels

As we have explained earlier, in order to meet most of your personal communications needs, the 2864I has 4 major communication channels built-in to communicate with the network.

> One for analog data (modem/fax),
> Two for ISDN data
> One for POTS port communication.

Let's take a look at how the channel is switched and how to use AT&V to verify changes. At your terminal program, proceed with the following instructions:

Type
`AT&F <ENTER>`   (Set 2864I to manufacturer default value)

2864I returns
`OK`

Type
AT&V0 (View current setting)

2864I returns
```
Switch Type : Northern Telecom DMS
DTE Channel : 2      Outgoing Service : V.120 64K
Calling Party Number :()
...
```

Here, the default DTE channel has been set to 2 (ISDN data), and Outgoing service
has been set to V.120 64K. Now let's issue a command to change the channel:

Type
AT&O0 (Set 2864I to channel 0)

2864I returns
```
OK
```

Type
AT&V0

2864I returns
```
Switch Type : Northern Telecom DMS
DTE Channel : 0      Service : Fax/Modem/Voice
Calling Party Number :()
...
```

Here, the DTE channel has been set to 0 (Fax/Modem/Voice), and the Service has
been set to Fax/Modem mode. You can change all fax/modem setups in this channel.
Let's issue an ISDN calling command and see what happens. Remember we are
currently in channel 0, fax/modem mode.

Type
ATDI11111110   (Ttrying to make an ISDN call)

2864I returns
```
NO CARRIER  (No ISDN data device connected to this number)
```

Type
AT&V0

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2864I returns:
```
Switch Type :Northern Telecom DMS
DTE Channel : 2        Outgoing Service : V.120 64K
Calling Party Number :()
...
```

The command "ATDI" has forced the 2864I to switch back to channel 2, ISDN data mode. Let's issue a fax command in this mode to see what happens.

Type
AT+FCLASS=2.0   (Trying to set the 2864I to fax mode)

2864I returns
ERROR (The command is not accepted)

The command is not accepted because the current channel can not perform fax functions. Our design team is currently working on an upgrade that will allow commands like this to perform channel switch functions for you. You should see some improvement in this area soon. Let's try one more test to switch it back to fax/modem function:

Type
ATDM11111110   (Trying to make a modem call)

Type any key to interrupt 2864I's attempt to connect to the remote modem
2864I returns
NO CARRIER (No modem is connected)

Type
AT&V0

2864I returns
```
Switch Type : Northern Telecom DMS
DTE Channel : 0       Service : Fax/Modem/Voice
Calling Party Number :()
```

An "M" command following the "ATD" will perform channel switching to the modem/fax function for you. It would be helpful, if you would put an "M" before the modem number, and an "I" before the ISDN data number. This way you won't need to change the Dialing Prefix of your communication software each time you dial to a different device.

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INCOMING CALLS

When a call comes in, as we have explained in a previous section, it can be one of the following types of communication protocol:

In ISDN data communication, the user information could be carried by:

❖   V.120

❖   HDLC PPP or SLIP

❖   X.75

❖   X.75 with CAPI

❖   V.110

In analog communication, the user information could be carried by:

❖   Modem data

❖   Fax

❖   Voice.

When an ISDN data call comes in, for North American applications, the 2864I is able to determine that it is an incoming ISDN data call. However, it not able to differentiate between a V.120 and HDLC PPP or HDLC SLIP. It will not be able to decide whether to send the call to the internal modem/fax or analog adaptor, even if it has identified it as an analog call.

This might create a problem in answering the call when the device is not set up properly. In most cases, if you only expect one type of call, you can set up the default to the type of communication protocol that is needed. However this will only be an annoyance if you have more than one type of call coming in. The following section will provide some general guidelines for setting up the device for call answer handling.

Be aware that the Elite 2864I will not automatically answer a call, even if it can identify the type of incoming call, unless the S0 register for that particular channel is set to greater than 0. Otherwise, it will only report "RING" to your terminal program. It can also sound (with an audible tone) a notification that will allow you to decide whether or not you should to take any action.

By defult the 2864I will use the protocol defined in DTE channel 2 to pick up any incoming calls. This is the V.120 protocol.

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When an analog call comes in, the 2864I will send the call to the POTS port as the factory default.

You have two different options to make the 2864I behave exactly the way you want when answering incoming calls. Let us break it down into two data types: ISDN and analog. Let's also break it into two separate categories: general setup and specific setup.

The Elite 2864I is able to tell whether the incoming call is either a digital or an analog data call before it picks up. The information is exchanged when the call is set up through the signaling protocol. (the 2864I will not answer a call unless S0 is set to greater than 0 for the channel used for answering calls).

Incoming Call Type	General Setup	Specific Setup
ISDN Data	Configure Channel 2 DTE to the expected protocol coming in (ATBnn in channel 2). Channel 2 outgoing protocol will be used as the default protocol to answer an incoming ISDN data call when the protocol used by remote is not recognizable.	Lookup Called-Party-Number and matching protocol on the AT&ZIn table. Use the specific protocol to answer a specific call (recognized by the number that caller dialed).
	Commands to Issue: AT&O2 (change channel to 2) ATBnn (select protocol) AT&W (save the selection) ATZ (reset and make the new changes the power on setting)	AT&ZIn=s s=Multiple Subscriber Number (the number(s) has been assigned to your ISDN line by your local phone company) n=0-4 n=0, assign the MSN to X.75 n=1, assign the MSN to V.110 n=2, assign the MSN to V.120 n=3, assign the MSN to HDLC SLIP

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Analog Calls	Set the priority parameter. Either the POTS port has a higher priority or the built in modem/fax has a higher priority when an analog call comes in (AT&Ln in any channel, it is a common parameter).	Lookup Called-Party-Number and matching protocol on the AT&ZIn table. Use the specific protocol to answer a specific call (recognized by the number that caller dialed).
	Command to Issue: AT&L1 (select built-in modem/fax has higher priority to answer a voice-band call, unless it is busy.)	Command to Issue: AT&ZIn=s s=Multiple Subscriber Number (the number(s) has been assigned to your ISDN line by your local phone company)
	AT&W (save the selection) ATZ (reset and make the new changes the power on setting)	n=5-6 n=5, assign the MSN to internal modem/fax n=6, assign the MSN to the Analog adapter.

Related command reference:

ATD<options>		Dial <number and options> that follows (see also S38b0, S35b4); Digits and modifiers that can be used with the "D" command:
	0-9,#,*	Digits for dialing
	P	Pulse dial
	T	Tone dial
	,	Pause for a time specified in S8
	;	Return to command state after dialing
	!	Hook flash, call transfer (see also S56)
	W	Wait for a second dial tone (see also S6)

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	@	Wait for a 5-second silence before proceeding, otherwise return "NO ANSWER"
	R	Reverse dial (go on-line in ANSWER mode)
<ISDN options>		ISDN specific options for ISDN call
	I	ISDN call
	M	Modem call

The following commands will be referred to later in this chapter.

ATBnn		Active outgoing protocol to be used when ISDN call is made. When ATZIn is not set, ATBnn value in channel 2 will be used as the default protocol for answering ISDN data call
ATB0n		X.75 Teleservice for channel 1-2
	B00	X.75 Transparent
	B01	X.75 T.70
ATB2		Select V.120 for communication
ATB4n		Select async. to sync. HDLC conversion for communication
	B40	HDLC async to sync. conversion for PPP
	B41	HDLC async to sync. conversion for SLIP
AT&Dn		Data Terminal Ready (DTR) options. (See also S25)
	&D0	Ignore DTR signal, assume DTR is always ON.
	&D1	108.1, DTR OFF-ON transition causes dial of the default number. (See also "AT*Dn" and S48b4)

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	&D2	108.2, DTR OFF causes the modem to hang up.
	&D3 *	Same as &D2, but DTR OFF causes the modem to hang up and reset from profile 0.
AT&Ln		Modem and Analog Adaptor address ambiguity resolution in answering mode when AT&ZIn is not set or same value(s) is(are) set for both analog channels.
	&L0 *	Analog Adaptor (CH 3) has higher priority.
	&L1	Fax/Modem (CH 0) has higher priority.
AT&Jn		B channel bundling protocol negotiation.
	&J0	No bundling protocol will be negotiated.
	&J1	Enable bundling protocolnegotiation for V.120 or X.75 only.
AT&Kn		Error control and data compression for DTE channels
	&K0	No error control.
	&K1	MNP4+MNP3 for modem.
	&K2	MNP4+MNP5 for modem, LAPD error control for V.120 and X.75.
	&K3	V.42+MNP4 for modem.
	&K4	V.42bis for modem and V.120, X.75.
AT&En		B channel line speed
	&E0	64Kbps.
	&E1	56Kbps

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AT&Wn	n=0-3	Write current settings to user profile n in NVRAM. (See also S35b6)
AT&Zn=s	n=0-49	Write phone number s to NVRAM at location n (n=0-49). Use AT*Dn or ATS29=n to set the default dial pointer.
AT&Sn		Data Set Ready (DSR) function selection.
	&S0 *	DSR overridden. DSR always ON.
	&S1	DSR according to CCITT (ITU-TSS). (See also S41b5, S44b4)
AT&On		Select the logical DTE channel.
	&O0	Select DTE Channel 0 (fax/modem).
	&O1	Select DTE Channel 1 (ISDN B).
	&O2	Select DTE Channel 2 (ISDN B).
	&O3	Select DTE Channel 3 (analog adapter).

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Fax/Modem Setup

Switching to the Fax/Modem Channel

The use of the 2864I's modem/fax functions do not vary much from typical modem/fax products. This is especially true if you are already familiar with the Elite 2864 or the U-1496 products. We will go through the major differences between the 2864I and a regular modem/fax device so you can begin to apply your current knowledge of modem/fax products.

