

**Models MTA128ST and MTA128NT
External ISDN Terminal Adapter
User Guide**



User Guide
Model MTA128ST/NT
S000305C Rev. C

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A	7/25/03	The manual replaces 82052305 Rev. G. Manual updated with NT info. AT commands and S registers moved into additional documentation on CD.
B	11/05/04	Changed temperature from -50 to -40 C.
C	09/06/07	Update tech support contact list.

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Chapter 1: Introduction and Description

Welcome to the world of ISDN communications.

You have acquired one of the finest ISDN terminal adapters (TAs) available today, model MTA1 28ST/NT from Multi-Tech Systems. The MTA128ST is a desktop TA with an S/T interface port to connect it to the ISDN network and an analog port to connect it to a telephone, modem, or fax machine. The MTA1 28NT is a desktop TA with a U-interface to connect it to the ISDN network and an analog port to connect it to a telephone, modem, or fax machine. The TAs ship with a software configuration utility for Windows® 98/NT/ME, and ConfigMenu, a built-in configuration utility for Windows and non-Windows operating systems. In addition, the MTA128ST/NT accepts AT commands that enable it to use the same communications software as an analog modem.

The MTA128ST is compatible with the popular EuroISDN switch protocol, it communicates using ISDN BRI (2B+D) service, which provides up to 128 Kbps data and voice communications, and it automatically detects whether an incoming call is voice or data and handles it appropriately.

The MTA128ST/NT provides dial-up asynchronous communication capability with other personal computers, terminals, on-line computer services, or other computer systems. Connection to your computer/terminal device is made via the RS232 connector (ISDN). Connection to analog devices is accomplished with an RJ1 1 connector and one RJ45 connector is used for your ISDN connection.

This User Guide will help you install, configure, and operate your MTA128ST/NT.

Product Description

There are two ISDN interface options, *S/T* and *U*. If you purchased the S/T interface adapter (MTA128ST), you need an ISDN NT1 device connection to the ISDN switch. If you purchased the U interface adapter (MTA1 28NT), it can directly connect to the ISDN switch (figure 1-1).

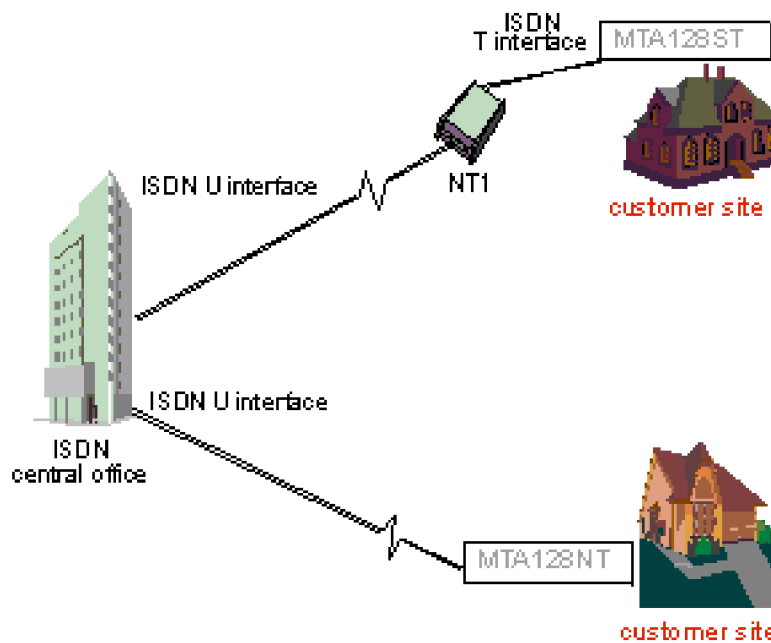


Figure 1-1. "S/T" and "U" Interface Options

Your ISDN TA is compatible with prevalent ISDN switch protocols. It communicates using ISDN BRI (2B+D) service, which provides up to 128K bps data communications. This manual documents the following models:

- MTA1 28ST for S/T interface with one POTS port
- MTA1 28NT for U interface with one POTS port

Some analog devices, including telephone set, answering machine, and modem, can be connected to the POTS port via an RJ-1 1 jack.

This User Guide will help you install, configure, and operate your terminal adapter.

Features

The MTA128ST/NT communicates over public ISDN telephone lines. Features include:

- Compatibility with EuroISDN (ETSI/DSS1/NET3), French VN4, and Japanese INS64 switch protocols
- Compatibility with U.S. NI-1, AT&T 5ESS, and DMS-100 switch protocols
- Compatibility with V.120, ML-PPP, and X.75 protocols
- Transparent synchronous communication capability (CLEAR)
- ISDN BRI (2B+D) and analog ports
- RS232E serial port
- Serial port speeds to 460.8 Kbps
- Support of PPP (Point-to-Point Protocol) for high speed ISDN connections
- Tone detection to allow use of a standard telephone for ISDN line access (an ISDN telephone is not required)
- Automatic detection of incoming calls as voice or data
- Windows 98/NT/ME software utility and a firmware utility for easy ISDN line configuration
- AT commands, S-registers, and result codes
- Ability to use the same communications software as analog modems
- Flash memory for easy firmware upgrades

ISDN BRI Line

Before running the ISDN adapter, you need to get an ISDN BRI (Basic Rate Interface) line from your local telephone company. Your ISDN service provider will provide information to you about the ISDN central switch type, pertinent subscriber information and SPID (Service Profile ID) number(s) if required.

SPID (Service Profile ID)

The Service Profile ID (SPID) is applicable in the U.S. only. SPIDs are a series of numbers that inform the central office switch which services and features to provide to an ISDN device. The generic SPID format comprises 14 digits. The first 10 digits are the main telephone number on the terminal. The last 4 digits are dependent on the number of terminals on the interface and the services they support.

NT1 Connection

An ISDN Basic Rate (BRI) U-Loop consists of 2 conductors from the CO (telephone company central office) to the customer premises. The equipment on both sides of the U-loop has been designed to deal with the long length of the U-loop and the noisy environment it operates in. At the customer premises the U-loop is terminated by an NT1 (network termination 1) device. An NT1 is a device which provides an interface between the two-wire twisted-pairs used by telephone companies in their ISDN BRI network and an end-user's four wire terminal equipment. The NT1 drives an S/T-bus which is usually made up of 4 wires, but in some cases may be 6 or 8 wires.

The name of the S/T bus comes from the letters used in the ISDN specifications to refer to two reference points, *S* and *T*. Point *T* refers to the connection between the NT1 device and customer supplied equipment. Terminals can connect directly to NT1 at point *T*, or there may be a PBX (private branch exchange, i.e. a customer-owned telephone exchange). When a PBX is present, point *S* refers to the connection between the PBX and the terminal. Note that in ISDN terminology, "*terminal*" can mean any sort of end-user ISDN devices, such as data terminals, telephones, FAX machines, etc. The diagram which follows reflects interface points in a typical ISDN network.

If your ISDN product operates with a S/T outlet interface, you need an NT1 device to connect to the ISDN switch. MTA128ST adapters need an NT1 device to connect to the ISDN switch, but the MTA128NT adapter does not require NT1 device. In the UK, and in many European countries, NT1 device is supplied by your telephone company.

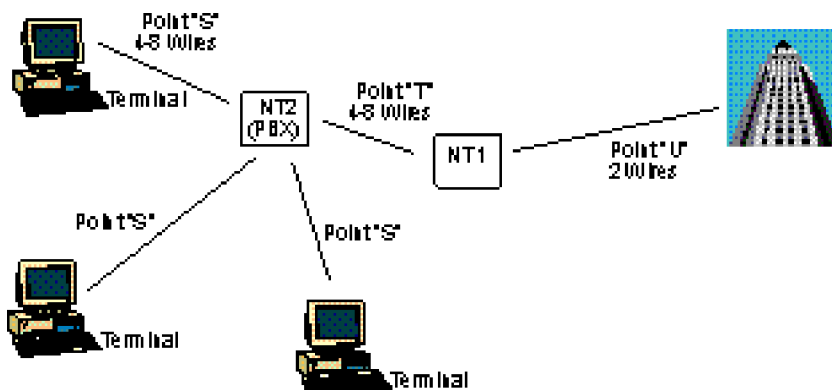


Figure 2-1 ISDN Interface Points

S/T Interlace

The S/T interface uses an 8-conductor modular cable terminated with an 8-pin RJ-45 plug. An 8-pin RJ45 jack located on the terminal is used to connect the terminal to the DSL (Digital Subscriber Loops) using this modular cable.

Table 2-1 shows the Pin Number, Terminal Pin Signal Name and SILC Pin Signal name for the S/T interface

Pin	TE Signal
1	Not used
2	Not used
3	Tx+
4	Rx-
5	Rx+
6	Tx-
7	Not used
8	Not used

U Interlace

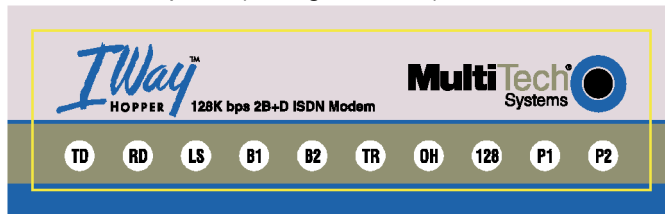
The U interface uses a 2-conductor twisted pair cable terminated with an RJ-45 jack. An RJ-45 jack located on the terminal is used to connect the terminal to the Digital Subscriber Loops using this twisted pair cable.

In Table 2-2 the Pin Number, Terminal Pin Signal Name and UILC Pin Signal Names for the U interface are listed.

Pin	Signal
1	N/A
2	N/A
3	N/A
4	Positive Input
5	Negative Input
6	N/A
7	N/A
8	N/A

LED Indicators

The ten LED indicators on the front panel (see figure below) of the MTA1 28ST/NT report status and line activity.



Transmit Data

TD Flashes when data is being transmitted (on for a space, off for a mark).

Receive Data

RD Flashes when data is being received (on for a space, off for a mark). **Link**

Status

LS For EuroISDN NET3, INS64, and VN4 switch protocols, lights when the TA is turned on. For US NI-1, DMS-100, and AT&T 5ESS switch protocols: On Steady, Link with central office is established (requires correct configuration of SPIDs) Flashing, Physical layer is down or one or both SPIDs have not been verified with central office

Bearer Channel 1

B1 When lit, indicates active data or voice connection on bearer channel 1.

Bearer Channel 2

B2 When lit, indicates active data or voice connection on bearer channel 2.

Terminal Ready

TR Lights to indicate that the computer is communicating with the MTA1 28ST/NT, so the MTA1 28ST/NT can answer an incoming call.

Off Hook

OH Lights when analog equipment on AUX port is active or off-hook.

128 Kbps

128 Lights to indicate that the B channels have been multiplexed into a single 128 Kbps communications link.

Data Protocol

P1 Lights in combination with P2 and 128 LEDs to indicate which data protocol (V.110, V. 120, X.75, PPP, MLPPP) is in use as shown in the table below.

Data Protocol

P2 Lights in combination with P1 and 128 LEDs to indicate which data protocol (V.110, V. 120, X.75, PPP, MLPPP) is in use as shown in the table below.

Data Protocol	128 LED	P1 LED	P2 LED
V.110	●	●	●
V.120	●	●	○
X.75 (1 channel)	●	○	●
PPP (1 channel)	●	○	○
MLPPP (2 channels)	○	○	○

● OFF ○ ON

Technical Specifications

Trade Name	lway Hopper™
Model Number	MTA128ST (International), MTA128NT
Network Interface	ST-Four-wire S/T interface NT-2-wire "U" interface
Switch Compatibility	EuroISDN (ETSI/DSS1/NET3), VN4, INS64, U.S. NI-1, AT&T 5ESS, DMS-100 (both models support all of the switch protocols)
B-Channel Protocols	V.120, X.75, PPP, ML-PPP, CLEAR
Voice Coding	PCM: A-Law; μ -Law (switch protocol dependent)
LED Indicators	10 front panel LED indicators: Transmit Data, Receive Data, Link Status, B1 Active, B2 Active, Terminal Ready, Off Hook (AUX port), 128Kbps, P1 Active (data protocol), P2 Active (data protocol)
Data Rates	300, 1.2K, 4.8K, 9.6K, 38.4K, 56K, 57.6K, 64K, 115.2K, 230.4K, and 460.8K bps
Async Data Format	7 bit data + odd/even parity + 1 start/stop, 8 bit no parity. 36 baud rate/parity settings via S-register. Baud rates of 300-460.8K bps with even, space, mark, odd, or no parity.
Data Connections	Two ISDN B-channels One ISDN D channel One analog port for connecting a standard telephone, modem, or fax machine.
Command Interface	AT commands, S-registers, result codes, ConfigMenu firmware configuration utility, Windows 98/NT/ME configuration utility, Dial-Up Networking (DUN)
Connectors	ISDN: RJ45 female receptacle, 4-wire S/T (accepts connection cable to the network provider's NT1 device) or 2-wire U interface AUX: RJ11 female receptacle, 2-wire voice service Serial Port: female DB-25 RS232E/V.24
Serial Interfaces	ITU-T V.24, EIA/TIA RS232E
Switches	Two-position power switch
Power Requirements	Two-prong outlet-mounted transformer (included), 240 VAC 50/60 Hz
Dimensions	15.0 cm x 10.7 cm x 2.8 cm (L x W x D)
Environmental	Temperature range 0° - 40° C (32° - 104° F) Humidity range 20-90% (noncondensing)
Power Consumption	4 watts
Weight	224 g (8 oz)
Warranty	5 years

Chapter 2: Hardware Installation

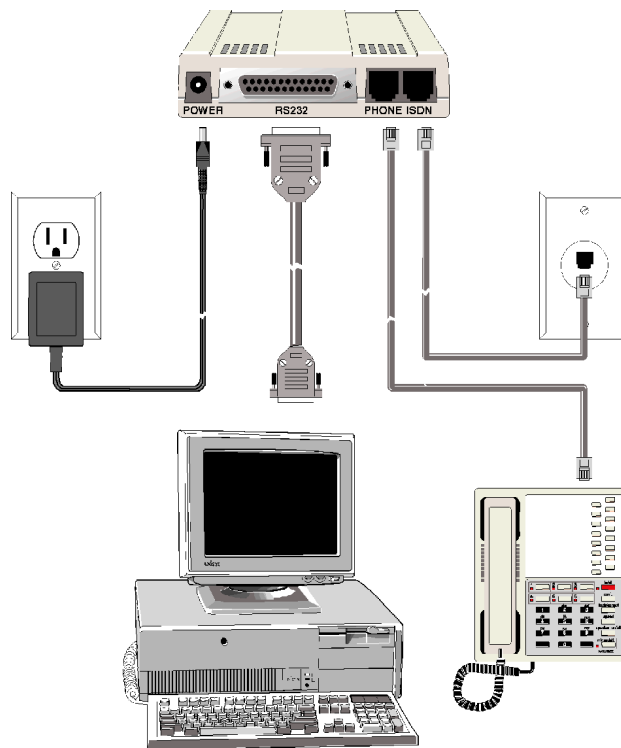
This chapter shows you step-by-step how to set up your MTA1 28ST/NT terminal adapter (TA) to your computer, power, network terminator, and an auxiliary analog device. Please follow these instructions carefully to avoid damage to your TA.

Safety Warnings

- Use this product only with UL-listed and CUL-listed computers.
- Never install phone wiring during a lightning storm.
- Never install a phone jack in a wet location unless the jack is specifically designed for wet locations.
- Never touch uninsulated phone wires or terminals unless the phone line has been disconnected at the network interface.
- Use caution when installing or modifying phone lines.
- Avoid using a phone (other than a cordless type) during an electrical storm; there is a risk of electrical shock from lightning.
- Do not use a phone in the vicinity of a gas leak.
- To reduce the risk of fire, use only 26 AWG or larger telephone line cord.

Connecting your TA

Turn off your computer. Place the modem in a convenient location, connect it to your computer's serial port, to the phone line, to AC power, and to your phone.



Cable Connections.

Connect the TA to the AC Power Outlet

Plug the DC power transformer into an AC power outlet or power strip. Plug the DC power transformer into the POWER jack on the TA.

Note: Use only the DC power transformer supplied with the TA. Use of any other transformer voids the warranty and can damage the TA.

Turn on the TA by sliding the power switch to ON and verify operation by observing the LEDs on the front panel. The LEDs first flash in a self-test pattern. Then the LS LED remains on. If the TA does not appear to be working, Refer to Chapter 5 for troubleshooting help.

Connect the TA to Your PC (RS-232 Connection)

Plug one end of the RS-232 serial cable into the RS-232 connector on the modem, and plug the other end into a serial port connector on your computer, such as COM1 or COM2. You supply the RS-232 cable.

Connecting to your ISDN Network Terminator

If you need a longer cable than the one provided with your TA, select a cable that is wired straight through (pin 1 to pin 1; pin 2 to pin 2, etc) with at least the middle four pins connected (pins 3, 4, 5, and 6).

Plug one end of the cable into the ISDN jack on the TA and the other end into the jack on your network terminator (MTA128ST) or U-interface (MTA128NT).