Difference Points	2864I	2864 series modem/fax
Data Voice Button	Can be used to force answering a call. It has limited function in an ISDN environment	Can be used to force answering a call. When used with phone set connected to the modem's phone jack, the call can be manually switched between the modem and phone set.
Phone Jack	Not available; A/B adapter is not the same as phone jack. A call to the internal modem/fax can not be passed through to the A/B adapter	Available, and it is connected to the same channel as the modem.
Telephony Function	Voice functions are not available at this time. Even if they are implemented, there are limitations.	Full voice function is available, including Telephony functions. Can be used with the phone connected to the Phone Jack for recording and message playback.

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Leased Line Function	Not available	2 wire leased line functions standard, optional 4 wire leased line available
Password and Call Back Security	Not available currently, could be upgraded later.	Available now
Data and Voice at the same time	Use channel 0 for modem/fax data and A/B adapter for voice	Not available
Loopback testing	Different	Different
Caller ID	From signaling information	FSK signal between first and second ring
Distinctive Ring and EDR	Distinctive Ring from signaling information, EDR not available	Use Ring pattern for Distinctive Ring, EDR supported

In most cases, you should be able to use the same program setup you used for the U-1496, to set up the Elite 2864I. This is particularly true if AT&O0 can be added in the beginning of the initialization string. We are also making drivers available for different application programs. Please check with ZyXEL's technical support staff, if you encounter any problems when running certain programs. Following are some of the most frequently used commands for your reference:

AT Command	Description
ATDM	This will automatically dial out using channel 0. This is the modem/fax channel.
ATDPM	This will automatically dial out using channel 0 in pulse mode.
ATDTM	This will automatically dial out using channel 0 in tone mode.

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AT Command	Description
ATZ	This will initialize the modem.
AT&D2	DTR Off causes the modem to hang up.
AT&D3	Same as &D2 but DTR Off causes the modem to hang up and reset to profile 0.
AT&F	Load Factory setting into RAM as active configuration.
AT&H3	Data flow control, DTE/DCE (S27b3-5.) Hardware (CTS/RTS) flow control.
AT&K4	Error control and data compression; for DTE channel 0. V.42bis for modem and V.120, X.75.
AT&N0	Data link mode option, DCE to DCE. Multi-Auto, auto negotiate highest possible link rate: V.34, ZyX 19200, ZyX 16800, V.32bis, V.32, V.22bis, V.22 and Bell 212A, G3 Fax V.17/V.29/V.27ter and cellular modes (See also S38b4, S43b0, S43b1, S43b3 and S48b5)
ATS0=0	S0=0 disable auto-answer; the range of rings is country specific.

Making a Call and Connecting Messages

A modem or fax call is usually initiated from your communication software(s). It can be a data communication program or a fax program. Before a call is made, the application software will first set up the modem/fax. This ensures that it will function properly with your software application and with the remote modem/fax.   An initialization string is usually sent to the modem/fax device before the remote number is dialed.

Most software allows you to enter an additional initialization string in case the standardized initialization string doesn't work properly. Drivers should be located in your 2864I box (on the diskette labeled "Drivers"). You can get the latest drivers on ZyXEL's BBS, CompuServe Forum, Web site, and FTP site.

If you can not find a proper driver to install and work with the 2864I, we suggest you select the U-1496 series or the 2864 series drivers. If you are not using the specific

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driver designated for the 2864I, you may be forced to alter the setup string, in order for it to work properly with your data communication/fax programs.

You should select the highest communication speed your software supports. (115.2Kbps or higher is needed to take advantage of some of the features of the 2864I.)

Add AT&O0 to the beginning of the initialization string, so the modem/fax channel will be selected before any modem/fax configuration parameters are sent to the 2864I.

Change the dialing prefix from ATDT to ATDM, if you frequently switch between ISDN data communication and modem/fax communication.

Once a modem call is made, the 2864I will report a conncetion result.   Depending on your setting, the result code can be as simple as "CONNECT" and as complete as "CONNECT 115200/V.34 28800/V42b/SREJ".   The following table shows the different options available when setting the ATXn command. The default "n" value is 5 when the device is shipped.

ATV0	ATV1	ATVX	X1	X2	X3	X4	X5	X6	X7
0	OK	V	V	V	V	V	V	V	V
1	CONNECT	V	V	V	V	V	@	$	#
2	RING**	V	V	V	V	V	V	V	V
3	NO CARRIER	V	V	V	V	V	V	V	V
4	ERROR	V	V	V	V	V	V	V	V
5	CONNECT 1200		%	%	%	%	@	$	#
6	NO DIAL TONE			V		V	V	V	V
7	BUSY				V	V	V	V	V
8	NO ANSWER				V	V	V	V	V
9	RINGING*				V	V	V	V	V
10	CONNECT 2400		%	%	%	%	@	$	#
11	CONNECT 4800		%	%	%	%	@	$	#
12	CONNECT 9600		%	%	%	%	@	$	#
14	CONNECT 19200		%	%	%	%	@	$	#
15	CONNECT 7200		%	%	%	%	@	$	#
16	CONNECT 12000		%	%	%	%	@	$	#
17	CONNECT 14400		%	%	%	%	@	$	#
18	CONNECT 16800		%	%	%	%	@	$	#

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ATV0	ATV1	ATVX	X1	X2	X3	X4	X5	X6	X7
19	CONNECT 38400		%	%	%	%	@		
20	CONNECT 57600		%	%	%	%	@		
21	CONNECT 76800		%	%	%	%	@		
22	CONNECT 115200		%	%	%	%	@		
23	CONNECT 230400		%	%	%	%	@		
24	CONNECT 460800		%	%	%	%	@		
25	CONNECT 921600		%	%	%	%	@		
26	CONNECT 307200		%	%	%	%	@		
27	CONNECT 153600		%	%	%	%	@		
28	CONNECT 102400		%	%	%	%	@		
29	CONNECT 61440		%	%	%	%	@		
30	CONNECT 51200		%	%	%	%	@		
31	CONNECT 624000		%	%	%	%	@		
32	CONNECT 124800		%	%	%	%	@		
33	CONNECT 62400		%	%	%	%	@		
34	CONNECT 41600		%	%	%	%	@		
39	CONNECT 28800		%	%	%	%	@	$	#
40	CONNECT 26400		%	%	%	%	@	$	#
41	CONNECT 24000		%	%	%	%	@	$	#
42	CONNECT 21600		%	%	%	%	@	$	#

V	Supported
%	Reporting DTE rate
@	CONNECT DTE speed/Protocol Link speed/Error control level*** Example: CONNECT 38400/V.32bis 14400/V.32bis
$	CONNECT Link speed/Error control (ARQ) Example: CONNECT 14400/ARQ
#	CONNECT Link speed/Error control (ARQ)/Error control level*** Example: CONNECT 14400/ARQ/MNP5

* Use S42b6 to disable "RINGING" result code

** When more than one type of Distinctive Ring is turned on (S40b3-6) "RING n" will be reported, n = Ring Type # (1-4)

*** Data compression included. "SREJ" is appended if a V.42 connection with selective reject is established

Use ATS35 bit 7 (ATS35.7=1) to enable the following numerical result codes when an error control connection is made.

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Answering a Fax/Modem Call

When an analog call comes in, you will be required to make a decision about where the call should be routed; to the internal modem/fax or to the analog adapter (POTS port).

Incoming Call Type	General Setup	Specific Setup
Analog Calls	Set the priority parameter, either the POTS has a higher priority or the built-in modem/fax has a higher priority when an analog call comes in (AT&Ln in any channel, it is a common parameter). Command to issue:	Look up Called-Party-Number and matching protocol on the AT&ZIn table. Use the specific protocol to answer a specific call (recognized by the number that caller dialed). Command to issue:
	AT&O0 (change to channel 0)	AT&ZIn=s
	AT&L1 (select built-in modem/fax has higher priority to answer a voice-band call, unless it is busy.) or AT&L0 (select A/B adapter has higher priority to answer a voice-band call, unless it is busy.)	s=Multiple Subscriber Number (the number[s] has been assigned to your ISDN line by your local phone company) n=5-6 n=5, assign the MSN to internal modem/fax. n=6, assign the MSN to the A/B adapter.
	AT&W (save the selection)	
	ATZ (reset and make the new changes the power-on setting.)	

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When the Elite 2864I is shipped, the default setting is such that analog calls are routed to the analog adapter. When a voice call comes in, if you have a phone connected to the analog adapter, it should ring. The internal modem/fax will not notice if a call has come in.

If you want all the calls to be routed to the internal modem/fax of your Elite 2864I, issue the following commands:

AT&L1[ENTER]
Route analog calls to the internal modem/fax channel, channel 0

AT&W0[ENTER]
Write the setting to NVRAM, thereby ATZ0 initialize the modem making them the default power-on setting.

These simple commands will route all analog calls to your modem/fax channel. If you have S0 set (i.e. S0=1), the Elite 2864I will answer the call using channel 0, and try to handshake with the remote device when an analog call comes in. If S0 is not set (S0=0), it will report "RING" to the serial port that the Elite 2864I is connected to, and will make an audible notification.

When you have two or more phone numbers (Multiple Subscriber Number) assigned to your ISDN line, you can program the Elite 2864I to direct incoming calls to the specific modem feature you desire. The Elite 2864I has a built-in table that lets you program the modem to direct calls to the specific module (based on the number dialed) where you want the call to be routed.

Suppose you have two numbers assigned to your ISDN line:

714-693-1111
714-693-2222

and you would like to have 714-693-2222 answered by channel 0, modem/fax. You also would like 714-693-1111 answered by channel 3, and passed to the analog adapter when an analog call comes in. The following commands will be issued:

AT&ZI6=6932222 [ENTER]
Assign Subscriber Number, 6932222, to channel 0, modem/fax

AT&ZI7=6931111[ENTER]
Assign SN, 6931111, to channel 3, analog adapter.

The value will be automatically saved without further instructions.

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Any analog call made to you thereafter, dialed at 6932222, will always be routed to channel 0, and analog calls dialed at 6931111 will always be routed to channel 3.

This setting will only affect analog calls. ISDN data calls will not be affected.

You are not required to enter the complete number string for the AT&ZIn command. The last few distinguishable digits will be enough for the Elite 2864I to make the decision. For example, the following commands will yield the same results:

```
AT&ZI6=2[ENTER]
AT&ZI7=1[ENTER]
```

For information on complete list of AT&ZIn Commands, please refer to Appendix E.

Printing A Received Fax Directly To Your HP Laser Printer

The 2864I provides direct fax reception and printing, which routes incoming faxes directly to your HP laser printer.

This feature lets you obtain plain-paper laser copies of incoming faxes, without having to purchase an expensive dedicated plain-paper facsimile machine.

Direct Fax Reception

The Elite 2864 supports HP LaserJet II and compatible printers, as well as laser printers that support the HP PCL II programming command language. This broad base of support includes nearly all HP-compatible laser printers available on the market.

To access the modem's direct fax reception feature:

1. Use a cable that has a female DB-25 connector at one end for your modem's PARALLEL connector, and the appropriate connector on the other end for your laser printer.

Note: *If you are using a standard PC printer cable to make this connection, you'll need a female-to-female adapter to connect the cable to your modem.*

2. Verify that you have made all other necessary modem connections described in Chapter 3.

3. Turn on your computer, laser printer, and modem. Make sure your laser printer has sufficient paper to accommodate incoming faxes.

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4.   Load your communications software and place it in either terminal-ready or direct-connect mode.

5.   Issue AT&L1, this will give the Fax/Modem (CH 0) higher priority. Or, if you wish, you can set AT&ZIn, (refer to the topic discussed in an earlier section of this manual).

6.   Issue AT&O0 to select DTE Channel 0 (internal date/fax/voice).

7.   Type ATS0=n, where "n" is a number between 1 and 255. This number indicates the number of incoming rings that will occur before the modem automatically answers a call.

8.   Type AT+FCLASS=Z and press the Enter key. You will receive an OK result code from your modem.

9.   Type AT+FZF=n and press Enter, where "n" equals one of the following values:

0 =   modem answers fax calls only and routes them to the laser printer. If a printer is not connected, or if a voice or data call is received, the modem automatically hangs up.

1 =   modem answers fax and data calls. Then it routes the fax call to the parallel port and the data call to the serial port.

You will receive an OK result code from your modem.

Type AT&WZ to save the setting and make it the power on value.

Note: *Since you connected your modem's parallel connector to the laser printer, use an RS-232 cable to connect the modem's serial connector to your computer.*

(Please refer to the section on cable connection).

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Storing Received Faxes in Memory

ZyXEL offers optional DRAM modules that let you store received faxes in the modem's memory. Instructions for installing this module can be found in Appendix A.

If you desire, you can combine this feature with the direct fax reception (described in the previous section) to store and print received faxes.

1. Load your communications software and place it in terminal-ready or direct-connect mode.

2. Issue AT&L1, this will give the Fax/Modem (CH 0) higher priority (or you can set AT&ZIn, (refer to earlier section).

3. Issue AT&O0 to select Channel 0.

4. Type ATS0=n, where "n" is a number between 1 and 255. This indicates the number of incoming rings that occur before the modem automatically answers a call.

5. Type AT+FCLASS=Z and press the Enter key. You will receive an OK result code from your modem.

6. Type AT+FZF=n where n equals one of the following values:

2 = Modem answers fax calls only, stores the fax in memory, and also routes it to a laser printer (if one is connected).

3 = Modem answers fax calls only and stores the fax in memory

Type AT&WZ to store the value and make it the power on default.

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Using The Analog Adapter

Placing a call

Making a call from the analog adapter is as easy as picking up the telephone device that is connected to the analog port and dialing the number. With a terminal program's assistance you can also use the Elite 2864I to dial the number for you:

Type
AT&O3[ENTER]   (Switch to channel 3)

2864I returns
OK

Type
ATDT714-693-0808[ENTER]   (Dial the number)

2864I returns
CONNECT   (Dialing is complete)

You can now pickup the phone handset and wait for the remote device to answer.

Limitation

If you are using the Elite 2864I to do modem or fax communication, you should set your phone to Pulse dialing. This is because the Elite 2864I has dedicated all the DSP resources for modem communication. Therefore, it might have difficulty detecting the DTMF tone if Tone dialing is used. Once the number is dialed, you can switch back to Tone dialing, if you need to use DTMF tones for communication needs.

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Answering

When an analog call comes in, you need to make a decision as to where the call should be routed: to the internal modem/fax or to the analog adapter (POTS port).

Incoming Call Type	General Setup	Specific Setup
Analog Calls	Set the priority parameter, either the POTS port has a higher priority or the built in modem/fax has a higher priority when an analog call comes in (AT&Ln in any channel, it is a common parameter)	Lookup Called-Party-Number and matching protocol on the AT&ZIn table. Use the specific protocol to answer a specific call (recognized by the number that caller dialed)
	Command to Issue: AT&O0 (change channel to 0) AT&L1 (select built in modem/fax has higher priority to answer a voice-band call, unless it is bury.) AT&L0 (select A/B adapter has higher priority to answer a voice-band call, unless it is busy) AT&W (save the selection) ATZ (reset and make the new changes the power on setting)	Command to Issue: AT&ZIn=s s=Multiple Subscriber Number n=5-6 n=5, assign the MSN to internal modem/fax n=6, assign the MSN to the A/B adapter

The Elite 2864I's default setting will automatically route all analog calls to the analog adapter. When a voice call comes in, if you have a phone connected to the analog adapter, it should ring. The internal modem/fax will not notice a that phone call has come in. Use the AT&L command to change analog call routing.

`AT&L1[ENTER]`   (Route analog calls to internal modem/fax channel, channel 0)

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`AT&L0[ENTER]`   (Route analog calls to A/B adapter (if you need the setting to be saved and used as the power on default value, the AT&W0Z0 command will be needed.)

What if you have more than one number (Multiple Subscriber Number) assigned to your ISDN line, and you only want calls made to a particular number to be routed to channel 3? The Elite 2864I has a Multiple Subscriber Number table built-in, that lets you specifically route calls for any given number to a certain channel, or to be answered in a specific way.

Say you have two numbers assigned to your ISDN line:

714-693-1111
714-693-2222

and you would like to have 714-693-2222 answered by channel 0, modem/fax; and 714-693-1111 answered by channel 3, A/B adapter when an analog call comes in. The following commands will be issued:

`AT&ZI6=6932222[ENTER]`
Assign SN, 6932222, to channel 0, modem/fax

`AT&ZI7=6931111[ENTER]`
Aassign SN, 6931111, to channel 3, analog adapter.

The value will be automatically saved without further instructions. Any analog call you make thereafter, dialed to 6932222, will always be routed to channel 0, and analog calls dialed to 6931111 will always be routed to channel 3.

This setting will only affect analog calls. ISDN data calls will not be affected.

You are not required to enter the complete number string for the AT&ZIn command. The last few distinguishable digits will be enough for the Elite 2864I to make the decision. For example, the following commands will yield the same results:

`AT&ZI6=2[ENTER]`
`AT&ZI7=1[ENTER]`

For further information on AT Commands, please refer to Appendix E.

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ISDN Data Communication Basics

Digital Data

The Elite 2864I currently supports Circuit Switched Data (CSD) for ISDN data applications. The CSD protocols supported by the Elite 2864I include: V.120, X.75 and V.110. V.120 is the most popular protocol used in North America. Recently, some ISDN Internet service providers have started using synchronous Point-to-Point Protocol (PPP) to provide access for remote ISDN users. This protocol is also supported by the Elite 2864I.

Determining the Packet Length

The user's information is sent on a frame-by-frame basis for V.120 and X.75 protocols. Sometimes we call it "packetized". The maximum frame length on the sending side should not exceed the maximum frame length that the receiving side allows. Sometimes this information will be exchanged during handshaking. However, few manufacturers, if any, have implemented this mechanism.

If the sending side sends packets greater than what the receiving side allows, the receiving side will discard the frame and reply with a Frame Reject Frame (FRMR). The FRMR indicates that the information received is too long. Both sides will then reset their link layer negotiation and re-send the frame again. Usually this will happen repeatedly until the call gets disconnected.

The Elite 2864I has a fixed maximum receiving frame size of 2048 bytes which is larger than most devices can support. The default maximum sending frame size is 252 bytes, which is small enough that it should not create any problems. If you need to change the maximum sending frame size, the ATCL command should be used.

Type
`ATCL=252[ENTER]`   (Set the frame size to 252 octets, user value between 1-2048)

2864I returns
`OK`

Type
`ATCL?` (To inquire about the current setting of the packet length)

2864I returns
`Maximum user data length in a packet (byte) : 252`

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For further information on AT Commands, please refer to Appendix E.

Which Channel To Use?

Logical DTE channels 1 and 2 are allocated for ISDN data communication purposes. You can use either channel interchangeably for your digital data communications. You can use one channel for your outgoing calls and the other channel (preferably channel 2) for receiving calls. This way, you will not have to re-configure the channel for answering, when changing the setting for special calls.

V.120 ISDN digital data communication

Making a call, connecting a message

To make a V.120 call, you'll need to select the proper DTE channel first. It can be either channel 1 or channel 2. For illustration purposes, we will use channel 2. You can always change the commands if you need to change the selection to channel 1 (AT&O1 to select channel 1).

Some switches transmit all the network signals through the D channel, allowing both B channels to be used exclusively for your communication purposes. This allows a throughput of 64Kbps per channel. However, not all switches support out-of-band signaling at this time. For switches that do not support out-of-band signaling, network signals are transmitted through the B-channels. This reduces the bandwidth to 56Kbps. This happens most frequently when you are making a call across different types of switches.

When you are making a V.120 call, you'll need to make sure that the communication supports Out-of-Band signaling. If it does not support out-of-band signaling, you'll need to set your Elite 2864I to 56K mode using the AT&E1 command. Use AT&E0 to set it back to 64k mode. If your Elite 2864I is on the receiving end, you can keep the setting at AT&E0, 64k data mode. The Elite 2864I will automatically switch between the two speeds.