Note: The PHONE jack and ISDN jack are not interchangeable.

(Optional) Connecting to Analog Equipment

You can connect an analog device such as an analog telephone, modem or fax machine to the TA. Simply put the device's module telephone cable into the PHONE Jack (RJ1 1) on the TA.

Note: The PHONE jack and the ISDN jack on the TA are not interchangeable.

Chapter 3: Configuration Utilities

Introduction

You can configure the MTA128ST/NT to match your ISDN service and the remote terminal adapter (TA) with any of four methods listed below:

- **ISDN TA Configuration Utility**
This configuration utility is recommended for computers running Windows 98/NT/ME operating systems. Because it is a software-based utility, you can use it to create and store as many configurations as you want.
- **Con figMenu**
This firmware-based configuration utility is recommended for computers running other OS with terminal capabilities. To run it, you must have a VT100/ANSI-compatible terminal or a data communication program that includes VT100/ANSI terminal emulation.
- **Windows Dial-Up Networking**
With Dial-Up Networking you can gain access to shared information on another computer, even if your computer is not on a network. The computer you are dialing in to must be set up as a network server for you to use its shared resources. Windows includes a remote-node client called Dial-Up Networking (DUN). The MTA128ST/NT can be configured to communicate using this utility.
- **AT Commands**
If you prefer using AT commands or want to fine tune the operation of your TA, configure your TA by using AT commands and S-registers much as you would configure an analog modem. You must enter these commands in your data communication program's terminal mode. For more information see ST and NT AT command documents included on this CD.

Before You Start

Whatever method you use to configure your TA, consider your network and call control configuration choices and COM port settings beforehand listed below and record your choices. Refer to them during the configuration procedure. Before you begin, verify your switch type and TEI with your local ISDN provider and have that information readily available

Network Configuration

Network Switch Type _____

Select the network switch type your ISDN service provider uses at its local central office. You can set the MTA128ST/NT to NET3 (DSS1), VN4, INS64, U.S. NI-1, AT&T 5ESS, or DMS-100. If you don't know the switch type, get the information from your ISDN service provider.

AT command: !C0

Data TEI _____

Data TEI is the TEI assigned to the data channel. You can select Auto TEI, a fixed TEI, or Disable. A TEI (terminal endpoint identifier) is a number used by the central office switch to uniquely identify each device connected to the network. When it uses dynamic TEI assignments (Auto TEI), the central office switch assigns a TEI each time the TA connects to the network. However, the ISDN service provider may assign a fixed TEI at subscription time, in which case you must configure the TA with the fixed TEI number. You also can disable the channel, which may be useful when multiple TAs are attached to a network terminator bus.

AT command: !D3

Voice TEI

Voice TEI is the TEI assigned to the voice channel. Choices are: Auto TEI, a fixed TEI number, or Disable.

AT command: ***!D3**.

Data MSN

The Data MSN (multiple subscriber number) allows a caller to specify an individual TA when more than one TA is connected to you network terminator. If you don't assign a value to the MSN, the TA accepts all incoming calls. If you only assign a base address to the MSN, the TA accepts any incoming call with the same base address, regardless of whether a subaddress is included. If you assign a base address and a subaddress to the MSN, the TA only accepts calls that match both the base address and the subaddress. The following examples show the syntax for setting the MSN with and without a subaddress.

AT command: **!N1**.

MSN with subaddress: 5551000:001 (base address is 5551000; subaddress is 001)

MSN without subaddress: (base address is 5551000)

Voice MSN

Selects calls on the voice channel in the same way the Data MSN selects calls on the data channel.

AT command: ***!N1**.

SPIDs and DNs

The TA must be configured with the Service Profile Identifier (SPID). The SPID is assigned by the local phone company and is for the specific BRI line where the TA is attached. The SPID field is empty prior to configuration.

AT commands: **AT!C6=** and **AT*!C6=**

Directory Number (DN) is the phone number another user calls to contact this TA once it is attached to the ISDN.

AT commands: **AT!N1=** and **AT*!N1=**

Note: SPIDs and DNs are used only by the U.S. NI-1, AT&T 5ESS, and DMS-100 switch types.

Call Control Configuration**Persistent DTR Dialing**

A high DTR (Data Terminal Ready) signal on the RS232/V.24 serial port indicates your computer or terminal is ready to communicate with your TA. DTR normally goes high when a communication program starts or is ready to dial. Persistent DTR dialing enables the TA to automatically redial the number stored in memory location 0 whenever DTR is high and the serial port does not have an active call. You can enable or disable this feature.

AT command: **\$D**.

Auto Answer Data Calls Rings to Answer

Select Auto Answer if you want your TA to automatically answer all incoming data calls (this option does not affect the analog port). The Rings to Answer number, in the range of 1 to 255, selects the number of rings the TA waits before answering an incoming call. The default is one ring.

AT command: **S0=**

Dialing Method

Select either the Enbloc or the Overlap dialing method for use when establishing a data call. Your ISDN provider determines the dialing method. The enbloc method is used for most ISDN dialing; however, you can select the overlap method if you are working with a private network.

AT command: **%A97=**

Data Protocol

The data protocol, also known as the B-channel protocol and the rate adaptation protocol, is the *language* spoken over each 64 Kbps channel between two ISDN devices. The devices on both ends of the ISDN link must use identical protocols.

AT command: **!Z=**

V.120 Protocol—Similar to V.110 protocol, but provides rates up to 64000 bps on each B channel.

X.75 Protocol—Packet-switched network protocol for international use. Layer 2 portion of this protocol is used commonly as a rate adaption protocol.

MLPPP Protocol—MLPPP (Multi-Link PPP) protocol provides rates up to 64 Kbps per channel. This protocol uses both B channels at once, providing an aggregate data transmission speed of 128 Kbps.

Dialing Numbers _____

The MTA128ST/NT can dial telephone number *n*, where *n* can be up to 20 characters.

AT command: **Dn** (*n* = phone number).

Stored Numbers _____

The MTA128ST/NT can store as many as ten phone numbers, up to 20 characters each.

AT command: **&Z=**

Dialing Stored Numbers _____

The MTA128ST/NT can dial a number previously stored in directory number *n* with the **&Zn=x** command.

AT command: **e.g., DS3**

COM Port Settings

COM port settings control how your TA communicates with your computer through the RS232/V.24 serial port.

Select the initial speed at which your TA communicates with your computer. For V.110 data protocol, the

Baud Rate or Bit Rate _____

rates must be identical on the local and remote TAs and may not exceed 38400 bps. For all other data protocols (V.120, MLPPP, X.75, etc.), the default initial baud rate is 115200 bps. Typically, in command mode, the MTA128ST/NT selects a serial port speed of 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, or 230400 bps depending on how fast the AT commands are coming from the computer or terminal. The **\$SBn** command sets the default serial speed used when the TA first powers up. Using the **%S** command you can disable automatic speed selection and lock the serial port speed to 460800 bps. See Serial Port Configuration Commands in Chapter 4 for more information.

AT commands: **\$SB or %S**

Note: Your computer must have a high speed serial port with a 16550AFN UART, or equivalent, to utilize ISDN's high speeds.

Flow Control _____

Select the method by which your TA and computer control the flow of data between them. Unless you know your computer has special requirements, select the default RTS/CTS method. The other choice is XON/XOFF.

AT command: **&E**

Data Bits, Parity, and Stop Bits _____

These settings further control initial communications between the TA and computer. Unless you know your computer has special requirements, use the default settings of 8 data bits, no parity checking, and 1 stop bit (8-N-1). The TA sets these parameters automatically the first time it receives an AT command from the computer.

AT commands: **@P4=, @P3=, @P6=**

DTR Detect Time _____

Sets the time, in 0.1-second increments, that DTR must remain low before the TA disconnects. The default value is 0.5 second; however, you can set it anywhere within the range 0–255 (0.05–25.5 seconds).

AT command: **S25=**

DCD Drop Time _____

Sets the time, in 0.1-second increments, that a carrier must be lost before the TA disconnects. The default value is 0.7 seconds; however, you can set it anywhere in the range 0–254 (0–25.4 seconds). Setting DCD Drop Time to 255 causes the TA not to disconnect with loss of carrier when DCD Control is set to Momentary Drop.

AT command: **S10=**

DTR Control

A high DTR (Data Terminal Ready) signal on the RS232 serial port indicates your computer or terminal is ready to communicate with your TA. It normally goes high when a communication program starts or is ready to dial. Normal causes the TA to break the link and go into command mode when DTR drops. Ignore causes the TA to ignore the DTR signal. Reset on DTR causes the TA to reset when DTR drops for the time specified in register S25.

AT command: **&D**

CTS Control _____

A high CTS (Clear to Send) signal on the RS232 serial port indicates the TA is ready to receive data. Normally, it follows the state of the RTS signal. Select Normal to make CTS act normally. Select Always On to force CTS high when the TA is offline. When the TA is online, CTS still provides flow control. Select Momentary Drop to cause CTS to drop momentarily when the link is lost; then to go high again.

AT command: **&R**

DSR Control _____

A high DSR (Data Set Ready) signal on the RS232 serial port indicates your TA is ready to communicate with your computer or terminal. Normally, it follows the state of the DTR signal. Select Normal to make DSR act normally. Select Always On to cause the TA to ignore the state of the DTR signal. Select Momentary Drop to cause DSR to drop momentarily when the link is lost; then to go high again.

AT command: **&S**

DCD Control _____

Normally, the DCD (Data Carrier Detect) signal on the RS232 serial port goes high when the TA receives a connect message from a remote TA, and drops when the link is lost. Select Always On to satisfy a requirement by some software packages for this state to be present constantly. Select Normal for normal operation. Select Momentary Drop to cause DCD to drop momentarily when the link is lost; then to go high again. The length of the drop is governed by register S10.

AT command: **&C**

Asynchronous/Synchronous Mode _____

Normally, the MTA1 28ST/NT communicates in asynchronous mode. If you need transparent synchronous

communication, change this register setting.

AT command: **&M**

Configuring your TA

If you use Windows 98/Me/NT, perform the following procedure using the Configuration Utility provided on your system CD. If you are using another operating system, you can configure the TA using the firmware-based configuration utility or AT commands. Procedures for using the firmware-based configuration utility and AT commands are described in Appendix E.

Before you begin, verify your switch type and TEI with your local ISDN provider and have that information readily available

1. When installing from CD, insert the MTA1 28ST/NT System CD into your CD ROM drive. When the MTA1 28ST/NT Terminal Adapter AutoRun screen is displayed, click on the Config Utility icon. Follow the on screen directions to load the Configuration Utility onto your pc.
2. When the Configuration Utility is loaded onto your pc, click **Start>Programs>ISDN TA Config Utility**. The Welcome screen is displayed



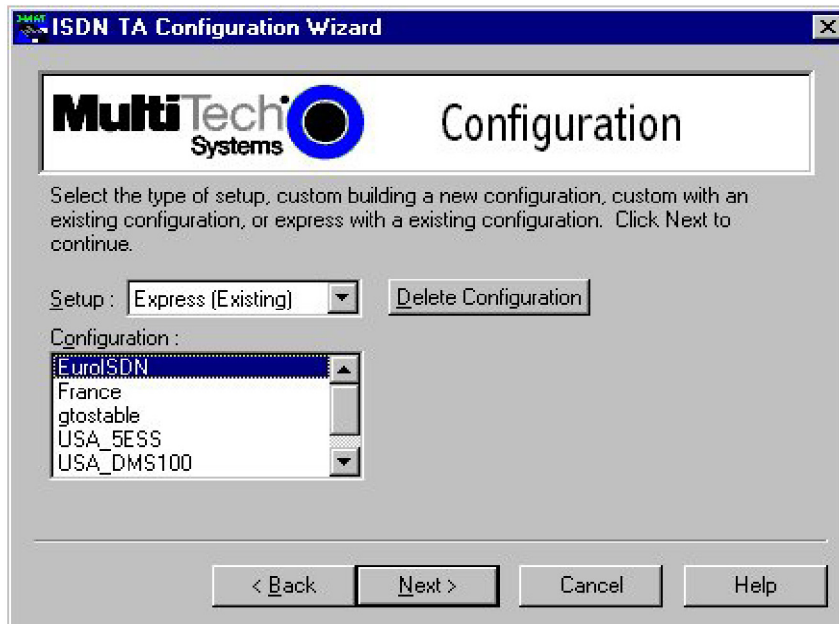
Do you want the wizard to search for your ISDN TA? with the **Yes** option enabled. Click **Next** to continue.

3. Searching for TA screen is displayed with please wait while the configuration utility searches for your ISDN TA(s). This may take up to 20 seconds. Then the Searching for TA screen with Devices have been identified. Please select a device to configure



Click **Next** to continue.

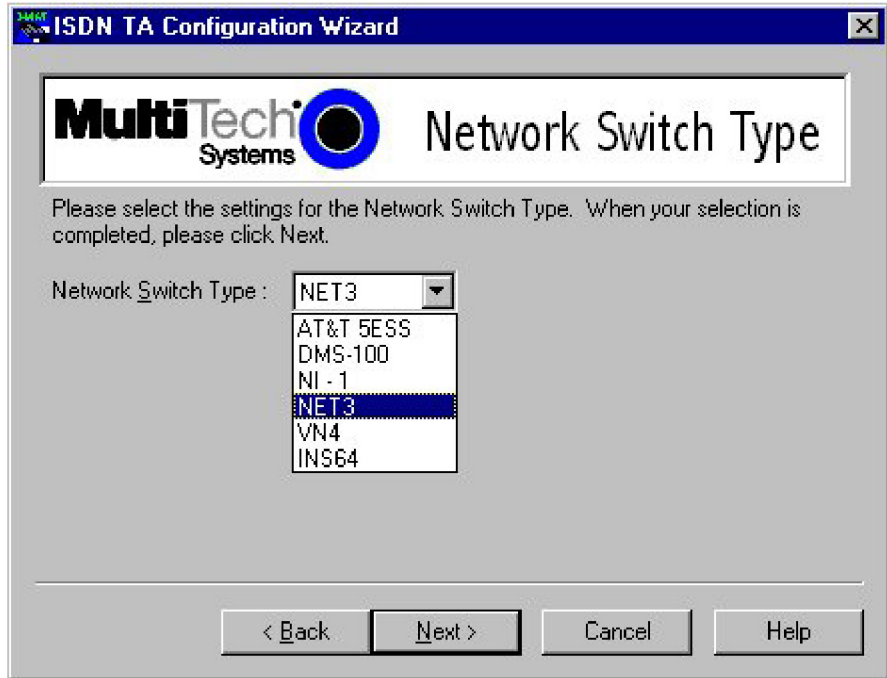
4. The Configuration screen is displayed with Select the type of setup, custom building a new configuration, custom with an existing configuration, or express with an existing configuration.



From the Setup pull down window you can choose Express (Existing), Custom (Existing), or Custom (New). The Express (Existing) opens an existing configuration, allowing you to modify some elements of the configuration. Custom (Existing) opens an existing configuration, allowing you to modify all elements of the configuration. Custom (New) allows you to customize a new configuration.

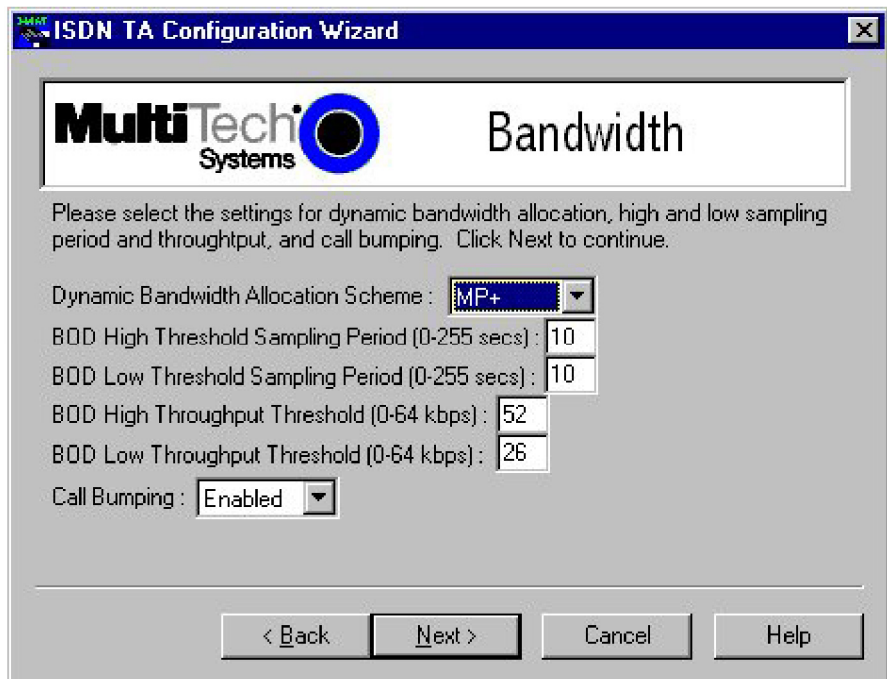
I have chosen Custom (New) for this example.

5. The Network Switch Type screen is displayed with Please select the settings for the Network Switch Type.



Select the network switch type you listed in the Before You Start section of this chapter.

6. Please select the settings for dynamic bandwidth allocation, high and low sampling period and throughput, and call bumping.



Click **Next** to continue.

7. The TEI (Terminal Endpoint Identifier) screen is displayed with Please select the settings you would like for Data TEI and Voice TEI.

The TEI is a unique number assigned to the TA at subscription time. The TEI is used by the telephone central office (CO) to identify the various TAs connected to the ISDN network. The TEI number can be fixed (range 0 - 63) or dynamic and is assigned automatically at the CO each time the TA connects to the ISDN interface and powers up.

Click Next when you are finished.

8. The SPID (Service Profile Identifier) North America only, is displayed with Please enter the data SPID, voice SPID, data directory numbers, and voice directory number of your network.

SPID is only used in North America. A SPID is the ISDN network parameter for local terminal identification

and tracking. A SPID is assigned by your local ISDN provider when you subscribe, they are in the form of a string of up to 20 characters. A SPID points to a specific location in the provider's central office memory where service and feature parameters are stored.

Click Next when you have entered your SPID information.

9. The Call Control Setup screen is displayed with Please select the settings for call control.



Call Control Setup allows you to set up your terminal adapter and customize how it dials and answers. You can configure persistent DTR dialing, calling line identification, auto answer data calls, and number of rings. You can also set the online inactivity timer as well as the dialing method.

Click **Next** when you are done.

10. The Data Protocol Setup screen is displayed with Please select the setting you desire for the Data Protocol.

The screenshot shows a window titled "ISDN TA Configuration Wizard" with a sub-header "MultiTech Systems Data Protocol Setup". The main text reads: "Please select the setting you desire for Data Protocol. Click Next after your selection is made." Below this, there is a dropdown menu for "Data Protocol" with "V.120" selected. A checkbox labeled "Auto protocol detection" is checked. At the bottom, there are four buttons: "< Back", "Next >", "Cancel", and "Help".

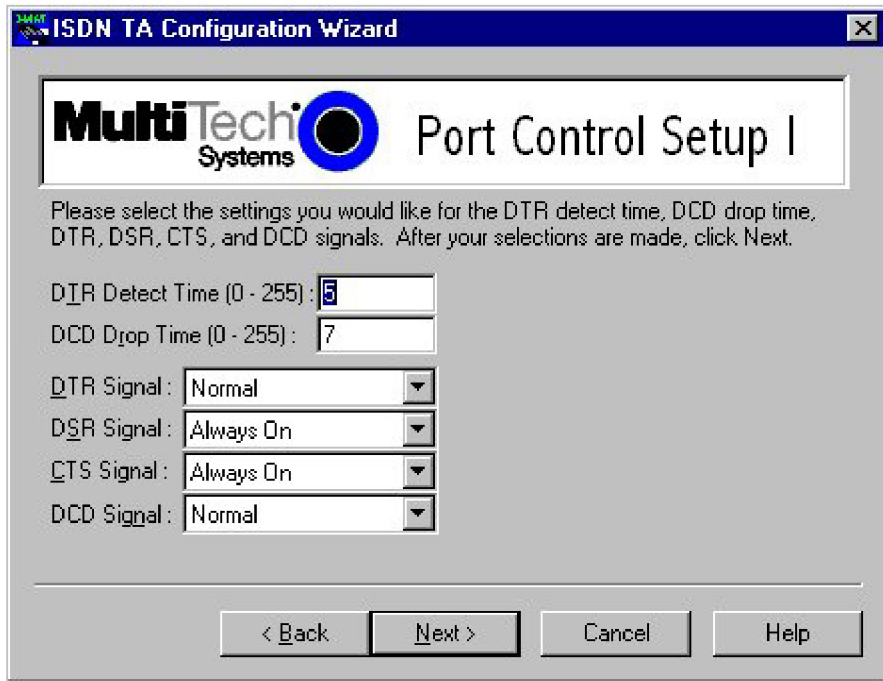
If you would like the TA to detect the data protocol of an incoming data call and automatically change the TA's protocol to match the incoming call, click auto protocol detection check box. Click **Next** to continue.

11. The Stored Numbers screen is displayed with Please enter the numbers you would like to store.

The screenshot shows a window titled "ISDN TA Configuration Wizard" with a sub-header "MultiTech Systems Stored Numbers". The main text reads: "Please enter the numbers you would like to store. Click Next when you are done." Below this, there are ten input fields arranged in two columns, labeled 0 through 9. A note on the right states: "Note: Stored phone number 0 is used with persistent DTR dialing." At the bottom, there are four buttons: "< Back", "Next >", "Cancel", and "Help".

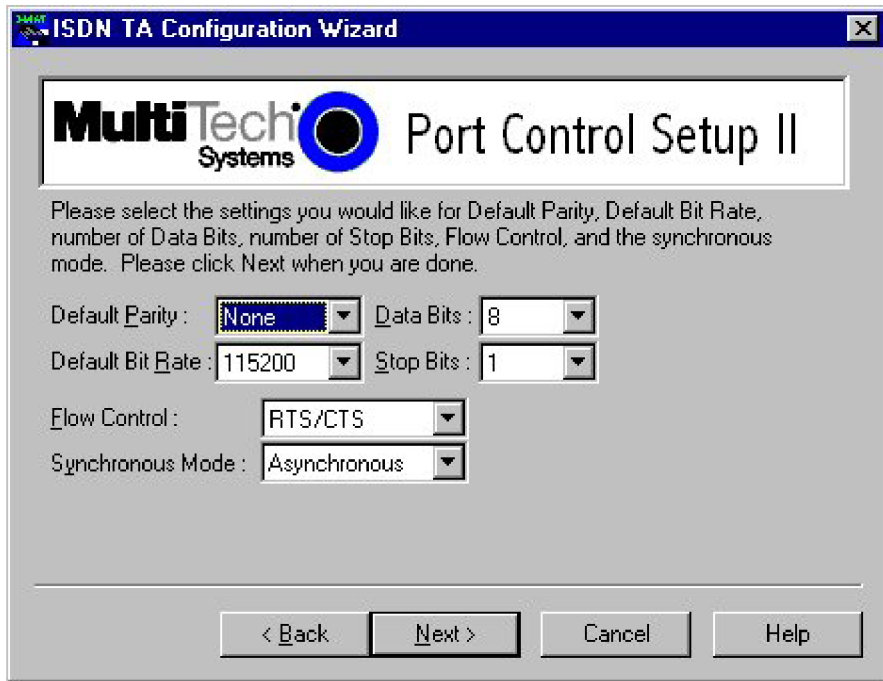
You can store up to ten phone numbers with up to 25 characters per number. Stored number zero is used if Persistent DTR Dialing is enabled in Call Control Setup screen.

12. The Port Control Setup 1 screen is displayed with Please select the settings you would like for the DTR detect time, DCD drop time, DTR, DSR, CTS, and DCD signals.



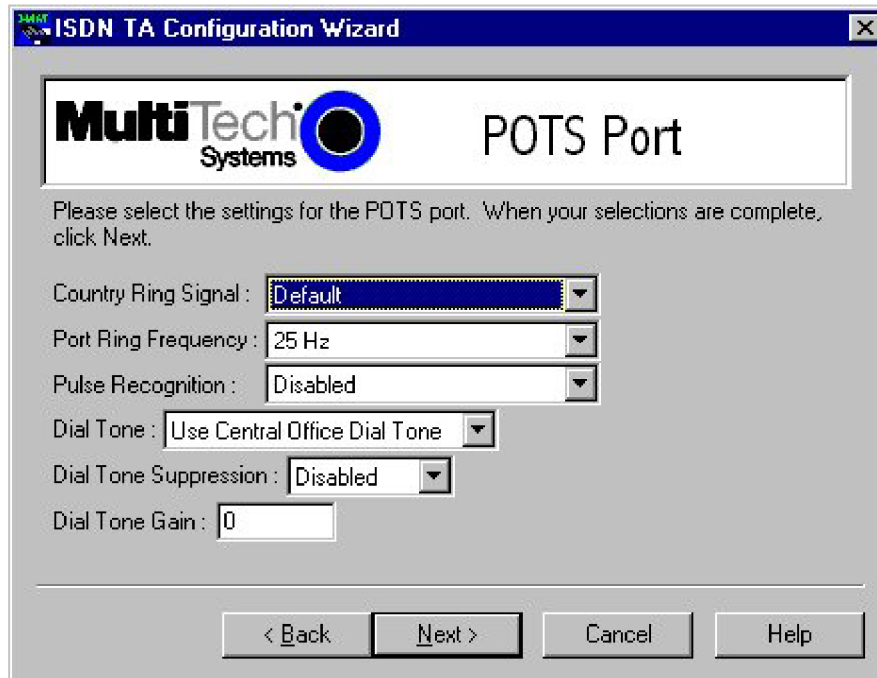
lick Next when you have finished entering your settings.

13. The Port Control Setup II screen is displayed with Please select the settings you would like for the Default Parity, Default Bit Rate, number of Data Bits, number of Stop Bits, Flow Control, and synchronous mode.



Click **Next** when you are finished.

14. The POTS Port screen is displayed with Please select the settings for the PORTS port.



The screenshot shows a window titled "ISDN TA Configuration Wizard" with a close button in the top right corner. The window contains the MultiTech Systems logo and the text "POTS Port". Below the logo, there is a message: "Please select the settings for the POTS port. When your selections are complete, click Next." The settings are as follows:

- Country Ring Signal: Default (dropdown menu)
- Port Ring Frequency: 25 Hz (dropdown menu)
- Pulse Recognition: Disabled (dropdown menu)
- Dial Tone: Use Central Office Dial Tone (dropdown menu)
- Dial Tone Suppression: Disabled (dropdown menu)
- Dial Tone Gain: 0 (text input field)

At the bottom of the window, there are four buttons: "< Back", "Next >", "Cancel", and "Help".

When your selections are complete, click **Next**.

15 The Save Configuration screen is displayed with Please enter the name to store the configuration as in the .ini file.



The screenshot shows a window titled "ISDN TA Configuration Wizard" with a close button in the top right corner. The window contains the MultiTech Systems logo and the text "Save Configuration". Below the logo, there is a message: "Please enter the name to store the configuration as in the .ini file. Click Next after you have selected a name." There is a text input field labeled "Store Configuration as:" which is currently empty. At the bottom of the window, there are four buttons: "< Back", "Next >", "Cancel", and "Help".

You can enter any name up to 35 characters or less in the Store Configuration as: window. Click **Next** after you have selected a name.

16. The Load Configuration screen is displayed with To load the configuration now, click **Next**.



17. Your ISDN TA is currently being configured.



When the Finish button becomes active, click **Finish**.

18. The Configured screen is displayed. Click **Finish** to exit the Configuration Utility.

Chapter 4: ATCommands, S-Registers, and Result Codes

MTA128S T/NT Commands and S-Registers

All references to “TA” in this chapter refer to the MTA1 28ST/NT. This chapter also assumes knowledge of issuing AT commands. <CR> refers to the carriage return character (typically generated by pressing the ENTER or RETURN key on the keyboard).

For command execution details see the additional documents on this CD.

AT Commands

The TA’s command buffer can store 80 characters, including spaces and other characters used in telephone numbers. If you mistype a command string, you can edit it by using the backspace or the delete key, but only before you press <CR>. As you type a command string, it appears on your monitor screen, letting you verify your input as you type it. The table below lists the AT commands recognized by the TA.

If your MTA1 28ST/NT is connected to a computer terminal, you can send AT commands to the MTA1 28ST/NT by entering them on the keyboard. If your MTA1 28ST/NT is connected to a computer, you can send AT commands to the MTA128ST/NT by typing them in the terminal window of a data communications program such as HyperTerminal. You can also send some AT commands indirectly by configuring your data communications program.

To enter AT commands, use the following format: **AT <command string> <cr>**. The characters AT cause the MTA128ST/NT to interpret the following string as a command. The command string consists of one or more commands. The carriage return character, <cr>, sends the command string to the MTA128ST/NT. If you are entering a command string in your communication program’s terminal window, insert the carriage return character by pressing the ENTER key on your keyboard. If configuring a communications program, you typically must insert the carriage return character by adding ^M to the end of the command string.

The MTA128ST/NT has three modes of operation: offline command mode (the default state), online command mode, and data mode. The MTA1 28ST/NT responds to AT commands only when it is in one of the command modes. After the MTA1 28ST/NT establishes a connection and goes online in data mode, it interprets any further characters you enter as data rather than as commands and transmits them to the remote device.

When the MTA1 28ST is in data mode, you can switch it to online command mode by sending it an *escape sequence*. The MTA1 28ST/NT responds to two types of escape sequences:

- *In-band* where the escape sequence is part of the data stream. The in-band escape sequence is **+++AT<cr>**. To change the in-band escape character (+), change the value in register **S2**.
- *Out-of-band* where the escape sequence is outside the data stream. The out-of-band escape sequence is **<break >AT<cr>**. You can send the break signal in the out-of-band escape sequence only from software, *not* by pressing SHIFT+BREAK on your keyboard.

When it detects the escape sequence, the MTA1 28ST/NT enters online command mode where it responds to commands while maintaining the connection with the remote device.

The MTA1 28ST/NT’s command buffer can store 80 characters, including spaces and other characters

used in telephone numbers. If you mistype a command string, edit it by using the backspace or the delete key but only before you press ENTER. As you type a command string, it appears on your monitor screen, letting you verify your input as you type it.

The AT commands recognized by the MTA128ST/NT are listed by function in this chapter first in an abbreviated list. For an alphabetical list of AT commands, see the AT commands documents on the CD included with this product.

AT Commands by Function

Command Execution

AT	Attention code
A/	Repeat AT Command
Return or Enter	Command execution
+++AT<CR>	In-band escape code
<BREAK>AT<CR>	Out-of-band escape code

General Information Commands

In	Display Product Information
Ln	List Active Profile Information
!L	Display Network Configuration
>MIBn	Management Information Block (MIB) Information

Network Configuration Commands

**s	User-User Information Element String
%A97=n	Dialing Method
>A0=n	Type of Coding
!C0=n	Network Switch Type
!C6=n	Data SPID
*!C6=n	Voice SPID
!D0=n	V.120 LLC Information Element
!D3=n	SAPI-0 Data TEI
*!D3=n	SAPI-0 Voice TEI
!DNn	Disable Data DN/MSN n
*!DNn	Disable Voice DN/MSN n
!ENn	Enable Data DN/MSN n
*!ENn	Enable Voice DN/MSN n
>MULT=N	Multi-point setting
!Nn=s	Data DN/MSN n
*!Nn=s	Voice DN/MSN n

Serial Port Configuration Commands

&Cn	DCD (Data Carrier Detect) Control
&Dn	DTR (Data Terminal Ready) Control
\$Dn	Persistent DTR Dialing
&En	Flow Control
&Mn	Asynchronous Mode
@P3=n	Parity
@P4=n	Data Bits
@P6=n	Stop Bits
&Rn	CTS (Clear To Send) Control
&RFn	CTS/RTS Interaction Control
&Sn	DSR (Data Set Ready) Control
\$SBn	Serial Port Speed
%Sn	Serial Port Mode
#Xn	Send Multiple Xoff Characters

General Configuration Commands

@CONFIG	Configuration Menu
En	Command Mode Echo
%En	Escape Sequence Options
&Fn	Load Factory Profile
%Mn	Management Mode
Qn	Quiet Mode

Sr=n	Set S-register
Sr?	Read S-register
Vn	Verbose Result Codes
&Wn	Store Active Profile
Xn	Connect Messages
Z	Reset to Stored Profile
&Zn=	Store Telephone Number
!Z=n	Rate Adaptation/Data Protocol

Digital (Data) Call Commands A

	Answer Digital Call
Dn	Dial Digital Number
DSn	Dial Stored Number
Hn	Hang up Digital Call
!Hn	Digital Call Hold-off Time
&Jn	Channel Bundling
O	Return Online

Analog (POTS) Call Commands

*An	Answer Analog Call
*Bn	Send Analog Dial Digit
*Dn	Dial Analog Number
*Hn	Hang up Analog Call
*!Hn	Analog Call Hold-off Time
!RXGn	POTS Port Receive Gain
!TXGn	POTS Port Transmit Gain

S-Registers

S-registers are sections of memory in which values are stored that affect how the TA operates. S-registers are so-called because each has a name that begins with the character S. Use the **Sr=n** command to assign a value to an S-register or use the **Sr?** command to read the current value of an S-register. S-registers are stored in non-volatile RAM (NVRAM) by using the **&W0** command. **ATZ<CR>** restores S-registers to values stored in NVRAM if any were stored using the **&W0** command, otherwise they revert to factory default settings in ROM. Table 4-2 summarizes the available S-registers and their function.

See the additional documents on this CD for more information on each S register.