You can also use the "ATDI" command in your dialing string to perform channel switching. However, you'll need to make sure the channel you are switching to is setup for V.120 communication. The "ATDI" command will switch the DTE channel to channel 2, if the DTE is not already located at channel 1 or 2.

To make a 56K V.120 call:

Type
AT&O2[ENTER]   (Switch to channel 2)

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2864I returns
OK

Type
ATB2 (Select V.120 for communication)

2864I returns
OK

Type
AT&E1 (Select 56K data mode)

2864I
OK

Now you are ready to dial the phone number. If you need to save the setting into NVRAM, issue the commands:

Type
AT&W[ENTER]   (Save the settings)

2864I
OK

Type
ATZ[ENTER] (Make the stored settings as the power on settings)

2864I
OK

All the above commands can be simplified to:

AT&O2B2&E1&WZ[ENTER]

This way, you can combine all the commands into one line. Make sure the channel switching command (&On) is on the left-most side, since the Elite 2864I performs commands from left to right.

Use the ATDnnn command to make the call. Once the connection is made, you should see the following connect message:

     CONNECT 115200/V120 56000/LAPD

This indicates that the connection is made with:

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DTE speed of   115,200bps
Protocol V.120
Date Speed   56,000bps
Error Control LAPD

To enable V.42bis Data Compression, you can set the ISDN data channel to AT&K4. The default value for V.120 is &K3 which controls LAPD error correction only. No data compression will be negotiated here. With the &K4 setting, the 2864I will try V.42bis data compression. If the remote side doesn't support V.42, then LAPD error correction will be used.

You can try to enable AT&K4 and call our BBS at 714-939-7524. You should be able to see the V.42bis connection:

```
CONNECT 115200/V120 56000/V42b.
```

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The following table shows the V.120 related result codes:

ATBn	Xn	Connect Messages
00	0	Connect
	1	Connect 115200
	2	Connect 115200
	3	Connect 115200
	4	Connect 115200
	5	Connect 115200/X.75 56000/X.75
	6	Connect 56000
	7	Connect 115200/X.75 56000/X.75
	0	Connect
	1	Connect 115200
	2	Connect 115200
	3	Connect 115200
	4	Connect 115200
	5	Connect 115200/V.120 56000 LAPD
	6	Connect 56000/ARQ
	7	Connect 56000/ARQ/LAPD
	&K4 X5	Connect 115200/V.120/56000/V.42b
	&K4 X6	Connect 56000/ARQ
	&K4 X7	Connect 56000/ARQ/V.42b
40	0	Connect
	1	Connect 15200
	3	Connect 15200
	5	Connect 115200/PPP 56000 None
	6	with &K3, &K4 Error
	7	with &K3, &K4 Error

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Answering incoming calls

V.120 and HDLC PPP or HDLC SLIP are almost identical in the way they call the Elite 2864I (during the call setup signaling). For this reason, you'll need to determine how you want the Elite 2864I to answer the call. This is especially true, if you are receiving combinations of all three types of calls.

When an ISDN data call comes in, the 2864I will automatically route the call to data channel 2, unless a Multiple Subscriber Number has been programmed to setup otherwise. Once the call gets routed to channel 2, the 2864I will not automatically answer, unless S0 is set to greater than 0. If S0 is set to 1, the 2864I will answer the call right away, using the protocol that is set up for that channel. To check which protocol is set up for channel 2, use the following commands:

Type
AT&O2 (Switch to channel 2)

Type
AT&V   (View setting)

2864I returns:
Switch Type :Northern Telecom DMS
DTE Channel :2   Outgoing Service : V.120 64K
Calling Party Number :()

The second part of the second line shows the protocol that is currently set. This will be the default protocol, used to answer all future calls unless otherwise indicated in AT&ZIn table.

When the Elite 2864I is shipped, V.120 64K is the default setting for channel 2.

If you need to verify the setting, you can issue these commands:

AT&O2 (Select channel 2)

ATB2&E0 (Select V.120 (B2) and 64K data (&E0))

AT&W (Write the setting to NVRAM)

ATZ (Reset and make new changes as the power on setting)

or issue all the commands in one line:
AT&OZBZ&E0&WZ[ENTER]

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There is no need to set the Elite 2864I to 56K data in answer mode. The Elite 2864I will make the change according to the signal sent by the calling party. These simple commands will set V.120 as your default ISDN data answering protocol. If you have S0 set (i.e. S0=1), the 2864I will answer the call using channel 2, and will try to handshake with the remote device using V.120 protocol. If S0 is not set (S0=0), it will change the channel to 2 and report "RING" to the serial port that the Elite 2864I is connected to. It will also provide an audible notification.

What if you have more than one number (Multiple Subscriber Number) assigned to your ISDN line, and you only want calls made to a particular number to be answered by V.120? The Elite 2864I has a Multiple Subscriber Number table built-in for you to specifically route calls for certain numbers to specific channels or to be answered in a certain way.

Suppose you have two numbers assigned to your ISDN line:

> 714-693-1111
> 714-693-2222

and you'd like to have 714-693-2222 to be answered by fax and receive fax directly to your HP laser printer; and 714-693-1111 to be answered by channel 2, V.120. The following commands will be issued:

```
AT&ZI6=6932222    (Assign SN, 6932222, to channel 0, modem/fax)
AT&ZI2=6931111   (Assign SN, 6931111, to channel 2, V.120.)
```

The value will be automatically saved without further instruction. Any analog call thereafter dialed into 6932222 will always be routed to channel 0, and any analog call dialed into 6931111 will always be routed to channel 2.

You'll need to make sure that channel 0 has been setup to receive fax only. You should also be certain that the fax you received will be redirected to the HP laser printer connected to the parallel port of the 2864I. For details, please refer to the "Printing A Received Fax Directly to Your HP Laser Printer" section of this Guide. The following command should perform this function

> ```
> AT&O0S0=1+FCLASS=Z+FZF=0
> ```

You don't need to enter the complete number string for the AT&ZIn command. The last few distinguishable digits will be enough for the Elite 2864I to make the decision. For example, the following commands will yield the same results:

> ```
> AT&ZI6=2[ENTER]
> AT&ZI2=1[ENTER]
> ```

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Speed of 128Kbps

Narrow band ISDN (also called Basic-Rate-Interface, or BRI) consists of three (2B+D) logical channels. Each B channel can be used independently for a dialup connection running at 56K or 64K bps (bits per second).

The two B channels can be used together for a single data connection to provide 112K (with In-Band Signaling) or 128K (when Out-of-Band Singling is used). It is called a "Bundle Connection" (different from BONDING). If V.42bis data compression is used, the line speed can go over 250Kbps for typical text file transfer.

Identifying your line provisioning

For bundled connections, the two B channels of your ISDN line must be able to handle data circuit switch connections with unrestricted 64K or 56K bps line speeds. Two separate data calls will be established consecutively. The Multiple Link Protocol (MLP) will be used to bundle the two B channels.

Making a Bundled Call

The channel bundling command AT&J1 must be set on both sides. Otherwise a single channel connection will be made.

Type
AT&J1

and type
AT&WZ   (If you want to save the setting)

Once this is done, the ATD command will generate two consecutive SETUP messages to invoke bundle initiation.

For the Northern Telecom switch, each BRI phone number can only be called once at any given time. So if you dial this number, it will report "busy" to any other incoming calls.

When placing a call to a number served by a Northern Telecom switch, each B channel can only handle 1 setup message. In order to use two B channels for aggregation, we must place two calls with different phone numbers. To do this, seperate the two numbers with a "+" sign after the "ATD" command:

    ATD[phone_number_1]+[phone_number_2][ENTER]

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The answering Elite 2864I determines that the call is a bundle request: when AT&J1 is set, and two consecutive SETUP messages are received. The two data calls are established as one message. The phone company's ISDN line splits it off into two messages. That is, the ISDN network treats them as two independent calls. Finally, the receiving side receives one bundeled message into the computer's serial port.

The success of a bundle connection initiation is indicated by the connect message reported to the DTE:

```
CONNECT 115200/V120 128000/LAPD or
CONNECT 115200/V.120 112K/V42b with data compression
```

Async. to Sync. HDLC

Internet and remote access PPP and SLIP

More and more Internet Service Providers are offering their services through dial-up ISDN lines for higher data bandwidth. The equipment used at the service provider's location are frequently ISDN LAN routers which, unlike Terminal Adapters, do not have asynchronous capability. For this reason, Terminal Adapters that support only V.120 or asynchronous protocol will not work with this type of equipment.

The Elite 2864I is able to convert the asynchronous data it receives from your computer to synchronous format in order to communicate with ISDN LAN routers. We call this process asynchronous to synchronous HDLC conversion. To simplify it, call it HDLC PPP (Point-to Point Protocol) or HDLC SLIP (Serial Line Internet Protocol) protocol.

In order to communicate with an ISDN LAN router (from vendors such as Ascend and Cisco), you'll need to set your Elite 2864I for HDLC PPP mode. Select the proper channel and issue the command:

```
Type    ATB40       HDLC PPP
Type    ATB41       HDLC SLIP
```

You should also set the channel speed based on the bandwidth the switches support. Until new standards are set, there are no universal standards for us to follow for data compression. At this time, the Elite 2864I only supports a single channel for HDLC PPP communication.

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Asynchronous to Synchronous HDLC

Setting up the Elite 2864I to answer a synchronous PPP call

Most of the time, you will use this protocol for making calls to ISDN LAN routers. If you are setting the Elite 2864I for a Remote Access host, you want to set it to HDLC PPP (even if you are running PPP protocol). If the calling site is using a Terminal Adapter or Elite 2864I, V.120 will be a better choice as it provides data compression and channel bundling.

When you are connecting to Internet Service Providers or Remote Access Server using ISDN LAN Router:
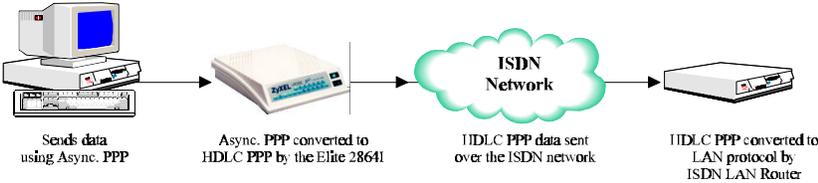
Figure 4-1

If you have Elite 2864I-like equipment installed at both ends, the communicaiton will look like:

Figure 4-2

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In case you need to set up HDLC PPP to answer a call, (and this is the only type of call that you will receive), you should change channel 2 protocol to HDLC PPP. This is done by using the ATB40 (or ATB41 for SLIP) command, since all ISDN data calls will be routed to channel 2. If more than one type of call is coming in, you should use the Multiple Subscriber Number table for call routing.

To check which protocol is set for channel 2, use command:

Type   AT&O2   Switch to channel 2
Type   AT&V   View settings

2864I returns
Switch Type :Northern Telecom DMS
DTE Channel : 2   Outgoing Service : Transparent 64K
Calling Party Number :()
...

"Transparent" means that it has been set to HDLC PPP mode.

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Incoming Call Type	General Setup	Specific Setup
ISDN Data	Configure Channel 2 (ISDN B2) to the expected protocol going to come in (ATB*nn* in channel 2). Channel 2 outgoing protocol will be used as the default protocol to answer an incoming ISDN data call when the protocol used by the remote device is not recognizable. Command to issue:	Look up Called-Party-Number and matching protocol on the AT&ZI*n* table. Use the specific protocol to answer a specific call (recognized by the number that caller dialed). Command to issue:
	AT&O2 (change to channel 2.)	AT&ZI*n=s*
	ATB*nn* (select protocol.) AT&W (save the selection) ATZ (reset and make the new changes the power on setting)	*s*=Multiple Subscriber Number (the number[s] has been assigned to your ISDN line by your local phone company) *n*=0-4 *n*=0, assign the MSN to X.75. *n*=1, assign the MSN to V.110. *n*=2, assign the MSN to V.120. *n*=3, assign the MSN to HDLC PPP. *n*=4, assign the MSN to the HDLC SLIP.

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When the 2864I is shipped, V.120 64K is the default setting for channel 2.

To change the settings, you can issue the commands:

```
AT&O2<Enter>   (Select channel 2)
ATB40&E0<Enter>  (Select HDLC PPP (B40) and 64K data (&E0)
AT&W<Enter>  (Write the setting to NVRAM)
ATZ<Enter>   (Reset and make the new changes the power on setting)
```

You don't need to set the Elite 2864I to 56K data in receiving mode. It will change according to the signal sent by the calling party. These simple commands will set HDLC PPP as your default ISDN data answering protocol. If you have S0 set (i.e. S0=1), the Elite 2864I will answer the call using channel 2. It will use asynchronous to synchronous conversions to and from the DTE. If S0 is not set (S0=0), it will change the channel to 2 and report "RING" to the serial port that the Elite 2864I is connected to. It will also make an audible notification.

What if you have more than one number (Multiple Subscriber Number) assigned to your ISDN line, and you only want calls made to a particular number to be answered by HDLC PPP? The Elite 2864I has a Multiple Subscriber Number table built-in. that lets you specifically route calls for any given number to certain channel or to be answered in a specific way.

Suppose you have two numbers assigned to your ISDN line:

        714-693-1111
        714-693-2222

and you would like to have 714-693-2222 answered by your fax function. Then, after you receive the incoming fax, you want it directly routed to your HP laser printer for printing. You also want 714-693-1111 to be answered by channel 2, HDLC PPP. Then the following commands will be issued:

```
AT&ZI6=6932222<Enter>    (Assign SN, 6932222, to channel 0, modem/fax)
AT&ZI3=6931111<Enter>     (Assign SN, 6931111, to channel 2, HDLC PPP.)
```

The value will be automatically saved without further instructions. Any analog call you make thereafter (dialed at 6932222) will always be routed to channel 0, and analog calls dialed at 6931111 will always be routed to channel 2. This setting will only affect analog calls. ISDN data calls will not be affected.

You'll need to make sure that channel 0 is setup to receive fax only. You'll also need to ensure that the fax received will be redirected to the laser printer that is connected to the parallel port of the Elite 2864I. For further information, please refer to the "Print Received Fax Direct to HP Laser Printer" section.

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```
     AT&O0  S0=1+FCLASS=Z+FZF=0
```

You are not required to enter the complete number string for the AT&ZIn command. The last few distinguishable digits will be enough for the Elite 2864I to make the decision. For example, the following commands will yield the same results:

```
AT&ZI6=2<Enter>
AT&ZI3=1<Enter>
```

For futher information on AT Commands, please refer to Appendix E.

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Chapter 5

SPECIAL PROTOCOL CONFIGURATIONS

This chapter will describe how to setup and configure your Elite 2864I with X.75 and V.110 protocols. It will also describe Data Encryption Standard (DES) and its application within a growing market of companies and individuals who are concerned with sending and receiving secured messages. With many helpful tables, this chapter provides many tips on working with various kinds of protocols. It even provides a section on the embedded protocol analyzer, which records and analyzes various protocols on the B-channel, D-channel and the DTE-DCE interface.

X.75 and V.110 Setup

X.75 was originally designed for packet-switched signalling systems in public networks to provide data transmission services. But it is now also used as the link layer for telematic services (as defined in T.90) in ISDN. These services include both ISDN circuit-switched mode (DTE-DTE communication) and ISDN packet-switched mode (DTE-DCE communication).

	V.110	**V.120**	**X.75**
Layer 1	80 Bits Framing	HDLC	HDLC
Layer 2	None	LAPD	LAPB Transparent
Layer 3	None	V.120	ISO8208 T.70 NL
Error Control	No	Yes	Yes
V.42bis	No	Yes	Yes

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Async or Sync if used with V-Series DTE	Async and Sync	Async Only	Async Only
Bundle	No	Yes	Yes
Max. Line Speed	Async: 38.4 Kbps Sync: 64 Kbps	One B-Channel: 64 Kbps Bundle: 128 Kbps	One B-Channel: 64 Kbps Bundle: 128 Kbps
AT-Command Configuration	ATB1	ATB2	ATB0: Transparent ATB01: T.70 NL ATB02: ISO8208 ATB03: T.90 (Note*)

Note * : *T.90 specifies ISO8208 as its layer 3 protocol, but an optional usage of T.70 NL is allowed.*

Placing an X.75 Call

CAPI 1.1a specifies X.75 with T.70 NL as its default.

CAPI 2.0 specifies X.75 with transparent layer 3 as its default.

The default data protocol of the Elite 2864I is ATB20, (that is, V.120). X.75 protocols can be chosen using the following AT commands:

ATB0 or **ATB00** X.75 with transparent layer 3
ATB01 X.75 with T.70 NL
ATB02 X.75 with ISO8208 (DTE-to-DTE X.25 packet layer)
ATB03 X.75 with T.90

The ATB0x commands not only specify the outgoing protocol, but also set the default layer 3 for an incoming X.75 call without layer 3 information. It is important for both ends of an X.75 connection to execute the same preassigned layer 3 protocol, since there is no way for both ends to obtain layer 3 information from the other side via the SETUP message.

Placing a V.110 Call

Placing an Async V.110 Call

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Make sure that the Elite 2864I is in the asynchronous mode (AT&M0). Then use the following commands to configure V.110:

       ATB1   User rate follows DTE speed (Note)
       ATB13   User rate = 2400 bps
       ATB14   User rate = 4800 bps
       ATB15   User rate = 9600 bps
       ATB16   User rate = 14400 bps
       ATB17   User rate = 19200 bps
       ATB18   User rate = 38400 bps

Note :   *The highest async V.110 user rate is 38400 bps. If the DTE speed is higher than this, the user rate will be 38400 bps. The X bits in the 80-bit frame will be used for remote flow control.*

Placing a Sync V.110 Call, use the following commands to configure V.110 for synchronous operation :

       ATB1   User rate determined by in-band negotiation
       ATB13   User rate = 2400 bps
       ATB14   User rate = 4800 bps
       ATB15   User rate = 9600 bps
       ATB16   User rate = 14400 bps
       ATB17   User rate = 19200 bps
       ATB18   User rate = 48000 bps
       ATB19   User rate = 56000 bps
       ATB11   User rate = 64000 bps

Note :   *The Elite 2864I does not support network independent clock compensation. The synchronous timing source must be supplied by the Elite 2864I, which is phase locked to the network synchronous clock.*

There are two modes of V.110 synchronous operation :

1)   A**synchronous commands, synchronous data (AT&M1):**
      The 2864I accepts AT commands in asynchronous mode. Once the call is connected, it enters synchronous mode for data transmission.

2)   **Synchronous mode (AT&M3):**
      The Elite 2864I accepts synchronous commands **(V.25 bis)** and exchanges data synchronously with a remote TA. Synchronous communication has traditionally been used by larger computers.

For further information on AT Commands, please refer to Appendix E.

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X.75 Data Encryption

For many years, the cryptographic protection of data communication has been a matter of importance only to military or government security agencies. But during the last two decades, with the advance of microelectronics and computer-communication technology, the following trends may change its significance and application:

1)   Companies and individual users rely more on data communication to exchange sensitive information. Specifically, more and more people are using ISDN for LAN-to-LAN interconnection and Internet services.

2)   Inexpensive but powerful equipment makes the interception job of wire-tappers or hackers easier than before.

3)   It is possible now for civilians to employ security practices that can protect against even the most powerful adversaries.

Note: *ZyXEL does not assume any liability arising out of the application or use of any of the security functions described in this chapter. Neither does it convey any license under its patent rights nor the rights of others.*

Data Encryption Standard (DES)

DES is a Federal Information Processing Standard in the United States. DES is a block cipher: that means it encrypts data in 64-bit blocks. A 64-bit block of plain text goes in one end of the algorithm, and a 64-bit block comes out of the other end. Both encryption and decryption use the same algorithm. The key length is 56 bits. Some of the 56-bit numbers are considered to be weak keys. But the weak keys will be automatically avoided by 2864I. One major criticism of the DES standard, is that its key is too short to survive the brute force (exhaustive search) attack of today's technology.

Triple DES, which uses two DES keys, has been adopted to improve the DES algorithm in ISO 8732 standard. In this way, the equivalent key length is 112 bits, and the resultant cipher text is much harder to break using an exhaustive search : 2^{112} attempts instead of 2^{56} attempts.

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The table below is an estimation of security, depending on key length using the 1990s' technology: (Please refer to Dr. Dobb's Journal, April 1994 for more detailed information):

Key Length	Time for a $1M Machine to Break	Time for a $1B Machine to Break
56Bits	3.5 hours	13 seconds
100Bits	7 billion years	7 million years
128Bits	1018 years	1015 years

Manual DES Key Generation

The Elite 2864I currently supports encryption with X.75 protocol. The key used by DES can be manually entered via an AT command before each connection is made (the Elite 2864I will not remember the Key you used).