S-Register Summary

S-Register	Function
S0	Rings Until Answer
S1	Ring Count
S2	Escape Character
S3	Carriage Return Character
S4	Line Feed Character
S5	Backspace Character
S7	Wait for Connection (Abort Timer)
S8	Pause Time for Comma
S10	DCD Drop Time
S25	DTR Drop Time
S26	Delay DTR Monitoring After Connect
S27	RS-232 CLEAR Synchronization Sequence
S29	On-line Inactivity Timer Period
S30	On-line Inactivity Timer
S31	Maximum Re-dial Timeout Value
S32	Escape Sequence Timeout

S34	Maximum Escape Sequence Length
S44	POTS Port Ring Frequency
S45	Use Dial Tone From Central Office
S46	Pulse-Dial Recognition
S49	POTS Port Dial Tone Gain
S50	Caller Line ID (CLI)
S51	POTS Port Dial Tone Suppression
S52	Auto-Protocol Detection
S53	Maximum X.75 Buffer Size
S54	Force 56Kbps B-Channel Data Rate
S55	Information Transfer Capability for POTS Port Calls
S56	Calling Party Number Information Element Settings
S57	Called Party Number Information Element Settings
S58	Client-side PPP/ML-PPP Authentication Protocol Negotiation
S59	Dynamic Bandwidth Allocation (DBA) Scheme
S60	Bandwidth-On-Demand (BOD) High Threshold Sampling Period
S61	Bandwidth-On-Demand (BOD) High Throughput Threshold
S62	Bandwidth-On-Demand (BOD) Low Threshold Sampling Period
S63	Bandwidth-On-Demand (BOD) Low Throughput Threshold
S64	Call Bumping (CB)
S65	POTS Call Bump Forwarding Delay
S66	Country Selections for POTS Ring Signal
S67	Single or Dual Cadence POTS Ring Signal
S68	POTS Ring Signal First Active Duration
S69	POTS Ring Signal First Idle Duration
S70	POTS Ring Signal Second Active Duration
S71	POTS Ring Signal Second Idle Duration
S73	MultiLink Endpoint Discriminator Type
S74	Maximum CLEAR Buffer Size
S80	Persistent DTR Dialing Delay
S81	Link Setup Timeout
S84	Data to Terminal Delay
S85	Data to B-channel Delay
S87	INS64 Analog Call Origination Delay
S154	B-Channel Answer Rate

Result Codes

When the MTA128ST/NT receives an AT command from the computer or terminal, it attempts to execute the command, then sends a status message to the computer or terminal that reports the result of the command. The MTA1 28ST/NT provides you with several of these response messages, or *result codes*, which can be displayed on your monitor or intercepted and used by your communications software. Using the **V** command, you can select whether the result codes are *terse* (numbers) or *verbose* (words).

The MTA128ST/NT's result codes are listed below. Note that the speed of an ISDN channel is always either 56 Kbps or 64 Kbps. *Connect* messages indicate the speed of the connection between the MTA1 28ST/NT and your computer or terminal.

TERSE	VERBOSE	DEFINITION	
	0	OK	TA executed the command without error
	1	CONNECT	TA established an ISDN connection
	2	RING	TA detected a ring caused by incoming call
	3	NO CARRIER	TA did not detect carrier within time allotted by register S7
	4	ERROR	Error in the AT command
	5	CONNECT 1200	TA connected at 1200 bps
	6	NO DIALTONE	TA has a poor connection to ISDN network
	7	BUSY	TA detected a busy signal
	8	CONNECT 300	TA connected at 300 bps
	9	CONNECT 600	TA connected at 600 bps
	10	CONNECT 2400	TA connected at 2400 bps
	11	CONNECT 4800	TA connected at 4800 bps
	12	CONNECT 9600	TA connected at 9600 bps
	14	CONNECT 19200	TA connected at 19200 bps
	17	CONNECT 56000	TA connected at 56000 bps
	18	CONNECT 57600	TA connected at 57600 bps
	19	CONNECT 64000	TA connected at 64000 bps
	28	CONNECT 38400	TA connected at 38400 bps
	79	PPPC PROTOCOL	TA using Point-to-Point protocol
	80	HDLC PROTOCOL	TA using raw HDLC mode
	83	V.120 PROTOCOL	TA using V.120 rate adaption protocol
	84	X.75 PROTOCOL	TA using X.75 rate adaption protocol
	87	CLEAR PROTOCOL	TA using CLEAR (transparent) protocol

Using AT Commands to Operate the MTA128ST/NT

You can configure and operate the MTA1 28ST/NT entirely with AT commands if you like. But remember, you can issue AT commands only from a terminal or from a computer running a communications program in terminal mode. This section describes how to use AT commands for basic operations, such as calling, answering a call, and hanging up.

Modes of Operation

The MTA1 28ST/NT has three modes of operation. They are:

- *Offline Command Mode*—MTA1 28ST/NT communicates with the terminal or computer and responds to AT commands. There is no data communications link with a remote device.
- *Data Mode*—MTA128ST/NT enters data mode when it makes a successful data communications link with a remote device. In data mode, the TA can send and receive data, but it does not respond to AT commands. Instead it treats them as data and transmits them to the remote device.
- *Online Command Mode*—MTA128ST/NT responds to AT commands while maintaining a data communications link; however, transmission of data is suspended. To enter online command mode from data mode, type the escape sequence **+++AT<cr>**. To return to data mode from online command mode, type **ATO<cr>**.

Making a Call

Before you can place a data call, configure the MTA1 28ST/NT for the local switch type, serial port speed, and the data type of the ISDN device you want to call. See Chapter 3, Configuration Utilities.

Dialing

To dial a number using AT commands, you must first start a data communications program. In the program's terminal mode, type **ATDxxxxxx<cr>**, where xxxxxx is the telephone number you want to dial, and <CR> is the carriage return character that is sent when you press the ENTER key, such as **ATD7853500<cr>**. The dial string can contain up to 80 characters.

To place an ML-PPP call, use an ampersand character (&) to join two telephone numbers, such as **ATD7853500&7853502<cr>**. The telephone numbers can be the same or different. Using this method, two B-channels are activated to transmit data at an aggregate speed of 128 Kbps.

To make it easier to read the dial string, you can use hyphens, spaces or parentheses. These characters are ignored by the MTA1 28ST/NT. For example, the MTA1 28ST/NT would read the following dial strings the same way:

```
ATD17637853500 <cr>
ATD 1-763-785-3500 <cr>
ATD 1 (763) 785-3500 <cr>
```

Channel Bundling Flag Dialing

The command AT&Jn is used to indicate whether outgoing calls should be made on two B-channels by default. The command AT&J1&W0<cr>, configures the TA to place a call, dialing on two B-channels by default. If no second number is given in the dial string, that single number is dialed twice. This compensates for the interworking issues with Windows Dial-Up Networking. On the other hand, if the user explicitly indicates two numbers in the dial string, then two numbers are dialed (e.g., **ATD7853500&785 3502<cr>**). The command AT&J0&W0<cr>, disables automatic call bundling. Note other valid characters joining two telephone numbers include a plus sign (+), and an exclamation mark (!).

Note: In Windows Dial-Up Networking, if the *Use Country Code and Area Code* box is checked in the **Properties** window for dial-up connection, the bundling modifier (i.e., &, + or!) is removed from the dialing string when the user attempts to make a connection. The solution is to not check the *Use Country Code and Area Code* box or to simply add the bundling dial modifier to the phone number at the time of connection.

Canceling a Call

To cancel a call before the MTA128ST/NT makes a connection, press any key.

Storing a Telephone Number

To store a telephone number, type **&Zn=x** in terminal mode, where *n* is the number of the memory register in which the number is to be stored, and *x* is the dial command string that you want to store. For example, type **AT&Z9=763-785-3500 <cr>** to store the number 763-785-3500 in memory register 9.

Dialing a Stored Telephone Number

To dial a stored telephone number, type **DSn** in terminal mode, where *n* is the location of the number you wish to dial. For example, type **ATDS3 <cr>** dials a telephone stored in memory register 3 location.

Displaying a Stored Number

To display a stored telephone number, type **&Zn?** in terminal mode, where *n* is the memory register in which the number is stored. For example, type **AT&Z5? <cr>** to display the telephone number in memory register 5. To list all ten telephone numbers stored in memory, type **ATL <cr>**.

Answering a Call

You can answer incoming calls to the MTA128ST/NT either manually or automatically. When the TA detects an incoming call, it turns on the RI signal on the V.24 interface and sends a *RING* result code to the computer or terminal after each ring. If autoanswer is enabled, the TA automatically answers the call. You can manually answer the call with the **A** command. Both methods are described below.

Answering Manually

If your communication program is in terminal mode when the *RING* result code appears on your monitor, you can manually answer the call by typing **ATA <cr>**.

Answering Automatically

To cause the MTA128ST/NT to automatically answer a call:

1. Enable autoanswer by setting register **S0** to the ring on which you want the TA to answer (e.g., in terminal mode, type **S0=4** to make the TA answer on the fourth ring). You also can use either of the configuration utilities to turn on autoanswer and set the number of rings.
2. Make sure that the TA is offline.

The TA answers the call after the number of rings specified by **S0**. To disable autoanswer, use a configuration utility or the command **S0=0**.

Note: If the user wants to accept calls while DTR is low, the TA must be configured to ignore DTR. To do this, enter **AT&D0<cr>**. With this configuration, the TA can accept calls while DTR is low. If this configuration setting is not made, the TA rejects incoming calls until DTR is high while calls come in.

Hangup Up

To hang up a call, escape to online command mode (**+++AT<cr>**), then enter the **H** command (**ATH<cr>**). The escape sequence and hangup command can be combined into one command string: **+++ATH<cr>**.

Chapter 5: Troubleshooting

Troubleshooting the TA

Introduction

This chapter describes basic problems you may run into with your MTA128ST/NT and how to solve them. Your MTA1 28ST/NT was thoroughly tested at the factory before it was shipped. If you are unable to make a successful connection, or if you experience data loss during your connection, it is possible that the MTA1 28ST/NT is defective. However, it is more likely that the source of your problem lies elsewhere. Problems you may encounter include the following:

- None of the LEDs light when the MTA1 28ST/NT is on.
- The MTA1 28ST/NT does not respond to commands.
- The MTA128ST/NT dials but cannot make a connection.
- You can place data calls but not voice calls, or vice versa.
- You cannot place two simultaneous data calls.
- The MTA1 28ST/NT disconnects while online.
- The MTA1 28ST/NT cannot connect when answering.
- File transfer appears slower than it should be.
- Data is being lost.
- There are garbage characters on the monitor.

If you experience problems, please check the following possibilities before calling Tech Support (see Chapter 7).

Specific Troubleshooting Situations

SITUATION 1: The *!Hn* and **!Hn* commands can be very useful for certain RAS environments that require at least 1 second to initialize a port after a call has disconnected (such as Citrix and Novell). For example, when a call disconnects, Citrix and Novell will begin initializing the port that just disconnected. However, it typically takes more than 1 second and during that time a call may be received by the digital or analog port. When this happens, Citrix and Novell do not answer the call nor do they finish the initialization process. To prevent this problem, setting *!H5* and/or **!H5* will set the TA to hold of digital and/or analog calls for 5 seconds after the respective port(s) disconnect(s). This should give enough time for the digital and/or analog port to be initialized by Citrix or Novell and enter the “waiting for a call” state.

SITUATION 2: The autobauding code cannot differentiate between 7 data bits, no parity, 1 or 2 stop bits (7N1 or 7N2) and 7 data bits, mark parity, 1 or 2 stop bits (7M1 or 7M2). The TA assumes 7 data bits, mark parity, 1 stop bit (7M1) and this case covers 7N1, 7N2, 7M1 and 7M2. However, if for some reason the assumption of 7M1 causes a problem, then there is a workaround. The addition of the *%S3* command and use of *\$SBn*, *@P3=n*, *@P4=n*, and *@P6=n* will help work around this limitation. See the description for the *%Sn* command.

SITUATION 3: The autobauding code cannot differentiate between 8 data bits, no parity, 1 or 2 stop bits (8N1 or 8N2) and 7 data bits, space parity, 1 or 2 stop bits (7S1 or 7S2). The TA assumes 8 data bits, no parity, 1 stop bit (8N1) and this setting covers 7S1, 7S2, 8N1 and 8N2. However, if for some reason the assumption of 8N1 causes a problem, then there is a workaround. The addition of the *%S3* command and use of *\$SBn*, *@P3=n*, *@P4=n*, and *@P6=n* will help work around this limitation. See the description for the *%Sn* command.

SITUATION 4: The autobauding code does not report the number of stop bits. This may become a problem if the terminal is expecting a certain number of stop bits. The addition of the *%S3* command and use of *\$SBn*, *@P3=n*, *@P4=n*, and *@P6=n* will help work around this limitation. See the description for the *%Sn* command.

Debugging/Logging/Troubleshooting Commands

The AT commands in this section can be used in attempting to troubleshoot or debug a current problem. Some commands may be enhanced or limited by the debugging/logging/troubleshooting S-registers. For complete descriptions of the commands and S-registers, see the additional documents on this CD.

Debugging/Logging/Troubleshooting Command Summary AT

<i>Command</i>	<i>Function</i>
>Dn	Embedded Protocol Analyzer (EPA)
*FSn	Reset TA
*Ln	Fatal Error Information
>LOG	Display Logging Buffer Contents
>Sn	Logging Variables
>TIME	Display Current Timestamp
*V	Various State Information

Debugging/Logging/Troubleshooting S-Registers

The S-registers in this section can be used in attempting to troubleshoot, debug, or even correct a current problem. Some S-registers modify functionality of various features. Some S-registers modify the functionality of the debugging/logging/troubleshooting commands described in the additional documents on the system CD.

Debugging/Logging/Troubleshooting S-Register Summary

S-register Function

S47	Pulse-dial Maximum Break Pulse Period
S48	Pulse-dial Maximum Interdigital Pause
S72	EuroISDN Variant
S90	Local PPP Capabilities
S91	Remote PPP Capabilities
S92	Channel ID Information Element Octet 3 Settings
S93	Blacklisting
S94	Minimum Buffer Space After Trigger
S95	Logging Buffer Functionality
S96	Decode (EPA) Buffer Functionality
S98	ISDN_MSG Size
S99	Startup Options
S100	Flow Control High Threshold
S101	Flow Control Low Threshold
S102	Data to Save for Decoding

None of the LEDs light when the MTA128ST/NT is on

When you turn on the MTA128ST/NT, the LED indicators on the front panel should flash briefly as the TA runs a self-test. If the LEDs remain off, the TA probably is not receiving power.

- Make sure the MTA128ST/NT's power switch is on, especially if you normally turn on the TA by turning on a power strip.
- If the power supply is plugged into a power strip, make sure the power strip is plugged in and its power switch is on.
- Make sure the power supply module is firmly connected to the MTA128ST/NT and to the wall outlet or power strip.
- If the power strip is on and the MTA1 28ST/NT is switched on, try moving the TA's power supply to another outlet on the power strip.
- Test that the outlet is live by plugging a lamp into it.

- The MTA1 28ST/NT or power supply may be defective. If you have another Multi-Tech MTA1 28ST/NT, try swapping MTA128ST/NTs. If the problem goes away, the first MTA128ST/NT or power supply may be defective. Call Tech Support for assistance.

Caution: Do not under any circumstances replace the power supply module with one designed for another product, as it may damage the MTA1 28ST/NT and void your warranty.

The MTA128ST/NT does not respond to commands

- Make sure the MTA1 28ST/NT is plugged in and turned on. (See *None of the LEDs Light When the MTA 128S T/NT Is On.*)
- Try resetting your MTA128ST/NT by turning it off and on.
- Make sure you are issuing the MTA128ST/NT commands from the data communications software, either automatically, or manually in terminal mode. (You cannot send commands to the MTA1 28ST/NT from the DOS prompt.)
- Make sure you are in terminal mode in your data communications program. Then type **AT** and press ENTER. If you get an *OK* response, your connections are good and the problem likely is in your phonebook entry or session settings.
- If you don't get an *OK*, the problem may still be in the communications software. Make sure you have done whatever is necessary in your software to make a port connection. Not all communications programs connect automatically to the COM port. Some connect when the software loads and remain connected until the program ends. Others, like MultiExpress Terminal, can disconnect without ending the program (make sure the Connect icon looks plugged in). MultiExpress Terminal also allows multiple terminals to be open, but only one can access the MTA128ST/NT at a time. If MultiExpress Terminal reports that it cannot make a connection, yet the MTA128ST/NT's *TR* indicator is on, click on the Window menu to see if more than one terminal is open. The MTA128ST/NT's *TR* indicator shows that the software has made a connection with the TA through the COM port.open, but only one can access the MTA128ST/NT at a time. If MultiExpress Terminal reports that it cannot make a connection, yet the MTA128ST/NT's *TR* indicator is on, click on the Window menu to see if more than one terminal is open. The MTA128ST/NT's *TR* indicator shows that the software has made a connection with the TA through the COM port.
- Your communications software settings may not match the physical port the MTA128ST/NT is connected to. The serial cable may be plugged into the wrong connector—check your computer documentation to make sure. Or you may have selected a COM port in your software other than the one the MTA1 28ST/NT is connected to. Compare the settings in your software to the physical connection.
- If the MTA1 28ST/NT is on, the cable is plugged into the correct port, the communications software is configured correctly, and you still don't get an *OK*, the fault may be in the serial cable. Make sure it is firmly connected at both ends.
- Is this the first time you have used the cable? If so, check the cable description on the packaging to make sure the cable is correct for your computer.
- Peripheral expansion cards, such as bus mouse and sound cards, may include a serial port preconfigured as COM1 or COM2. The extra serial port, or the card itself, may use the same COM port, memory address, or interrupt request (IRQ) as your communications port. Be sure to disable any unused ports.

To look for address or IRQ conflicts, select *File*, Run in Program Manager, type **MSD**, and press ENTER. Then select *Mouse*, *COM Ports*, and *IRQ Status* and note the addresses and IRQs that are in use. If you find an IRQ conflict, note which IRQs are not being used, then change one of the conflicting devices to use one of the unused IRQs. If you find an address conflict, change the address of one of the conflicting devices.

To change a port address or IRQ, double-click the *Control Panel* icon, then the *Ports* icon. Click on the port you want to change, click *Settings*, click *Advanced*, and select the new port address and/or interrupt. If you wish to use COM3 or COM4, note that COM3 shares an IRQ with COM1, as does COM4 with COM2, so

you should change their IRQs to unused ones, if possible.

Right-click on *My Computer*, select *Properties* from the menu, click on the *Device Manager* tab, double-click on *Ports*, then double-click on the *Communications Port* your MTA1 28ST/NT is connected to. In the port's Properties sheet, click on the *Resources* tab to see the port's Input/Output range and Interrupt Request. If another device is using the same address range or IRQ, it will appear in the Conflicting Device List. Uncheck *Use Automatic Settings* to change the port's settings so they do not conflict with the other device, or select the port the conflicting device is on and change it instead. If you need to open your computer to change switches or jumpers on the conflicting device, refer to the device's documentation.

- The serial port may be defective. If you have another serial port, install the MTA1 28ST/NT on it, change the COM port setting in your software, and try again.
- If using serial rates above 115,200 baud, make sure the serial port can handle higher rates. Most standard serial ports have a maximum serial rate of 115,200. To handle serial rates of 230,400 baud and 460,800 baud, you need a high-speed serial port. Even though some terminal emulation programs allow you to select higher rates, the serial ports cannot always handle those rates.
- The MTA1 28ST/NT may be defective. If you have another Multi-Tech MTA1 28ST/NT, try swapping MTA1 28ST/NTs. If the problem goes away, the first MTA1 28ST/NT is possibly defective. Call Tech Support for assistance (see Chapter 7).

The MTA128ST/NT dials but cannot make a connection

There can be several reasons the MTA128ST/NT fails to make a connection. Possibilities include

- Lack of a proper physical connection to the communication line.
- A busy signal.
- A wrong number.
- No terminal adapter at the other end.
- A faulty communications device, computer, or software at the other end.
- Incompatibility between communications devices.
- An improperly configured MTA128ST/NT.

Narrow the list of possibilities by using extended result codes. To enable them, enter **ATV1X2** and press ENTER while in terminal mode or include **V1X2** in the MTA128ST/NT's initialization string (**V1X2** is enabled by default). When you dial again, the MTA128ST/NT reports the call's progress.

- If the MTA128ST/NT reports *NO DIALTONE*, check that the ISDN S/T cable is securely connected to both the TA's ISDN jack (not the PHONE jack) and the ISDN network terminator or wall jack. If the cable looks secure, try replacing it. If that doesn't work, the problem may be in your building's telephone installation. Make sure ISDN cables on all devices are wired straight-through (pin 1 to pin 1, pin 2 to pin 2, etc.) and do not have reversed pairs. The cable must have at least the middle four pins (pins 3, 4, 5, and 6) connected. A reversed pair on the U (phone company) side is not important, but a reversed pair on the S/T (your) side can create problems if you have more than one device, since multiple devices attached to the S/T interface must all have the same polarity.
- If the MTA1 28ST/NT reports *BUSY*, the other number may be busy, in which case you should try again later.
- If the MTA1 28ST/NT reports *NO CARRIER*, no connection was made. You might have dialed the correct number but the other computer or software was turned off or faulty. Check the number and try again, or try calling another system to make sure your TA is working. Also, check that you accurately configured the TA with the correct switch type, TEIs, data protocols, and other parameters needed for a successful call (see Chapter 3).

You can place data calls but not voice calls or vice versa

- You might not have ordered both voice and data service from your ISDN provider. Check your contract or latest statement of service from your ISDN provider.
- Your ISDN provider may have programmed the switch incorrectly. Call the provider.

You cannot place two simultaneous data calls

- You may not have ordered an ISDN line configuration that supports two simultaneous calls. Check your contract or latest statement of service from your ISDN provider. Also, your ISDN provider may have programmed the switch incorrectly. Call the provider.
- You may have misconfigured your MTA128ST/NT to dial two simultaneous data calls. The command AT&J1&W0<cr> is used to indicate whether outgoing calls should be made on two B-channels by default.
- You may be using the wrong *bundling* dial modifier (e.g., ATD7853500&7853502<cr>). The ampersand in this command string is correct. Other valid characters joining two telephone numbers include a plus sign (+) and an exclamation mark (!).

Note: In Windows 98/NT/ME, if the *Use Country Code and Area Code* box is checked in the **Properties** window for dial-up connection, the bundling modifier (i.e., &, + or!) is removed from the dialing string when the user attempts to make a connection. The solution is not to check the *Use Country Code and Area Code* box or to simply add the bundling dial modifier to the phone number at the time of connection.

The MTA128ST/NT disconnects while online

- Check for loose connections between the MTA128ST/NT and the computer, the ISDN jack, and AC power.
- The problem may have originated at the other end of the line. Try again.
- If you were online with a BBS or online service, it may have hung up on you because of lack of activity on your part or because you exceeded your time limit for the day. Try again.

The MTA128ST/NT cannot connect when answering

- Autoanswer may be disabled. Turn on autoanswer in your data communications program or send the command **ATS0=1** to your MTA128ST/NT in terminal mode.

Note: If the user wishes to accept calls while DTR is low, the MTA1 28ST/NT must be configured to ignore DTR. This is accomplished by entering AT&D0<cr>. With this configuration, the MTA128ST/NT is able to accept calls while DTR is low. If this configuration setting is not made, the TA rejects incoming calls until DTR is high while the calls comes in.

File transfer appears slower than it should be

- If you have a Universal Asynchronous Receiver/Transmitter (UART) that is compromising data throughputs, we recommend replacing it with a special I/O card.
- If you are running under Windows 3.1 and have a 1 6550AFN UART, replace the Windows serial driver, COMM.DRV, to take full advantage of the UART's speed.
- Check the serial port baud rate in your communications software, and make sure it is set as high as your UART allows.

Data is being lost

- Your UART may not be reliable at serial port speeds over 9600 bps or 19,200 bps. Reset your serial port speed to a lower rate, or replace your serial port with a faster one.
- Check the serial port baud rate in your communications software, and make sure it is set as high as your UART allows.
- Make sure the flow control method you selected in software matches the method selected in the MTA1 28ST/NT.

Garbage characters appear on the monitor

Your computer and the remote computer may be set to different parities. Check with the remote system and set your communications software to use the same parity as the remote system.

Making a V.120 call, caller gets a NO CARRIER message after dialing the number.

Some switches don't support ISDN SETUP messages that contain a LLC (low layer compatibility) element. When these switches receive an LLC in the SETUP, they immediately reject the call and a NO CARRIER message displays. Disable LLC for V.120 calls by issuing the command AT!D0=0. To enable LLC again for V.120 calls, issue the command AT!D0=1 (the default setting).

When using X.75 data protocol to transfer data via the Zmodem, the Zmodem displays Intermittent *bad packet* errors and data throughput drops.

This occurs in cases when the X.75 packet size is greater than 1024 bytes and the terminal adapter sending the file has a fast serial baud rate (e.g., 115200 bps) and the terminal adapter receiving the file has a slow serial baud rate (e.g., 19200 bps). To reduce or possibly eliminate this, reduce the X.75 packet size (S53) to a value less than or equal to 102 bytes (e.g., ATS53=512). However, if you set the receiving terminal adapter's serial baud rate nearly equal to or greater than the serial baud rate of the sending terminal adapter, then the packet size can be greater than 1024, and Zmodem transfers the data without *bad packet* errors.

The MTA128ST/NT won't accept V.120 calls from a 3Com Impact IQ terminal adapter. The Impact IQ displays a connected status, but the MTA128ST/NT does not.

The MTA128ST/NT is looking for a SABME command from the Impact IQ to finish establishing the V.120 connection. However, the Impact IQ won't send a SABME until it has data to send. Have the Impact IQ send a character by pressing any key (such as the space bar) on the terminal attached to the Impact IQ. The MTA128ST/NT responds with a CONNECT message and displays the key you pressed (e.g., a space).

MTA128ST/NT receives garbage characters when connected to a 3Com Impact IQ terminal adapter.

Most likely, the Impact IQ has compression turned on. The compression used by the Impact IQ is incompatible with the compression used by the MTA1 28ST/NT. Disconnect the data connection and give the Impact IQ the command AT%CO and then establish the data connection again. The garbage characters should disappear.

The MTA128ST/NT receives garbage characters after receiving several good characters when connected to a 3Com Sonix adapter.

Most likely, the Sonix has compression turned on. The compression used by the Sonix is incompatible with the compression used by the MTA1 28ST/NT. Disconnect the data connection and give the Sonix the command AT"HO (that's a double quote) and then establish the data connection again. The garbage characters should disappear.

Each time a 3Com Sonix terminal adapter originates a V.120 call, the MTA128ST answers the call as a V.110 call.

The Sonix sends V.1 10 information in the SETUP message to the network. Since the MTA128ST's default is with Auto Protocol Detection enabled (ATS52=1), it looks at SETUP information from the Sonix and determines erroneously that it is a V.1 10 call. Disable Auto Protocol Detection in the MTA128ST with the command ATS52=0 and try the connection again.

The MTA128ST/NT won't connect to an ELSA terminal adapter with the V.120 data protocol.

Most likely, the ELSA terminal adapter has compression turned on. The compression used by the ELSA terminal adapter is incompatible with compression used by the MTA128ST/NT. Give the ELSA the command AT%CO to disable compression and try again.

Apple Macintosh Compatibility

The IWay Hopper works with all Macintosh models with a serial port. Some models may require a USB-to-serial adapter since the MTA1 28ST/NT is a serial RS-232 device. Scripts are provided for Mac OS 8 through Mac OS X. These scripts also work with Mac OS 7.x with the Apple Internet Connection Kit installed. (OS 8 and 8.1 have the Apple Internet Connection Kit built-in and Mac OS 8.5 through Mac OS X have Internet connection capabilities built-in.) If you don't use the Internet connection abilities provided by the Mac OS, then you will need to create your own initialization string to suit your needs. Generally, these initialization strings can be based on the Factory Profile command **&Fn** to set up the desired protocol.

Chapter 6: Point-to-Point Communications: PPP/MLPPP

Bonding Using the &, ! and + Characters

You can use the **&**, **!** and **+** characters to bond two channels together when performing channel bonding (available only with the MLPPP protocol).

When you use the **&**, **+**, or **!** characters with the MLPPP protocol, the TA regards the number following that character as a second phone number. When used with MLPPP, the TA first dials the number given before the **&**, **+**, or **!** character. After establishing the LCP (Link Control Protocol) and authenticating (if requested), the TA dials the second number (the number after the **&**, **+**, or **!** character).

This is an alternative method to set up a MultiLink PPP call as opposed to using the **&J1** command, which dials the given number twice rather than dialing two different numbers.

Example: **ATD5551000&5553000** dials 5551000 first, sets up the LCP and authenticates, and then dials 5553000 and sets up the LCP and authenticates on the second B-channel (thus setting up an MLPPP call).

Note: Using these characters with any protocol other than the PPP/MLPPP protocol does not result in the use of two B-channels at this time.

Making PPP/MLPPP Connections

Making a PPP or MLPPP connection is not as simple as using a terminal emulation program and dialing one or two phone numbers. Using the PPP data protocol provided by the TA (**!Z=9**) requires that the TA receives PPP-formatted data from the terminal. If the TA does not receive PPP-formatted data, the data is discarded by the TA and never sent to the peer. The TA can receive PPP-formatted data from the peer and send it to the terminal, but if it is sending the data to a terminal emulation program running on the terminal, the data appears as *garbage*.

The PPP data protocol requires PPP data to be sent from the terminal in order for the data to be sent to the other side. The MultiLink protocol requires the PPP protocol to establish itself on one B-channel before the second channel is dialed. The LCP can be established only if data is sent by the terminal to the TA. Negotiation actually occurs between the local terminal and the remote peer. The TA simply views the negotiation, so it knows how to negotiate on the second B-channel. When the second B-channel connects, the local terminal is unaware and doesn't participate in the LCP negotiation. Therefore, the TA must mimic the negotiation that was witnessed on the first channel.

For example, sending **ATDT5551000&5553000** from a terminal emulation program to the TA does NOT cause the TA to dial two channels and bring up the 128K LED. However, if that dial command was given by Windows Dial-Up Networking, for example, then there is a chance that the TA dials two channels and brings up the 128K LED if the user name and password are correct, if the IP address is okay, and if the peer allows a MultiLink connection. If MultiLink is not allowed, then the TA uses one channel for the PPP connection. If the user name or password are invalid or incorrect, the connection is terminated. If an IP address is in conflict, the connection is terminated as well.

Software Applications that can Format PPP Data

Software applications that can format PPP Data for Microsoft-compatible PCs include Windows Dial-Up Networking (DUN) and WinSock.

Software applications that can format PPP Data for Apple Macintoshes include OT/PPP, MacPPP, FreePPP, GearBox, and pppd via Internet Connect (Mac OS X).

Dynamic Bandwidth Allocation (DBA)

Dynamic Bandwidth Allocation (DBA) supports the addition and removal of data channels according to the level of throughput through the TA and according to analog POTS port use.

If throughput is above a given threshold, a second data channel is added to facilitate higher throughput.

If throughput drops below a given threshold, the second channel is removed to save the cost of having the second B-channel active but not fully used.

If an outgoing analog call is desired or there is an incoming analog call, a data channel can be bumped (removed) to allow analog POTS port use.

Bandwidth-on-Demand (BOD) checks the data throughput to determine whether a channel should be added or removed.

Call Bumping (CB) determines whether a channel needs to be added again (analog call disconnected) or removed (incoming or outgoing analog call desired) due to activity on the analog POTS port.

To activate Bandwidth-on-Demand or Call Bumping, enable Dynamic Bandwidth Allocation in S-register S59.

The 128 LED flashes if DBA is active and only one data channel is connected. The 128 LED stops flashing and remains on after the second B-channel is successfully added. If the second channel is disconnected due to low throughput or a call-bump, the 128 LED flashes again to indicate that DBA is still active.

If the TA attempts to add a B-channel, but the host is busy or not answering, the TA starts a timer (time is set in S-register **S31**). However, if the analog device goes off-hook or an analog call is received, the timer is stopped and reset. After the analog call finishes, the TA again attempts to add the B-channel. Taking the analog device off-hook and placing it on-hook again interrupts the timer, thus allowing control over the amount of time it takes before attempting to add the second channel (rather than waiting for timeout values specified by **S31**).

DBA Data Protocols

MLPPP is the only data protocol that currently supports DBA. To start DBA, set **&J1** or give two numbers to be dialed. Otherwise, the TA will not negotiate the MultiLink Protocol (MP) option. If the MultiLink Protocol option is not negotiated, Dynamic Bandwidth Allocation is not possible.

DBA Features:

Bandwidth-on-Demand (BOD)—S60, S61, S62, and S63

- Bandwidth-on-Demand (BOD) is not available to the host TA if Dynamic Bandwidth Allocation is disabled (S59=0) or if the Dynamic Bandwidth Allocation scheme is PPP (S59=2).
- Setting S60=0 disables the BOD feature completely (meaning S61, S62, and S63 are disabled as well).
- To calculate High Throughput Average (in Kbps):
 - Divide the total number of bits *received* from the PC (not including start, stop, or parity bits) during the High Threshold Sampling Period (S60) by the High Threshold Sampling Period (S60) value (in Kbps).

$$\text{Total bits received} \div \text{S60} = \text{High Throughput Average}$$
 - Or, divide the total number of bits *transmitted* to the PC (don't include start, stop, or parity bits) during the High Threshold Sampling Period (S60) by the High Threshold Sampling Period (S60) value (in Kbps).

$$\text{Total bits transmitted} \div \text{S60} = \text{High Throughput Average}$$

If the average (transmitted or received) exceeds the High Threshold (S61) and only one data channel is active and the second B-channel is not already in use, the TA attempts to add a second data channel.

- To calculate Low Throughput Average (in Kbps):
 - Divide total number of bits *received* from the PC (not including start, stop, or parity bits) during the Low Threshold Sampling Period (S62) by the Low Threshold Sampling Period (S62) value (in Kbps).

$$\text{Total bits received} \div \text{S62} = \text{Low Throughput Average}$$
 - Or, divide total number of bits *transmitted* to the PC (not including start, stop, or parity bits) during the Low Threshold Sampling Period (S62) by the Low Threshold Sampling Period (S62) value (in Kbps).

$$\text{Total bits transmitted} \div \text{S62} = \text{Low Throughput Average}$$

If either average (transmitted or received) equals or is less than the Low Threshold (S63) and there are two active data channels, the TA disconnects the second data channel.