```
Type   ATCK<DES_Key>
Example ATCK<678901234567890>[Enter]
```

Use the above example to preset the DES key. The DES_Key is a string of printable characters. The number of characters in the string should be larger than 15 and less than 65. The AT command interpreter will convert the string DES_Key to a real DES key. The Elite 2864I will check to see if the converted key is a weak key for DES, if so, it modifies the key according to a predetermined rule to get a non-weak key.

Both ends of an ISDN link should key in the same DES_Key before a DES ISDN call can be established. Failure to do so will cause either an immediate disconnection or an unintelligible connection.

You can combine the DES_Key with your dialing string when you are making a call or combining it with your answering string when you are answering a call. For example:

When dialing   ATCK<678901234567890>D6931111[Enter]

When answering   ATCK<678901234567890>A[Enter]

This way, the encryption key is given to 2864I just before it is needed.

Control of Data Encryption

The AT commands to control the data encryption are as follows :

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ATS102.0 = 1   DES is desired
ATS102.0 = 0   DES is disabled (Default)
ATS102.1 = 1   Triple DES is preferred
ATS102.1 = 0   Single DES is preferred (Default)
ATS102.2 = 1   Use a manually generated key

The DES request as well as any key distribution parameters, are exchanged via XID frames in the same way as V.42bis negotiation. Interested users can use the embedded protocol analyzer to examine the structure of XID frames. Both V.42bis and the data encryption functions can be invoked simultaneously for an ISDN data call. But the DES can not be used for bundle connections, due to the limitation of computing resources.

LED Indicators For Data Encryption

The B-channel LED indicator (B1 or B2) lights up when the B-channel is connected. A single blinking LED indicates that data transmission is protected by Data Encryption Standard (DES). A triple blinking LED indicates that data is protected by triple DES.

For further information on the AT Commands, please refer to Appendix E.

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Embedded Protocol Analyzer

Embedded Protocol Analyzer Setup

The embedded protocol analyzer (hereafter abbreviated as EPA) records and analyzes various protocols on the B-channel, D-channel and DTE-DCE interface. The results are displayed with ANSI color. This professional tool is designed for hobbyists as well as users with technical backgrounds. The EPA enables you to examine messages exchanged between your Elite 2864I and the Central Exchange office when making an ISDN call. You can review the packets sent or received through the B-channel (for X.75 or V.120) to or from the remote site. You can also check the AT commands issued from an application software program. This will help you understand their causal relationship with other events.

In addition to its tutorial purpose, the EPA is very useful for diagnostics. If you have compatibility problems with your Central Exchange or with the TAs at the remote site, the EPA will be your first aid resource. According to the EPA's analysis, you may decide to fix the problem yourself (e.g. modify the configuration and try again) or log the analyzed results as a file (a very comprehensive bug report), and then send it to ZyXEL's Tech Support department.

Capturing the Protocol Data

The data captured by the EPA can be classified into three categories:

> B-channel user data protocols
> D-channel signalling protocols
> DTE-DCE protocols

The D-channel signalling protocols include layer 2 and layer 3 call control protocols. Frames and messages exchanged via the D-channel are all recorded for further analysis. These data messages are essential to understanding interactive operations between an ISDN TA and the ISDN network. They contain the compatibility information for the Elite 2864I and your Central Exchange.

The B-channel user data protocols include X.75 and V.120. Only the layer 2 header (addresses and control bytes) and layer 3 header are captured. Since X.75 may be used with various layer 3 protocols (e.g. T.70, T.90, and ISO8208), only the first 8 octets of the information field are recorded as the layer 3 header, and are displayed in raw data form. The analysis of the protocol data will be carried out by ZyXEL's Technical Support department.

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The DTE-DCE protocols (at the R reference point according to the ISDN nomenclature) include the AT commands/responses as well as the CAPI internal interface. The CAPI internal interface is used with ZyXEL CAPI driver. The ZyXEL CAPI driver communicates with the Elite 2864I through this internal interface. It is not recommended that users get involved in this internal interface. The AT commands/responses, on the other hand, are in a standard user interface. An analysis of these commands and responses might prove very informative. All messages captured by the EPA are tagged with a time stamp according to a free running timer that starts at the beginning of data capture. The resolution of this timing information is in 0.01 second. The following commands determine the kind of protocol data to be captured by the EPA :

ATCDn

      CD0   Disable the capture of D-channel protocols

      CD1   Enable the capture of D-channel protocols (default)

ATCBn

      CB0   Disable the capture of B-channel protocols (default)

      CB1   Enable the capture of B-channel protocols

ATCCn

      CC0   Disable the capture of DTE-DCE interface protocols (default)

      CC1   Enable the capture of DTE-DCE interface protocols

The EPA starts to capture data when the command ATCT is issued. This capturing process will continue until the command ATC$ is issued. The EPA maintains 8 KByte RAM as a ring buffer. In case the buffer is full, the earliest data captured will be overwritten by the latest data.

Analyzing the Captured Data

To view the analyzed result, use the command ATC$. For convenience, the relevant AT commands are summarized as follows:

ATCT   Clears buffer and starts the embedded protocol analyzer. Captures data immediately and starts the timer.

ATC$ Invokes the interpretation function of the embedded protocol analyzer and displays the results on the DTE screen.

The analyzed result can be viewed as if it were in a full screen editor. Several number keys are used to control the display. For PC users, it is convenient to use the keys on the numeric keypad (make sure that NumLock is on.).

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The functions of the control keys are summarized as follows:

Key	Function	Description
1	End	Display to the end of buffer
2	Cursor down	Scroll one line up
3	Page down	Display the next page
7	Home	Display the first page
8	Cursor up	Scroll one line down
9	Page up	Display the previous page
Q,q	Quit	Quit embedded protocol analyzer

Any other key will pop up this control menu.

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Control of The Outgoing Service Indicator

The Bearer-Capability as well as the Called-Party-Number/Keypad information elements are essential to initiate an ISDN call. The Bearer-Capability information element indicates what kind of bearer services are desired. The Called-Party-Number/Keypad provides the necessary information for the CO to direct the call to the remote party. Other optional information elements which are pertinent to call control include: High-Layer-Compatibility, Low-Layer-Compatibility, Called-Party-Subaddress, Calling-Party-Number, and Calling-Party-Subaddress. The purpose of the Bearer-Capability information element is to indicate the type of requested bearer service provided by the network. It can also be used for compatibility checking in the addressed entity. The purpose of the High-Layer-Compatibility information element, as well as the Low-Layer-Compatibility information element, is to provide a means for compatibility checking by the called party. They are transferred transparently (by the ISDN network) between the call originating entity (e.g. the calling user) and the addressed entity.

Outgoing High-Layer-Compatibility can be controlled by setting S114. Defined values of S114 are as follows:

S114=0   No High-Layer-Compatibility information element will be sent
S114=1   Telephony
S114=4   Facsimile Group 2/3
S114=40   Teletex service (Rec. F.220)
S114=49   Teletex service (Rec. F.200)
S114=50   International interworking for video services (Rec. F.300 and T.110)
S114=53   Telex service (Rec. F.60)
S114=56   Message Handling Systems (MHS) (Rec. X.400 series)
S114=65   OSI application (Rec. X.200 series)

The default value of S114 for all DTE channels is 0.

Bearer-Capability and Low-Layer-Compatibility information elements will be determined when you are using command ATBn. The outgoing Low-Layer-Compatibility can be turned on or off as follows:

S115.4=0   Disable outgoing Low-Layer-Compatibility (default)
S115.4=1   Enable outgoing Low-Layer-Compatibility

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Control of ISDN Phone Number and Subaddress

The purpose of the Calling_Party_Number information element is to identify the origin of a call. The Called_Party_Number/Keypad information element identifies the destination of a call.

Each DTE channel of the Elite 2864I can be assigned with one number-subaddress pair by using the command:

    AT&ZO = s

The number-subaddress-string "s" is defined as follows:

s=[[Yn][Nn]own-number or A][/[[Zn]own-subaddress]/]
where Yn specifies the type of number:
Y0   unknown (default if Yn is omitted)
Y1   international number
Y2   national number
Y3   network specific number
Y4   subscriber number

Nn is the identifier of numbering plan:
N0   unknown (default if Nn is omitted)
N1   ISDN numbering plan (Rec. E.164)
N3   data numbering plan (Rec. X.121)
N4   telex numbering plan (Rec. F.69)
N8   national standard numbering plan
N9   private numbering plan

Zn specifies the type of a subaddress:
Z0   NSAP (Rec. X.213) with AFI=0x50, IA5 characters (default if Zn is omitted)
Z2   user specified, IA5 characters

Modifier A is used to remove the assignment of its own number.

AT&ZO=//   will remove the assignment of the subaddress.

While dialing, the number and subaddress assigned by AT&ZO=s, if any, will be used for Calling_Party_Number and Calling_Party_Subaddress information elements respectively. The default settings of its own number and subaddress of all the DTE channels are UNASSIGNED. This means the SETUP message, sent by the Elite 2864I, contains neither Calling_Party_Number nor Calling_Party_Subaddress

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information elements. The command AT&V can be used to view the number and subaddress setting of the active DTE channel.

Answering a Call

When answering an incoming call, the call will first be identified as either an ISDN data call or a voice call (including the voice-band-data). ISDN data calls will be assigned to DTE channel 1 or DTE channel 2. Voice calls or voice-band-data calls will be assigned to DTE channel 0 (built-in fax/modem) or DTE channel 3 (analog adapter). The Multiple Subscriber Number (MSN) supplementary service enables multiple ISDN numbers to be assigned to a single ISDN BRI line. It allows the caller to select, via the public network, one or more distinct terminals from a variety of terminal choices. Since the Elite 2864I is a highly integrated multi-function ISDN modem, it is just like having a black box that contains multiple distinct terminals. Each of these "internal terminals" can be assigned one ISDN number using the following command:

        AT&ZIn=s n=0-7
        &ZI0   assign the MSN for X.75;
        &ZI1   assign the MSN for V.110;
        &ZI2   assign the MSN for V.120;
        &ZI3   assign the MSN for PPP async to sync HDLC;
        &ZI4   assign the MSN for SLIP to sync HDLC;
        &ZI6   assign the MSN for internal fax/modem;
        &ZI7   assign the MSN for the analog adapter.

AT&ZI? can be used to display the MSN numbers assigned by the AT&ZIn=s commands. The factory default for these numbers are UNASSIGNED.

If an incoming SETUP message is offered with addressing information (i.e. the appropriate part of the called_party_number), this address will be compared with the MSN numbers assigned by the AT&ZIn=s commands. The call will be accepted using the specific protocol, if the assigned number of this protocol matches the received called party number.

Note: *Two phone number strings are said to be matched if their least significant "n" digit(s) are identical, where "n" is the number of digits of the shorter string. Usually one digit is enough to distinguish the various protocols.*

Called_Party_Subaddress information within the incoming SETUP message is not used by the Elite 2864I to select the protocols or services. It just indicates the subaddress (if any) to the DTE.

For a voice (or voice-band-data) call, if the called_party_number matches with the MSN of the internal fax/modem or the analog adapter, the call will be delivered to

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the proper destination. However, there are times when an ambiguity of address matching exists. This may happen if the MSN numbers belonging to the various protocols are either unassigned or not matched. It may also occur when the address information is absent in the incoming SETUP message. In this case, users may prioritize that the call be answered by the built-in fax/modem or the analog adapter (for external devices). The AT&Ln command sets the address ambiguity resolution flag:

AT&L0   Analog adapter has a higher priority to answer the voice or voice-band-data call. If the analog adapter is busy, the call will be forwarded to the internal fax/modem.

AT&L1   The built-in fax/modem has a higher priority to answer the voice-band call. If the internal fax/modem is busy, the call will be forwarded to the analog adapter.

The Elite 2864I can exclusively determine the protocol to be used by means of the information conveyed by the SETUP message. Either one of the various protocols (i.e. the Bearer-Capability, Low-Layer-Compatibility, or High-Layer-Compatibility information elements), or the indicated protocol will be used. Otherwise, the called party number will be compared with the MSN of various ISDN B channel protocols. If there is a match, the protocol corresponding to the matched MSN will be used. If the address-matching process is, again, unable to tell which protocol will be used, a default protocol for ISDN data connection will then be used to answer the call. The default protocol for answering an ISDN data call is the same as the outgoing service protocol of DTE channel 2, which is assigned using the command ATBn in DTE channel 2.

Data calls, digital or analog, are accepted in the same way as with a typical modem. When alerted, the Elite 2864I will send a RING message to the DTE in the following format:

RING
[FM:[[Prefix]Calling-Party-Number][/Calling-Party-Subaddress/]]
[TO:[Called-Party-Number][/Called-Party-Subaddress/]]

The term [Prefix] is a predefined number string that can be assigned as follows:

ATCI<Prefix>   When and only when the type-of-number denotes an international number this "Prefix" will be added to the Calling_party_number before communicating to the DTE.

ATCI<>   Disables the international number prefix-adding function. (Default)

ATCN<Prefix>   When and only when the type-of-number denotes a national number, this "Prefix" 0 will be added to the Calling_party_number before communicating to the DTE channel

ATCN<>   Disable the national number prefix-adding function.(Default)

* The result may vary based on your local phone company

Placing a Call

To initiate a call, choose the proper DTE channel and configure the channel according to the bearer service (or protocol) you want to use.

AT&Nn or AT+FCLASS=n   for DTE channel 0 (internal fax/modem)
ATBn   for DTE channel 1 or DTE channel 2 (data call)

The ATD command is used for dialing:

ATD[Yn][Nn]called _party_number[/[Zn]called-party-subaddress/]
where Yn specifies the type of number:
Y0   unknown (default if Yn is omitted)
Y1   international number
Y2   national number
Y3   network specific number
Y4   subscriber number

Nn is the identifier of numbering plan:
N0   unknown (default if Nn is omitted)
N1   ISDN numbering plan (Rec. E.164)
N3   data numbering plan (Rec. X.121)
N4   telex numbering plan (Rec. F.69)
N8   national standard numbering plan
N9   private numbering plan

Zn specifies the type of subaddress:
Z0   NSAP (Rec. X.213) with AFI=0x50, IA5 characters (default, if Zn is omitted)
Z2   User specified, IA5 characters

The called_party_number/keypad or an appropriate part of it will be sent to the addressed entity. The called_party_subaddress will be transferred transparently by the ISDN network to the destination.

Use ATDL to redial the last dialed telephone number (and/or subaddress).

For further information on AT Commands, please refer to Appendix E.

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Chapter 6

Diagnostics

This chapter provides quick easy-reference diagnostic tables for the Elite 2864I. The Elite 2864I can perform its own diagnostic tests, which can provide invaluable information about the each of its functions.

The Elite 2864I ISDN modem provides several diagnostic capabilities:

❖ Embedded Protocol Analyzer (See Chapter 12in the Users manual)

❖ Power-on Self-test

❖ Analog Loopback Test (For internal fax/modem only)

❖ Analog Loopback with Self-Test (For internal fax/modem only)

❖ Local Digital Loopback Test

❖ Remote Digital Loopback Test (For internal fax/modem only)

❖ Remote Digital Loopback with Self-Test (For internal fax/modem only)

❖ Re-transmission Indicator

❖ Link Status Report (For internal fax/modem only)

❖ ISDN Modem Reset

For a detailed description of those diagnostic functions that are exclusive to the internal fax/modem, please refer to the Elite 2864 Series Modem User's Manual.

Power-on Self-test

At each power-up or upon a reset command from the panel, the modem will test the main-board's:

ROM code checksum, system RAM memory, DSP code checksum, DSP RAM memory, EEPROM, digital circuits and analog circuit calibrations. The Elite 2864I will also test the ISDN daughter board to make sure that the interface circuits are ready to perform.

Main-board's Self-test

The HLD LED will be ON during power-on main-board self-test. The LED will be OFF after the test, if it tested out OK. The LNK LED flashes if the test fails. The number of times the LED blinks indicate the number of errors according to the following table:

1.   ROM code checksum error.

2.   System RAM fail.

3.   EEPROM checksum error. The factory default settings will be downloaded to the EEPROM and the self-test will be re-initiated. This is not a real error.

4.   The testing of DSP RAM fails - Condition A.

5.   The testing of DSP RAM fails - Condition B.

6.   Analog circuit calibration error. (VO calibration fail)

7.   Analog circuit calibration error. (VR calibration fail)

8.   Analog circuit calibration error. (FR calibration fail)

9.   Communications between controller and DSP fail - Condition A.

10. Communications between controller and DSP fail - Condition B.

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ISDN Daughter Board's Self-test

Once the main-board's self-tests have been passed, the Elite 2864I starts to test the ISDN daughter board and its interface with the main-board. There are six test items for this test. Each test takes about half a second. The following table is a summary of the ISDN daughter-board self-test:

Test Seq.	LED B1	LED B2	LED AA	Test Description
1	on*	off	off	Siemens 2086 chip's address/data bus test
2	off	on*	off	Siemens 2086 chip's functional test
3	off	off	on*	Siemens 2160 chip's functional test
4	on*	off	off	Interface test 1 with Siemens 2086 chip
5	off	on*	off	Interface test 2 with Siemens 2086 chip
6	off	off	on*	Interface test 3 with Siemens 2086 chip

*Note : *The LED lights up while test is going and blinks if the test fails. The LNK LED lights up for half a second to indicate the success of the Elite 2864I's power- on self-test. After this, the LNK LED will become the normal physical layer (layer 1) active indicator.*

Loopback Test (AT&T1)

If the Elite 2864I is in the internal fax/modem channel, i.e. DTE Channel 0 (AT&O0) it is the analog loopback test mode. Issuing an AT&T1 will initiate the loopback test, please refer to the 2864 series modem user's manual for more information. If the Elite 2864I is in the ISDN data channel, i.e. either DTE Channel 1 (AT&O1) or DTE Channel 2 (AT&O2), the AT&T1 command will invoke an ISDN loopback test connection. The loopback point is in the S/T interface chip (Siemens 2086 chip) or the U interface chip (Siemens 2091 chip) just behind the line transformers. Thus, it checks almost every part of the ISDN TA and RS-232 cable, except the passive front-end of the ISDN S/T interface.

During this test, data from the terminal or computer is sent through the DTE interface to the ISDN modem's transmitter and is packetized to the proper frame format according to the B-channel protocol selected. Then it is loopbacked to the receiver, depacketized, and sent through the DTE interface back to the terminal or computer's screen. You can tell if anything is wrong by looking at the screen. The screen should show the data you have sent to the ISDN modem.

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Loopback with Self-test (AT&T8)

If the Elite 2864I is in the internal fax/modem channel, i.e. DTE Channel 0 (AT&O0). The AT&T8 command is the analog loopback with self-test. Please refer to the 2864 series modem user's manual for more information. If the Elite 2864I is in the ISDN data channel, i.e. either DTE Channel 1 (AT&O1) or DTE Channel 2 (AT&O2), the AT&T8 command will invoke an ISDN loopback connection with a self-test. The data is generated by the ISDN modem and will go through the same path as the Loopback test goes through. The data pattern is in printable ASCII characters. You can see the result on the screen. The loopbacked data is compared with the transmitted data. Should an error occur, the LNK LED will start to flash. Sending any character through the DTE interface to the ISDN modem will discontinue the test.

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Appendix A

Upgrading Your Modem

This appendix describes how to upgrade flash EEPROM and add DRAM memory modules.

Upgrading with Flash EEPROM

Your Elite 2864I modem employs a flash EEPROM that lets you conveniently download updated firmware, and program the modem with new features and enhanced functions.

1. Obtain the new firmware from ZyXEL's BBS, WWW, or FTP site (refer to Appendix B).

2. Turn on your PC and Elite 2864 modem.

3. Start any communications program that supports the Xmodem protocol.

4. Type ATUPX, press Enter, and wait for the following prompt characters:

   ```
   You have chosen Xmodem (128 bytes of data with
   checksum) protocol to update your modem. Data in
   Flash ROM will be erased !!!