- Ideally, the second channel should be added quickly (short High Threshold Sampling Period [S60] with a relatively small High Throughput Threshold [S61]). Also, the second channel should not be disconnected

for a relatively long period of time (long Low Threshold Sampling Period [S62] with a small Low Throughput Threshold [S63]).

- If data transmits or is received in bursts and the TA adds and removes a channel too quickly, increase the High Threshold Sampling Period (S60) and the Low Threshold Sampling Period (S62) *and* – decrease the Low Throughput Threshold (S63).

Call Bumping (S-register S64)

- Call Bumping is not available to the host TA if Dynamic Bandwidth Allocation is disabled (S59=0) or if the Dynamic Bandwidth Allocation scheme is PPP (S59=2).
- If the analog device goes off-hook or there is an indication of an incoming analog call and both B-channels are in use by a data call, the TA drops the second B-channel and rings the analog device.
- If the analog device goes on-hook or the peer disconnects the analog call, the TA adds the second B-channel again according to whether BOD is enabled or disabled (S60). If BOD is disabled (S60=0), the second channel is added immediately. If BOD is enabled (S60 is non-zero), the second channel is added after the High Threshold Sampling Period (S60) and High Throughput Threshold (S61) determine whether throughput is high enough to allow adding the second channel.

Chapter 7: Warranty, Service, and Tech Support

Multi-Tech Systems, Inc. Warranty & Repairs Policies

Warranty

Multi-Tech Systems, Inc., (hereafter "MTS") warrants that its products will be free from defects in material or workmanship for a period of two, five, or ten years (depending on model) from date of purchase, or if proof of purchase is not provided, two, five, or ten years (depending on model) from date of shipment. MTS MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED.

This warranty does not apply to any products which have been damaged by lightning storms, water, or power surges or which have been neglected, altered, abused, used for a purpose other than the one for which they were manufactured, repaired by Customer or any party without MTS's written authorization, or used in any manner inconsistent with MTS's instructions.

MTS's entire obligation under this warranty shall be limited (at MTS's option) to repair or replacement of any products which prove to be defective within the warranty period or, at MTS's option, issuance of a refund of the purchase price. Defective products must be returned by Customer to MTS's factory – transportation prepaid.

MTS WILL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES, AND UNDER NO CIRCUMSTANCES WILL ITS LIABILITY EXCEED THE PRICE FOR DEFECTIVE PRODUCTS.

Repair Procedures for U.S. and Canadian Customers

In the event that service is required, products may be shipped, freight prepaid, to our Mounds View, Minnesota factory:

Multi-Tech Systems, Inc.
2205 Woodale Drive
Mounds View, MN 55112
Attn: Repairs, Serial # _____

A Returned Materials Authorization (RMA) is not required. Return shipping charges (surface) will be paid by MTS in U.S. and Canada.

Please include, inside the shipping box, a description of the problem, a return shipping address (must have street address, not P.O. Box), and your telephone number. If the product is out of warranty, a payment in advance is required. Acceptable means of payment include credit card, wire transfer or a check in U.S.dollars drawn on a U.S. bank.

For out of warranty repair charges, go to [COMPANY/Policies/warranty/](#)

Extended two-year overnight replacement service agreements are available for selected products. Please call MTS customer service at (888) 288-5470, or visit our web site at

[/PARTNER/Programs/overnight replacement/](#) for details on rates and coverages.

Please direct your questions regarding technical matters, product configuration, verification that the product is defective, etc., to our Technical Support department at (800) 972-2439 or email support@multitech.com. Please direct your questions regarding repair expediting, receiving, shipping, billing, etc., to our Repair Accounting department at (800) 328-9717 or (763) 717-5631, or email mtsrepair@multitech.com.

Repairs for damages caused by lightning storms, water, power surges, incorrect installation, physical abuse, or user-caused damages are billed on a time-plus-materials basis.

Repair Procedures for International Customers (Outside U.S.A. and Canada)

Your original point-of-purchase Reseller may offer the quickest and most economical repair option for your Multi-Tech product. You may also contact any Multi-Tech sales office for information about the nearest distributor or other repair service for your Multi-Tech product. The Multi-Tech sales office directory is available at <http://www.multitech.com/partners/channels/offices/>

In the event that factory service is required, products may be shipped, freight prepaid to our Mounds View, Minnesota factory. Recommended international shipment methods are via Federal Express, UPS or DHL courier services, or by airmail parcel post; shipments made by any other method will be refused. Please include, inside the shipping box, a description of the problem, a return shipping address (must have street address, not P.O. Box), and your telephone number. If the product is out of warranty, a payment in advance is required. Acceptable means of payment include credit card, wire transfer, or a check in U.S. dollars drawn on a U.S. bank. Repaired units shall be shipped freight collect, unless other arrangements are made in advance.

Please direct your questions regarding technical matters, product configuration, verification that the product is defective, etc., to our Technical Support department nearest you or email support@multitech.com. When calling the U.S., please direct your questions regarding repair expediting, receiving, shipping, billing, etc., to our Repair Accounting department at (763) 717-5631 in the U.S.A., or email mtsrepair@multitech.com.

Repairs for damages caused by lightning storms, water, power surges, incorrect installation, physical abuse, or user-caused damages are billed on a time-plus-materials basis.

Repair Procedures for International Distributors

International Distributors should contact their MTS International sales representative for information about the repair of Multi-Tech product(s).

Please direct your questions regarding technical matters, product configuration, verification that the product is defective, etc., to our International Technical Support department (763) 717-5863. When calling the U.S., please direct your questions regarding repair expediting, receiving, shipping, billing, etc., to our Repair Accounting department at (763) 717-5631 in the U.S.A., or email mtsrepair@multitech.com.

Repairs for damages caused by lightning storms, water, power surges, incorrect installation, physical abuse, or user-caused damages are billed on a time-plus-materials basis.

Replacement Parts

SupplyNet, Inc., can supply you with replacement power supplies, cables and connectors for selected Multi-Tech products. You can place an order with SupplyNet via mail, phone, fax or the Internet at the following addresses:

Mail: SupplyNet, Inc.
 614 Corporate Way
 Valley Cottage, NY 10989
Phone: 800 826-0279

Appendix A: Configuration Profiles

Quick Setup Factory Profiles

For quick setup, the MTA1 28ST/NT includes six Quick Setup Factory Profiles, each of which is configured for a specific type of port operation. You can load a Quick Setup Factory Profile into active memory by using the command **&Fn**, in which *n* is the number of the profile you wish to load. If you wish, you can then customize the profile and store it, using the **&W** command, so that it loads automatically when the MTA1 28ST/NT is turned on or reset. These profiles are stored in permanent memory and are not user-configurable as such.

MTA1 28ST

- &F0** Profile 0—Modem-like operation (default)
- &F1** Profile 1—V. 110 async operation
- &F2** Profile 2—V.120 async operation
- &F3** Profile 3—X.75 async operation
- &F4** Profile 4—ML-PPP async operation
- &F5** Profile 5—SoftBonding Asynchronous Operation
- &F6** Profile 6—HDLC Asynchronous Operation
- &F7** Profile 7—CLEAR operation

MTA1 28NT

- &F0** Profile 0—Modem-Like Asynchronous Operation
- &F1** Profile 1—V.120 Asynchronous Operation
- &F2** Profile 2—X.75 Asynchronous Operation
- &F3** Profile 3—PPP Asynchronous Operation
- &F4** Profile 4—SoftBonding Asynchronous Operation
- &F5** Profile 5—HDLC Asynchronous Operation
- &F6** Profile 6—CLEAR Asynchronous Operation

Quick Setup Example

The following procedure assumes that you want to load, modify, and store Quick Setup Factory Profile 2 as your default configuration.

1. Select the profile closest to the requirements of your application, in this case— Quick Setup Factory Profile 2.
2. In terminal mode, type **AT&F2** and press ENTER. Quick Setup Profile 2 loads into the MTA128ST/NT's active memory.
3. Enter any additional AT commands that you need to customize the selected profile to your application (see Chapter 4, *AT Commands, S-Registers, and Result Codes*).
4. Type **AT&W0** and press ENTER to save your customized port configuration.
5. Your customized profile now loads automatically whenever the MTA128ST/NT is turned on or reset.

Appendix B: Ordering Your ISDN Line

There are two ways to specify your ISDN line configuration to your service provider. One is by using ISDN "ordering codes" in which the user, the Local Exchange Carrier (LEC) or Internet Service Provider (ISP) are using common nomenclature to describe elements of service. The other way of ordering service is to use a "building block approach"; where the naming conventions are non-standardized, and the user and provider must establish a set of provisioning options.

Loop Qualification

The first step in ordering ("provisioning") an ISDN BRI line is to contact your LEC and verify ISDN BRI loop availability in your location. There is a distance limitation of approximately 2 miles (1800Kf) from the BRI loop. Each request for BRI is handled on a case-by-case basis. Once qualified, the LEC requires information on the type of equipment and protocol used. Most ISDN BRI is configured as "voice and data" (due to the fact that the LEC network is primarily analog, and ISDN digital technology converts the digital signal into analog, transports it over their analog lines, and then re-converts it into digital data at the other end).

As a general procedure when ordering an ISDN BRI (2B+D) line:

1. Plan ahead; the BRI line order may take four weeks or more to get provisioned.
2. Contact your LEC representative early in the process to ensure ISDN BRI loop availability for your location.
3. Provide the LEC rep. with your correct address for the BRI service.
4. Provide the LEC rep. with the type of equipment (e.g., "Multi-Tech MTA128TA External ISDN Terminal Adapter") and the protocol specifications that it supports. Use the "ISDN BRI (2B+D) Line Ordering Checklist" provided later in this document for the protocol specifications.
5. Provide the LEC rep. with the type of jack required by the MTA128NT (i.e., "RJ45 male 2-wire U Basic Rate Interface").
6. Wait for notification of installation from the LEC; ask the LEC rep what type of switch is used (AT&T 5ESS and NT DMS-100 are most prevalent).
7. Ensure availability of an "auxiliary" analog line (if you plan on using the MTA1 28NT's "AUX" RJ1 1 analog connector for a standard telephone connection). Make sure you have a 115 VAC (60 Hz) power outlet near your computer for the MTA1 28NT's two-prong outlet-mounted power transformer.
8. Record all of the information provided by your LEC.

Bearer Service

The options of Circuit Switch Voice Bearer (CSV) and Circuit Switch Data Bearer (CSD) are broad categories of Bearer Services that the phone companies can provide. Different bearer services provide different types of guarantees about the reliability and synchronization of the data. There are currently ten different bearer services for circuit-mode, and three services for packet mode.

These bearer services are defined in terms of a number of attributes, which include mode (circuit or packet), structure (bit-stream or octet-stream), transfer rate (e.g. 64Kbps), transfer capability (basically, the content, for instance speech, 7Khz audio, video, or unrestricted), and several other attributes that specify protocols to use and other things.

The attributes of the bearer service are encoded into a Bearer Code, or BC, that is sent everytime a new connection is being set up. In theory, this allows the switches to dynamically choose from a variety of different switching paths techniques depending on requirements. In practice, the SPID is used to determine what services are needed for switching, as this greatly simplifies things for the telephone companies. The Bearer Code will not be completely ignored, however there are certain bearer services that will be unavailable on your B-channels, based on how they are configured. It is important to note that the Bearer Code is sent to the switch every time a connection is established. However, the SPID is only sent to the switch when you physically attach your

equipment to your phone line. At this time the switch gives your device a Terminal Equipment Identifier (TEI) which is used from then on to identify all connection requests from that piece of equipment. This allows the switch to look at the TEI and Bearer Code, determine the SPID, and see if the Bearer Code and the SPID match up.

Using ISDN Ordering Codes (IOCs)

An organization called *ISDN Solutions Group*, made up of ISDN service providers and equipment vendors, was formed to simplify the often complex task of ordering an ISDN line. This method, supported by most (but not all) service providers, uses ISDN ordering codes to define the ISDN line configuration. Your ISDN TA has been tested to operate with the following ordering codes: B1, Capability C, Capability R, I2, J2, J3, Capability S, and M5, as described in the following sections.

B1 (previously 'Generic Data B')

This ISDN line ordering code supports:

- 1 B Service,
- Data only on 1 B channel, and
- One directory number.

Capability C (previously 'Generic Data C')

This ISDN line ordering code supports:

- 1 B Service,
- Alternate voice and data on one B channel, and
- One directory number.

Capability R (previously 'Generic Data I')

This ISDN ordering code supports:

- 2B Service,
- Data only on each B channel, and
- Two directory numbers.

Applications for Capability R include:

- 115.2K or 128K bps data only (no voice capability, and
- Generic 115.2K/1 28K bps data transfer applications (including remote access and LAN/WAN connectivity and telecommuting).

I2 (previously 'Generic Data I-1DN')

This ISDN ordering code supports:

- 2B Service,
- Data only on each B channel, and
- One directory number.

I2 is not available on the Northern Telecom switch. Two directory numbers are required for 2B operation; in this case use J2.

J2 (previously 'Generic Data J')

This ISDN ordering code supports:

- 2B Service,
- alternate voice and data on one B channel, data only on other B channel, and
- Two directory numbers.

J3 (previously 'Generic Data J-1DN')

This ISDN ordering code supports:

- 2B Service,
- alternate voice and data on one B, data only on other B channel, and
- One directory number.

J3 is not available on the Northern Telecom switch. Since two directory numbers are required for 2B operation, use J2.

Capability S (previously 'Generic Data M')

This ISDN ordering code is the recommended IOC since it supports the most features for voice and data applications. However, ISDN tariffs in some areas may warrant ordering codes with fewer features (e.g., where there is an additional monthly charge for having voice service on both B channels). If yours is a data only application, you may find Capability R more cost-effective.

Capability S supports:

- 2B Service,
- alternating voice/data on each B channel, and
- Two directory numbers.

Applications for Capability S include:

- 115.2K or 128K bps data,
- 56K/64K bps data with voice or modem support, and
- Generic 1 15.2K/1 28K bps data transfer applications (including remote access and LAN/WAN connectivity and telecommuting).

M5 (previously 'Generic Data M-1DN')

This ISDN ordering code supports:

- 2B Service,
- alternate voice/data on each B channel, and
- One directory number.

M5 is not available for services provided with Northern Telecom or AT&T switches. Since two directory numbers are required for 2B operation, use Capability S.

Ordering ISDN Without IOCs

This section guides you and your telephone company in specifying and obtaining ISDN service when IOCs are not used. To support most ISDN TA features, your telephone service must meet certain requirements. These requirements are described in the following sections. Some features may be added or deleted, depending on your actual data service needs and availability in your area. Before ordering, talk to your telephone company about which of the services listed on the following pages are provided in your area.

The following form was created for you to complete and fax to your telephone company to request the proper ISDN line for use with your ISDN TA module.

Name: _____

Address: _____

City: _____ State: _____ ZIP Code: _____

Daytime Telephone Number: _____

1. Request an ISDN BRI (Basic Rate Interface) line with:

- U-Interface Reference Point, and
- 2B1Q Line Coding.

2. Choose one of the following:

___ 2B+D Service (supports up to 128K bps), or

___ 1 B+D Service (supports up to 64K bps).

3. Indicate the ISDN Switch Type and Software Protocol you will be using:

___ AT&T 5ESS, with:

___ Custom,

___ 5E6 and later software, or

___ NI1 (National ISDN-1).

___ Northern Telecom DMS-100, with:

___ BCS-32 and later software (Pvc1), or

___ National ISDN-1 (Pvc2).

___ Siemens EWSD with National ISDN-1

4. Request that the ISDN line you are ordering allocates one dynamic TEI (Terminal Endpoint Identifier) per phone number.

5. Order specific services for your particular ISDN Switch:

5a. AT&T 5ESS: request a line with:

Feature: Value

B1 Service: DMD (On Demand)

B2 Service: DMD (only if 2B+D ordered)

Data Line Class: PM (Point-to-MultiPoint)

Maximum B Channels: 2 (if 2B+D) or 1 (if 1 B+D)

Circuit Switched Voice (CSV) Bearer Channels: Any

CSV Calls: 1 (recommended for test purposes)

Number of Circuit Switched Data (CSD) Bearer Channels: Any

Number of CSD Calls: 2 (if 2B+D ordered), or 1 (if 1 B+D ordered)

Terminal Type: Type A Turn these features OFF:

Packet Mode Data

MultiLine Hunt

Multiple Call Appearances

EKTS (Electronic Key Telephone Sets)
 Shared Directory Numbers
 Accept *Special* Type of Number
 Intercom Groups
 Modem Pools (Network Resource Selector)
 Message Waiting
 Hunting
 InterLATA Competition

5b. Northern Telecom DMS-100: request a point-to-multipoint line with:

Line Type: Basic Rate, Functional

Electronic Key Telephone Sets (EKTS): No

Call Appearance Handling (CACH): No

Non-Initializing Terminal: No

Circuit Switched Service: Yes

Packet Switched Service: No

TEI: Dynamic

Bearer Service: Circuit Switched Voice and Data Permitted on Any B Channel (Packet Mode Data not permitted)

6. _____ Select a long distance carrier; note here:

7. Contact the selected long distance carrier and request Circuit-Switched 64K bps Clear Channel Access (if available).

8. Request that the telephone company provide ISDN TA configuring information (record here):

- ISDN Switch Type: _____
- ISDN Switch Protocol Version: _____
- ISDN Phone Number 1: _____
- ISDN Phone Number 2: _____ (if 2B+D ordered)
- ISDN Line Type: _____ (point-to-point or multipoint)
- If MultiPoint, SPID Number 1: _____ (with prefix and suffix)
- If MultiPoint, SPID Number 2: _____ (with prefix and suffix)

9. If you will be using standard 5ESS or DMS-100, your protocol selection is complete. Fax the information in steps 1-8 to your phone company. If you will be using 5ESS "Custom" or DMS-100 "Pvc1" protocol support, continue with step 10a (5ESS Custom) or step 10b (DMS-100 Pvc1).

10a. 5ESS Custom Line Additional Parameters

The AT&T 5ESS central office telephone switch supports a proprietary ISDN D-channel call control protocol called "Custom" which is based on CCITT recommendations. The ISDN TA configured for switch type AT&T 5ESS will work with lines providing this protocol on 5ESS switches with software version 5E6 or later.

The ISDN TA supports the following configurations on 5ESS Custom lines:

- Point-to-Point with one phone number (recommended configuration with no POTS interface)
- Multipoint with one phone number
- Multipoint with two phone numbers (recommended configuration with POTS interface)

The requirements for the 5ESS line are shown below:

B1 Service: DMD (On-demand)

B2 Service: DMD (On-demand)

Data Class Line: PM (Point-to-MultiPoint) Max. B

Channels: 2

Number of CSV Calls: 2

CSV Bearer Channels: Any

Number of CSD Calls: 2

Circuit Switched: Any

Terminal Type Bearer Channels: Type A

Multipoint lines require the phone company to create a SPID for each phone number on the line. With the exception of the ability to spread two calls across two phone numbers, multipoint lines offer no special features, and may create complications. However, if you use a multipoint line, the parameters are similar to the point-to-point lines, except for the SPIDs.

The 5ESS switch can provide a variety of supplementary features which the ISDN TA may not support. Enabling these features may have undesirable consequences.

Features to avoid are:

- Packet mode data
- Multiline Hunt Groups
- EKTS (Electronic Key Telephone Set)
- Shared directory numbers
- Intercom groups
- Modem Pools (Network resource selector)
- Message waiting
- Hunting
- Inter LATA competition
- Accept special type of number

10b. DMS-100 Pvc1 Line Additional Parameters

The Northern Telecom DMS-100 telephone switch supports a proprietary ISDN D-channel call control protocol called Protocol Version 1 ("Pvc1") which is based on CCITT recommendations. The ISDN TA configured for switch type DMS-100 will work with lines providing this protocol on DMS-100 switches with software version BCS-32 or later.

The ISDN TA supports the following configurations on DMS-100 Custom lines:

- Multipoint with one phone number (for 1 B+D service)
- Multipoint with two phone numbers (for 2B+D service)

The requirements for the DMS-100 multipoint line are defined in Local Interface Requirements, Local Service Requirements, and below. Fax this information to your local phone company.

The line should have two service profiles with the parameters below, to support BONDING and the POTS port, if installed.

Line Type: Basic rate, functional EKTS: No

CACH: No

Initializing terminal: Yes

Bearer services: Circuit-switched voice & data permitted (Packet mode data not permitted) Circuit-switched service: Yes

Packet-switched service: No Protocol

version: Functional Pvc1 TEI: Dynamic

Appendix C: FCC and Canadian Regulation

FCC

1. This equipment complies with Part 68 of the Federal Communications Commission (FCC) rules. On the outside surface of this equipment is a label that contains, among other information, the FCC registration number and ringer equivalence number (REN). If requested, this information must be provided to the telephone company.
2. As indicated below, the suitable jack (Universal Service Order Code connecting arrangement) for this equipment is shown. If applicable, the facility interface codes (FIC) and service order codes (SOC) are shown.

An FCC-compliant telephone cord and modular plug is provided with this equipment. This equipment is designed to be connected to the telephone network or premises wiring using a compatible modular jack which is Part 68 compliant. See installation instructions for details.
3. The ringer equivalence number (REN) is used to determine the quantity of devices which may be connected to the telephone line. Excessive REN's on the telephone line may result in the devices not ringing in response to an incoming call. In most, but not all areas, the sum of the REN's should not exceed five (5.0). To be certain of the number of devices that may be connected to the line, as determined by the total REN's, contact the telephone company to determine the maximum REN for the calling area.
4. If this equipment causes harm to the telephone network, the telephone company will notify you in advance that temporary discontinuance of service may be required. But if advance notice isn't practical, the telephone company will notify the customer as soon as possible. Also, you will be advised of your right to file a complaint with the FCC if you believe it is necessary.
5. The telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the operation of the equipment. If this happens, the telephone company will provide advance notice in order for you to make necessary modifications in order to maintain uninterrupted service.
6. If trouble is experienced with this equipment (the model of which is indicated below) please contact Multi-Tech Systems, Inc. at the address shown below for details of how to have repairs made. If the equipment is causing harm to the telephone network, the telephone company may request you remove the equipment from the network until the problem is resolved.
7. No repairs are to be made by you. Repairs are to be made only by Multi-Tech Systems or its licensees. Unauthorized repairs void registration and warranty.
8. This equipment cannot be used on public coin service provided by the telephone company. Connection to Party Line Service is subject to state tariffs. (Contact the state public utility commission, public service commission or corporation commission for information.)
9. If so required, this equipment is hearing-aid compatible.

Manufacturer:	Multi-Tech Systems, Inc.
Model Number:	MTA128NT
FCC Registration #:	AU7USA-24353-DD-N
Ringer Equivalence:	Modular Jack (USOC) RJ45/RJ1 1
Service Center in USA:	Multi-Tech Systems Inc. 2205 Woodale Drive Mounds View, MN 55112 Voice (612) 785- 3500/ FAX (612) 785-9874

Canadian Limitations Notice

Notice: The ringer equivalence number (REN) assigned to each terminal device provides an indication of the

maximum number of terminals allowed to be connected to a telephone interface. The termination of a interface may consist of any combination of devices subject only to the requirement that the sum of the ringer equivalence numbers of all the devices does not exceed 5.

Notice: The Industry Canada label identifies certificated equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Industry Canada does not guarantee the equipment will operate to the 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. The customer should be aware that 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. Users should ensure for their own protection 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 electric inspection authority, or electrician, as appropriate.



The CE mark is affixed to this product to confirm compliance with the following European Community Directives:

Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of Member States relating to electromagnetic compatibility;

and

Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits;

and

Council Directive 98/1 3/EC of 12 March 1998 on the approximation of the laws of the Member States concerning telecommunications terminal and satellite earth station equipment.

AppendixD: Configuration Methods

Firmware-based Configuration Utility

1. If you are using another operating system, turn on your computer and start your data communications program.
2. The TR (Terminal Ready) LED lights to indicate that your computer is ready to communicate with the TA.
Type **AT** in the communications program's terminal window and press ENTER. The TA should respond with *OK*.
If it doesn't, go to Chapter 5 for troubleshooting help.
3. To view your current configuration, type **ATIL** in the terminal window. Switch Type and Data Protocol information appear. The fields for SPIDs (Service Provider Identification) and for Voice and Data Directory Numbers will be empty. Your TA ships with Auto-TEI (terminal endpoint identifier) as its default. Refer to before you start in Chapter 3 for your network, call control configuration, and comport settings.
4. To change one or more settings, type **AT@CONFIG**, press ENTER, and follow the ConfigMenu directions.
5. Type **AT&W** and press ENTER to store your settings.

The following is a description of the menus.

Network Configuration Menu. *Select this menu to configure network parameters such as the switch type, data and voice TEIs, and data and voice MSNs. When you finish, select Save Network Configuration to save your work.*

Call Control Configuration Menu. *Select this menu to change how the MTA128ST/NT originates and answers calls. Options include Auto Answer, Rings to Answer, Dialing Method, and Persistent DTR Dialing.*

Data Protocols Menu. *Select this menu to change the rate adaption protocol used by the MTA 128ST/NT.*

Stored Numbers Menu. *Select this menu to store up to ten phone numbers with a maximum of 25 characters each. Stored number 0 is the phone number that is dialed if you enable persistent DTR dialing.*

Port Control Configuration Menu. *Select this menu to configure the MTA128ST/NT's serial port, including how the MTA 128S T/NT responds to control signals on the RS232 interface.*

POTS Port Configuration Menu. *Select this menu to configure the MTA128S T/NT's POTS port which includes the ring type, frequency, and pattern.*

Help Menu. *Select this menu for help on navigating through the MTA128ST/NT menu system.*

Configuration via AT Commands

You can configure the MTA128ST/NT by using AT commands, just as you would configure an analog modem.

Use this method if you prefer to work with AT commands or if you have a special requirement not addressed by either of the configuration utilities.

Using AT Commands to Configure the MTA128ST/NT

1. Connect a VT100/ANSI-compatible terminal, or a computer that has a communications program that has VT100/ANSI terminal emulation, to the MTA128ST/NT's serial port.
2. Turn on the MTA128ST/NT. The MTA128ST/NT automatically detects whether an ASCII or ANSI terminal is in use and adjusts accordingly.
3. Start a data communication program and select the COM port where the MTA128ST/NT is connected.
4. Referring to your *Before Your Start* notes, enter the desired AT commands in the terminal window of the data communications program.
5. When you finish making changes, use the **&W** command to save your new configuration, and to select it to automatically load when the MTA128ST/NT is turned on.
6. Quit the data communications program.

For more information on AT commands, see the MTA128ST and MTA128NT AT Commands documents

Glossary

Symbol

2B1Q (2 bits, 1 quaternary)—A line code at layer one for the BRI U interface. Two bits of data (2B) are mapped into one of four line values (1Q, or 1quaternary). This coding scheme allows a single copper pair to carry 160 Kbps of information bidirectionally and simultaneously at a distance of up to three miles.

A

ACK (acknowledgement code)—A communications code sent from a receiving modem to a transmitting modem to indicate that it is ready to accept data. It is also used to acknowledge the error-free receipt of transmitted data. Contrast with *NAK*.

address—A numbered location inside a computer. The computer uses addresses to access resources such as video cards, serial ports, memory, etc.

analog signal—A waveform that has amplitude, frequency, and phase, which takes on a range of values between its maximum and minimum points.

analog transmission—A type of telecommunications that uses an analog signal as a carrier of voice, data, video, etc. An analog signal becomes a carrier when it is modulated by altering its phase, amplitude, and/or frequency to correspond with the source signal. Compare with digital transmission.

API (application program interface)—A software module created to allow dissimilar, or incompatible applications programs to transfer information over a communications link. APIs may be simple or complex; they are commonly required to link computer applications with mainframe programs.

ASCII (American Standard Code for Information Interchange)—Pronounced *ass-key*. A binary code for data that is used in communications and in many computers and terminals. The code is used to represent numbers, letters, punctuation, and control characters. The basic ASCII code is a 7-bit character set, which defines 128 possible characters. The extended 8-bit ASCII code defines 255 characters.

ASI (application services interface)—A software module that creates the interface between a LAN-connected PC and the network operating system. ASIs packetize computer data for transport over the network. NASI, NCSI, MCSI and NETCI are specific examples.

AT commands—A standard set of commands used to control modems. Each AT command string begins with the characters *AT*, which get the *attention* of the modem before the actual command is issued. See also *command mode*.

B

background—An activity that takes place in the computer while you are running another application. In other words, the active user interface does not correspond to the background task.

bandwidth—The transmission capacity of a computer

channel, communications line or bus. It is expressed in cycles per second (hertz), the bandwidth being the difference between the lowest and highest frequencies transmitted. The range of usable frequencies that a transmission medium will pass without unacceptable attenuation or distortion. Bandwidth is a factor in determining the amount of information and the speed at which a medium can transmit data or other information.

Bandwidth-on-Demand—Ability to request the amount of data

speed you need in any situation. Allows you to automatically add and drop b-channels according to your preference; you pay only for the bandwidth you need.

basic access—A term that describes a simple standardized combination of access channels that constitute the access arrangements for most ISDN users.

B-channel (bearer channel)—A 64 Kbps ISDN channel used for digital high-speed data or voice transmission. Simultaneous voice and data transmission requires subscription to two B-channels. A voice call can be placed or received while a data call is in process (or vice versa); however, two simultaneous voice or two simultaneous data calls are not supported.

bearer capability (BC)—The level of functionality provided by the ISDN B-channel (e.g., data, 3.1 KHz audio, etc.).

bearer services—A set of ISDN functions provided by the B-channel, such as digital telephony, toll-free inbound/outbound calls, 64 Kbps circuit switched data, X.25 packet switched data, and frame relay data.

bit—A bit (binary digit) is a basic unit of information used in computing and other digital electronics. It can take a value of either 1 or 0, represented in a computer by a high or low electrical charge.

BONDING (Bandwidth on Demand Interoperability Group)—An inverse multiplexing method that combines multiple ISDN channels into a single channel for enhanced throughput. Trademark of the BONDING Consortium.

BONDING mode 1—An industry-standard ISDN B channel aggregation protocol that was developed by the Bandwidth On Demand Interoperability Group. This mode supports user data rates that are multiples of the bearer rate. It provides the full available bandwidth, but no in-band monitoring. Mode 1 is common to all implementations of BONDING; Modes 0, 2, and 3 are optional.

BONDING Consortium—A group that develops specifications for common control and synchronization for management of high-speed data over the public network.

BONDING Specification 1.0—The Version 1.0 BONDING specification (August 1992) defines four modes of inverse multiplexing interoperability. It allows devices from various manufacturers to subdivide a wideband signal into 64 Kbps or 56 Kbps channels, and then pass the individual channels over a switched digital network, recombining them into a single high-speed signal at the receiving device.

BONDING Specification 1.1—The Version 1.1 BONDING specification (September 1993) incorporates changes to the 1.0 specification resulting from interworking tests among various vendors, and comments from the TIA standardization process. No changes were made to the BONDING algorithm or procedures.

bps (bits per second)—The unit of speed at which data bits can be transmitted or received. Bps differs from baud when

more than one bit is represented by a single cycle of the carrier.

BRI (basic rate interface)—Also called 2B+D. One of two forms of ISDN service. BRI provides two 64 Kbps B-channels for video, voice or data, and one 16 Kbps D-channel for control information. The total BRI data rate is 192 Kbps, with 144 Kbps available to the user. See also *ISDN* and *PRI*.

buffer—A temporary storage register or random access memory (RAM), used in all aspects of data communications, that prevents data from being lost due to differences in transmission speed. Keyboards, serial ports, muxes and printers are a few examples of devices that contain buffers.

bus—A common channel between hardware devices, either internally between components in a computer, or externally between stations in a communications network.

byte—A unit of information consisting of eight binary digits (bits). A byte holds the equivalent of a single or character (such as the letter A).

C

Call Bumping—TA feature that reallocates the second B-channel to an analog port when both B-channels are in use. If you are performing a data transfer using both channels and need to make a phone call, one channel is dropped to handle the call and then is reestablished after it is completed. With call bumping you don't miss any calls.

call setup time—The time to establish a circuit-switched call between two points. Includes dialing, wait time, and central office— long distance service movement time.

carrier signal—An analog signal with known frequency, amplitude and phase characteristics used as a transport facility for useful information. By knowing the original characteristics, a receiver can interpret any changes as modulations, and thereby recover the information.

Centrex—A multi-line service, offered by telephone companies, that provides functions and features comparable to those of a PBX for large business users. See also *PBX*, *exchange*.

channel—A data communications path between two computer devices. It can refer to a physical medium (e.g., UTP or coax), or to a specific carrier frequency. In ISDN, two types of channels are specified: transparent (user can define the service), and nontransparent (service is assigned protocols for specific network functions). ISDN channel names are designated by a single letter, from A through M, sometimes combined with a number (see *B-channel* and *D-channel*).

CHAP(Challenge Handshake Authentication Protocol)—Security method used to verify the identity of a person or process.

CHAP MD5—Chap with MD5 digital signature algorithm implemented.

circuit-switched network—A technology used by the PSTN that allocates a pair of conductors for the exclusive use of one communication path. Circuit switching allows multiple conversations on one talk

path only if end users multiplex signals prior to transmission.

circuit switching—The temporary connection of two or more communications channels using a fixed, non-shareable path through the network. Users have full use of the circuit until the connection is terminated.

CO (central office)—The lowest, most basic, level of switching in the PSTN (public switched telephone network). A business PABX or any residential telephone connects to the PSTN at a central office.

COM port—A serial communications port on a personal computer. Normally, there are two: COM1 and COM2.