    Are you sure (Y/N) ?
   ```

5. Press Y. The following message then appears:

   ```
    Start programming, please upload
   ```

6. Use the Xmodem protocol to upload the file E2864I.vvv to your modem. This step updates the modem's flash EEPROM with the new firmware. When installation is complete, the modem will restart automatically.

In the unlikely event that your modem fails to respond to AT commands after upgrading the EEPROM:

❖   Turn off the modem.

❖   Press the O/A button while turning on the modem, then release the button after a few seconds. A kernel program, responsible for the update process, takes control of the modem. It accepts a limited set of AT commands, including the ATUPX command.

❖   Repeat steps 1 through 6 to upload a file that contains valid firmware for your modem.

For further information on AT Commands, please refer to Appendix E.

Installing DRAM

The following procedure describes how to install either 4 MB or 8 MB of optional DRAM to your Elite 2864I. This installation allows your modem to store fax pages in memory .

This installation requires you to have a flat-blade screwdriver and one, two, or four DRAM chips (Texas Instruments TMS461400-70 DJ chips are recommended). If you have a problem locating these chips, please contact ZyXEL Technical Support at (714) 693-0808.

☹ *Use extreme care when handling DRAM chips and touching the components on your modem's printed circuit board. Both contain sensitive components that are prone to damage from electrostatic discharge. Always follow antistatic precautions while handling electronic components.*

To upgrade the DRAM in your Elite 2864I modem:

1. Remove the screw on the bottom-center of the modem.

2. Use a flat-blade screwdriver to gently pry the tabs located on either side of the modem.

3. Remove the top cover of the modem.

4. Find the four empty DRAM sockets, labeled U26, U27,U38, and U39. Facing the front of the modem, you can find these sockets centered along the right side of the printed circuit board (see Figure A-1).
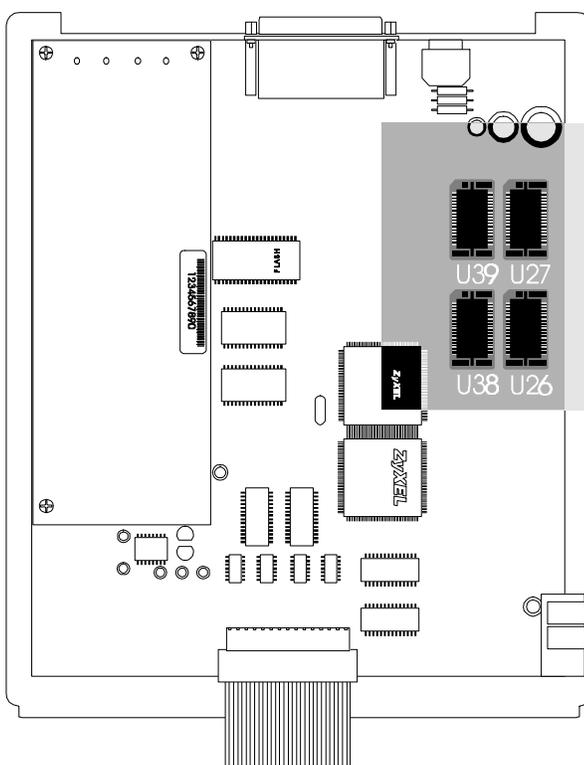
5. Align the dot or notch on the chip with the notch on the modem socket. The arrow in Figure A-1 shows the notch location for the top left socket.

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6. Install the DRAM chips (Texas Instruments TMS 461400-70 DJ chips are recommended) as follows:

To install 4MB of DRAM, install chips in DRAM sockets **U38** and **U39** (see Figure A-1)

Top install 8MB of DRAM, install chips in DRAM sockets U26, U27, U38 and U39 (see Figure A-1)

7. Carefully align the tabs on the top cover with the slots at the base of the modem, then replace the top cover and the screw you removed.

This completes the DRAM installation procedure.

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Appendix B

Contacting ZyXEL

ZyXEL takes pride in its products and its customers. We are continually striving to improve our products, and design them with your current and future communication requirements in mind.

To help us in that effort, we welcome your comments and provide a number of ways for you to contact us.

Voice Telephone Number

You can reach ZyXEL between 8:00 am and 5:00 pm PST at (714) 693-0808

Fax Number

ZyXEL provides the following 24-hour fax number for technical support and other comments: (714) 693-8811

BBS Number

ZyXEL operates a 4-node BBS 24 hours a day. This BBS contains updates to ZyXEL's ZFAX communications software, modem-configuration guidelines, software-setup instructions, and the latest firmware. SysOp pricing information and order forms are also available from the BBS.

To call the ZyXEL analog BBS, configure your modem 8 data bits, no parity bit, and 1 stop bit. Then dial (714) 693-0762.

To call the ZyXEL digital BBS using one B channel , configure your modem and then dial (714)939-7524.

To call the ZyXEL digital BBS using both B channels, configure you modem and then call (714) 939-7524 + (714) 939-8563.

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On-Line Access

You can also send E-mail to ZyXEL at the following Internet, FTP, Fidonet, and CompuServe addresses:

❖ **Internet**
   Sales inquiries: sales@zyxel.com
   Technical support: tech@zyxel.com

❖ **FTP**
   Address: ftp.zyxel.com
   ZyXEL-related information, such as ZyXEL software and ROMs, can be found in the /pub/other/zyxel directory.

❖ **Fidonet**
   Primary address: 1:103/725
   Secondary address: 1:202/701.101

❖ **CompuServe**
   CIS ID: 71333,2734
   Forum: GO ZYXEL
   Sales inquiries: internet:sales@zyxel.com

World Wide Web

ZyXEL has a home page on the World Wide Web (WWW). If you have a WWW browser, such as Mosaic, you can access this page at the following location: http://www.zyxel.com

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Appendix C

Phone Jack Pin Assignments

The Elite 2864I series ISDN modem features one RJ-45 phone jack and one RJ -11 phone jack. The RJ-45 (ISDN S) jack is for ISDN line connection (S/T interface), and the RJ-11 jack (PHONE) (it is also known as an A/B adapter in European countries) is for an optional connection to analog telephone equipment such as a telephone set or answering machine, fax machine or analog modem.

 The signals on the RJ-45 pins of S/T interface are:

1   Not Connected
2   Not Connected
3   RCV +
4   XMT +
5   XMT -
6   RCV-
7   -48V
8   -48V RTN

The signals on the RJ-11 analog adapter pins are:

1   Not Connected
2   Ring
3   Tip
4   Not Connected

For the U interface model, the signals on the RJ-45 pins are:

1   Not Connected
2   Not Connected
3   Not Connected
4   Ring
5   Tip
6   Not Connected
7   -48V
8   -48V RTN

Appendix D

ZyXEL Parallel Port Interface

Pinouts of the Parallel Port

Signal Pin	Signal Name	Description	Direction Adapter to Printer
1	- STROBE	Strobe Pulse	⇨
2	DATA 0	Data signal; bit 0	⇔
3	DATA 1	Data signal; bit 1	⇔
4	DATA 2	Data signal; bit 2	⇔
5	DATA 3	Data signal; bit 3	⇔
6	DATA 4	Data signal; bit 4	⇔
7	DATA 5	Data signal; bit 5	⇔
8	DATA 6	Data signal; bit 6	⇔
9	DATA 7	Data signal; bit 7	⇔
10	ACKNLG	Acknowledge signal; data is received by printer and printer is ready to accept other data.	⇦
11	BUSY	Busy signal; printer is not ready for receiving data.	⇦
12	PE	Paper end	⇦

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13	-SLCT	Printer is in the selected state; printer on line.	⇦
14	-AFTD	Auto-feed; paper is auto fed one line after every line printing	⇨
15	-ERROR	Printer is in error state	⇦
16	-INIT	Reset printer to initial state.	⇨
17	-SLCT IN	Enable printer for data entry	⇨
18	GND	Ground	-
19		Not connected	-
20	GND	Ground	-
21	GND	Ground	-
22	GND	Ground	-
23	-	Not connected	-
24	GND	Ground	-
25	GND	Ground	-

Note: *"Direction" column refers to the direction of signal flow. When the Elite 2864 ISDN or modem parallel port is connected to a PC parallel port, it emulates the printer side. Similarly, when the ISDN/modem parallel port is connected to a printer, it emulates the adapter side.*

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