CPE (customer premise equipment)—The generic term for data communications and/or terminal equipment that resides at the user site and is owned by the user (e.g., not telephone company equipment).

D

DCE (data communications equipment)—Any device that serves as the port of entry from the user equipment to a telecommunications facility. A modem is a DCE for the telephone network (PSTN) that is commonly on site at the user's premises. Packet Switched Networks have another level of DCE that is most often located at a central office.

D-channel—A non-transparent digital ISDN channel that operates at 16K or

64 Kbps, used for call control signalling, along with one or more B-channels. The D (demand) channel signal can control call setup, call teardown, and invocation of Supplementary Services. Is also used for telemetry and for low-speed, low-priority packet-switched data. Contrast with *B-channel*.

default—A preset value or option in software packages or in hardware configuration that is used unless you specify otherwise. **device driver**—Software that controls how a computer communicates with a device, such as a printer or mouse.

digital data—Information represented by discrete values or conditions (contrast *analog data*).

digital PBX—A private branch exchange that operates internally on digital signals. See also *exchange*.

digital signal— A discrete or discontinuous signal (e.g., a sequence of voltage pulses). Digital devices, such as a series of electrical pulses that have discrete jumps rather than gradual changes.

digital transmission—A method of electronic information transmission common among computers and other digital devices. Because a digital signal may be only *high* or *low* at any given time, noise and distortion can easily be removed from digital transmissions.

digitize—To convert an analog signal to a digital signal.

DIP switch—Pronounced *dip switch*. A set of tiny toggle switches, built into a DIP (dual in-line package), used for setting configurable parameters on a printed circuit board.

DN (directory number)—The phone number assigned to an ISDN TA at subscription time. It is a string of up to 24 characters, consisting of the valid dialing characters (0-9, *, and #).

driver—A software module that interfaces between the operating system and a specific hardware device (e.g., color monitors, printers, hard disks, etc.). Also known as a device driver.

DTE (data terminating equipment)—A term used to include any device in a network which generates, stores or displays

user information. DTE is a telecommunications term that usually refers to PCs, terminals, printers, etc.

DTMF (dual-tone multifrequency)—A generic push-button concept made popular by AT&T TouchTone.

DTMF detection—A capability in some fax/data modems that can differentiate between DTMF or fax calling tones. A typical application would be a program that routes calls to specific communications applications, depending either on the type of call or on a DTMF tone added to a dialing string.

E

EEPROM (Electrically Erasable Programmable Read-only Memory)—Upgradable memory chip often used to store firmware. **EISA** (Enhanced Industry Standard Architecture)—Pronounced *eesa*. The purpose of the EISA bus is to provide a 32-bit bus for faster throughputs while maintaining backward compatibility with the classic ISA bus architecture.

ET (exchange termination)—The carrier's local exchange switch. Contrast with *LT* (*loop termination*).

exchange—A unit (public or private) that can consist of one or more central offices established to serve a specified area. An exchange typically has a single rate of charges (tariffs) that has previously been approved by a regulatory group.

exchange area—A geographical area with a uniform set of charges (tariffs), approved by a regulatory group for telephone services. Calls between any two points within an exchange area are local calls. See *digital PBX* and *PBX*.

F

fax (facsimile)—Refers to the bit-mapped rendition of a graphics-oriented document (fax) or to the electronic transmission of the image over telephone lines bit-mapped approximation of a graphical document and, therefore, cannot be accurately interpreted according to any character code.

firmware—Software that is stored in read-only memory (ROM). Unlike random access memory (RAM), ROM can retain its content without electrical power. Some ROM, known as EEPROM, can be reprogrammed electrically while it is in a device.

foreground—The application program currently running on and in control of the PC screen and keyboard. The area of the screen that occupies the active window. Compare with *background*.

frequency—A characteristic of an electrical or electronic signal which describes the periodic recurrence of cycles. Frequency is inversely proportional to the wavelength or pulse width of the signal (e.g., long wavelength signals have low frequencies and short wavelength signals yield high frequencies).

H

handshaking—A process that two modems go through at the time of call setup to establish synchronization over the data communications link. It is a synchronization and negotiation process accom-

plished by the exchange of predefined, mutually recognized control codes.

HDLC (High-Level Data Link Control)—An ISO standard, bit-oriented data communications protocol that provides nearly error-free data transfers.

hexadecimal—A base 16 numbering system in which one character represents a four-bit binary value. Hexadecimal notation uses the numbers 0–9 and the letters A–F, usually suffixed by an *h* (e.g., 4CF h).

I

IDN (Integrated Digital Network)—The culmination of transmission and switching functions using digital technology in a circuit-switched telecommunications network.

IEC (Inter-Exchange Carrier)—A telephone company that is allowed to provide long distance telephone service between LATAs, but not within any one LATA. Also called *IXC*.

IETF (Internet Engineering Task Force)—

A self-organized group of people who make technical and other contributions to the engineering and evolution of the Internet and its technologies. It is the principal body engaged in the development of new Internet standard specifications.

I-mux (inverse multiplexer)—A device that will dial up and combine several lower speed circuits into a virtual broadband circuit. It takes any multiple up to an aggregate bandwidth, giving users *bandwidth on demand* for videoconferencing, LAN-to-LAN connections, etc. In ISDN devices, inverse multiplexing is performed by the BONDING protocol.

in-band signaling—A technique in which connection control information is sent over the same channel as assigned to the subscriber for end-to-end communication. Two common examples are DTMF line signaling and MF trunk signaling.

Internet—A computer network consisting of many millions of university, government, and private users around the world. **Internet address**—A unique 32-bit address for a specific TCP/IP host on a network. Normally printed in dotted decimal format (e.g., 129.128.44.227).

I/O address—A location within the I/O address space of your computer used by a device, such as an expansion card, a serial port, or an internal modem. The address is used for communication between software and a device.

IP address—A unique 32-bit address for a specific TCP/IP host on a network. Normally printed in dotted decimal format (e.g., 129.128.44.227).

IRQ (interrupt request)—The notification a processor receives when another portion of the computer's hardware requires its attention. IRQs are numbered so that the device issuing the IRQ can be identified, and so that IRQs can be prioritized.

ISA (Industry Standards Architecture)—Pronounced *ice-a*. The classic 8- or 16-bit architecture introduced with IBM's PC-AT computer. Due to speed constraints, IBM later introduced a restructured Micro Channel Architecture with a 32-bit bus and increased addressing capabilities.

ISDN (Integrated Services Digital Network)—International telecommunications standard for transmitting voice, video and data over a digital communications line.

ITU-T (formerly CCITT)—International Telecommunications Union—Telecommunications Sector; the United Nations

organization that prepares standards for resolving communications issues and problems.

L

LAPB (Link Access Procedure Balanced)—Based on the X.25 Layer 2 specification. A full-duplex, point-to-point, bit-synchronous protocol commonly used as a data link control protocol to interface X.25 DTEs. LAPB is the link initialization procedure that establishes and maintains communications between the DTE and the DCE.

LAPD (Link Access Protocol for the D-Channel)—Based on the ISDN Q.921 specification. A full-duplex point-to-point bit-synchronous link-level protocol for ISDN connections; different from LAPB in its framing sequence. Transmission is in units called *frames*, and a frame may contain one or more X.25 packets.

link optimization—An ISDN feature that permits only user data to open the communications link and keeps administrative packets from opening the link. A cost saving feature that ensures that remote connections are not unnecessarily utilized.

local loop—A transmission path, typically twisted-pair wire, between an individual subscriber and the nearest public telecommunications network switching center. Also called the *subscriber loop*.

LT (loop termination)—A device, similar to an NT1, that terminates the local loop at the carrier's central switching office. The LT provides the interface to the ISDN U reference point. Contrast *ET* (*exchange termination*).

M

MD5 (MD5 Message-Digest Algorithm)—Takes a message of arbitrary length as input and produces it as output as a 128-bit *fingerprint* or *message digest* of the input. The MD5 algorithm is used for digital signature applications where a large file must be compressed in a secure manner before being encrypted with a private (secret) key under public-key cryptosystem.

MLPPP (Multilink Point-to-Point Protocol, also the *PPP Multilink Protocol* or *MP*)—is an Internet standards track protocol for a method of splitting and recombining, and sequencing datagrams across multiple logical data links, giving you additional bandwidth-on-demand. Originally, MLPPP was used to combine two ISDN BRI channels into a single high-speed data path, but now is also used anywhere multiple PPP links connect two systems, including async links. This is done with new PPP options and protocols. Also known as *MPPP* and *PPP Multilink*, MLPPP is an effective means of bonding channels for providing bandwidth-on-demand.

modem—A communications device that enables a computer to transmit information over a telephone line. It converts the computer's digital signals into analog signals to send over a telephone line and converts them back to digital signals at the receiving end. Modems can be internal and fit into an expansion slot, or external and connect to a serial port.

MP+ (MultiLink Protocol Plus)—An extension to the PPP Multilink Protocol (MP) covered in IETF RFC 1717. MP+ is a new control protocol for managing multiple data links that are bundled by MP. Also called the *Multichannel Protocol Plus* or *MPP*.

MS-CHAP—Microsoft version of CHAP.

multilink—In point-to-point protocol, literally *many links*. A procedure used to route data packets over many links for increased bandwidth (e.g., two B-channels on a single BRI for 128 Kbps).

mux (multiplexer)—A device that merges several signals into one composite signal for transmission over a single medium or channel. A demultiplexer, built into most muxes, reverses the process at the receiving end.

N

nailed connection—A permanent or dedicated circuit of a previously switched circuit or circuits.

nailed-up circuit—A semi-permanent circuit established through a circuit-switching facility for point-to-point connectivity.

NAK (negative acknowledgment)—A communications code used to indicate that a message was not properly received, or that a terminal does not wish to transmit. Contrast with *ACK*.

network—A group of computers connected by cables or other means and using software that enables them to share equipment, such as printers and disk drives to exchange information.

NI-1 (National ISDN-1)—A physical standard to make all compliant ISDN lines appear the same. With ISDN-1 installed, additional costs are not incurred when changing from prestandard ISDN to *standard* ISDN. Most RBOCs now are moving to ISDN-1.

NI-2 (National ISDN-2)—A physical standard subsequent to NI-1. When tested and deployed, NI-2 will provide additional features and enhanced *plug and play* capabilities.

node—Any point within a network that has been assigned an address.

NT (network termination)—Devices that form the boundary between customer premise equipment and telephone company equipment. Two types of NTs are used: NT1 and NT2.

NT1 (Network TerminationType 1)—An interface device used in the BRI portion of ISDN to connect four-wire (S/T) ISDN devices to the two-wire (2B1Q U) IDN. It provides basic rate access in a 2B+D format with two 64 bps channels for voice, data, and video communications. It also provides one 16 Kbps channel for packet-mode signalling, low-speed data and telecommunications services at the OSI Layer 1 level. Similar in function to a DSU/CSU device. **NT2** (Network TerminationType 2)—A device at the customer premise (user) side responsible for the ISDN network connection and for functions such as multiplexing and switching (may be an intelligent device).

NTE (network terminating equipment)—A set of ISDN functions residing at the boundary of the IDN and the subscriber.

NUI (network user identification)—A unique alphanumeric number provided to dial-up users to identify them to packet-switched networks world-wide. The number is used for network access and billing.

O

off-hook—The condition of a device that has accessed a phone line (with or without using the line). In modem use, this is equivalent to a telephone handset being picked up. Dialing and transmission are allowed, but incoming calls are not answered.

on-demand dialing—A cost-saving feature of ISDN that sets up, transfers, and then closes a call only when the ISDN device detects a *data* packet addressed to the remote network, but will not perform setup/transfers of just administrative (non-user data) packets.

out-of-band signaling—A system that uses a separate communications channel or frequency outside the voice band for signaling. Modern systems use a separate channel, either TDM or virtual. SS7 uses messages for signaling that are carried on signaling links distinct from voice channels. ISDN uses messages for signaling that are carried on the D-channel distinct from the voice carried on the B-channels. Frame Relay and ATM use messages that are carried on a separate virtual connection reserved for signaling.

on-hook—The condition of a device which has not accessed a phone line. In modem use, this is equivalent to a telephone handset that has not been picked up. In other words, it can receive an incoming call.

P

packet data—Packet-mode calls.

packet mode—The switching of chunks of information for different users using statistical multiplexing to send them over the same transmission facility. ISDN packet mode capabilities are based on the ITU-TSS Recommendation X.25 procedures.

PAP (Password Authentication Protocol): (RFC 1334)

parity bit—An extra bit attached to each byte of sync—chronous data used to detect errors in transmission.

PBX (private branch exchange)—A telephone exchange located on the customer's premises. The PBX provides a circuit switching facility for telephone extension lines within the building, and access to the public telephone network. See also *exchange*.

P-channel (PCHAN)—The ISDN physical channel identification; contrast logical channel or virtual channel.

PDN (public data network)—A packet-switched network that is available to the public for individual (subscriber) use. Typically, controlled by a government or a national monopoly.

port—A location for input or output data exchange. Computers, muxes, etc. have ports for various purposes.

PPP (Point to Point Protocol)—A protocol that lets a computer user access a TCP/IP address using an ISDN terminal adapter or a highspeed modem over a standard telephone line.

PRI (Primary Rate Interface)—One of two forms of ISDN service. PRI provides 23 64 Kbps B-channels for video, voice or data, and one 64 Kbps D-channel for control

information. Usually used to connect high-capacity CPE, such as PBXs, to the network. Also called *23B+D* in the U.S. and *30B+D* in Europe.) See also *ISDN* and *BRI*.

primitive—An abstract representation of interaction across the access points indicating that information is being passed between the service user and the service provider. The OSI Reference Model defines four types of primitives: Request, Indication, Response and Confirm.

PSTN (public switched telephone network)—The group of circuit-switching voice carriers, which are commonly used as analog data communications services. A worldwide public voice telephone network that is used as a telecommunications medium for the transmission of voice, data and other information.

pulse dialing—One of two methods of dialing a telephone, usually associated with rotary-dial phones. Compare with *tone dialing*. **PVC** (permanent virtual circuit)—A connection between two endpoints dedicated to a single user. In ISDN, PVCs are established by network administration and are held for as long as the user subscribes to the service.

Q

Q.921—The ITU-T recommendation for user-network interface layer 2 specifications for D-channel signaling. Similar to LAPD. See also *ISDN*.

Q.931—The ITU-T recommendation for user-network interface layer 3 specifications for D-channel signalling. See also *ISDN*.

R

R reference point—Establishes the boundary between non-ISDN compatible equipment (TE-2) and the IDN network. TAs are used to convert the communication protocol used by the non-ISDN terminals to the desired BRI or PRI protocol. Non-ISDN (TE2) terminal equipment connects to IDN at the R-Reference point with a TA. (This interface may follow the RS232 or V.35 specification.) Also called the R interface. (Contrast *S reference point*.)

RAM (random access memory)—A computer's primary workspace. All data must be stored in RAM (even for a short while), before software can use the processor to manipulate the data. Before a PC can do anything useful it must move programs from disk to RAM. When you turn it off, all information in RAM is lost.

reference point—A connection point between ISDN equipment classes (rather than the specific protocol of the interconnection). Can include R, S, T, and U reference points.

RFC (Request for Comments)—Name for the IETF document that provides internet standards.

RJ-11—An industry standard interface used for connecting a telephone to a modular wall outlet; comes in 4- and 6-wire packages. **RJ-45**—An 8-wire modular connector for voice and data circuits. **RPOA** (recognized private operating agency)—A corporation, private or government-controlled, that provides telecommunications services. RPOAs, such as AT&T, participate as non-voting members in the ITU-T.

RS-232—An EIA/TIA standard for a serial interface between computers and peripheral devices (modem, mouse, etc.). It uses a 25-pin DB-25, or a 9-pin DB-9 connector. The RS-232 standard defines the purposes, electrical characteristics and timing of the signals for each of the 25 lines. Similar to the ITU-T V.24 standard.

S

S reference point—Provides the connection between NT2 equipment and the TA or TE-1. Can provide both primary and basic rate services. Also called the S-interface. (Contrast *R-reference point*.)

SAP (service access point)—A point at which the services of an OSI layer are made available to the next higher layer. See also *SAPI*. **SAPI** (service access point identifier)—A logical point at which data link layer services are provided by a data link layer entity to a layer 3 entity. See also *SAP*.

serial port—The connector on a PC used to attach serial devices (those that need to receive data one bit after another), such as a mouse, a printer or a modem. This consists of a 9- or 25-pin connector that sends data in sequence (bit by bit). Serial ports are referred to as *COMx* ports, where x is 1 to 4 (e.g., COM1 through COM4). A serial port contains a conversion chip called a *UART* that translates between internal parallel and external serial formats.

service—The requirements offered by an RPOA to its customers to satisfy specific telecommunications needs.

signaling—The process of establishing, maintaining, accounting for, and terminating a connection between two endpoints (e.g., the user premises and the telco CO). Central office signals to the user premises can include ringing, dial tone, speech signals, etc. Signals from the user's telephone can include off-hook, dialing, speech to far-end party, and on-hook signals.

In-band signaling techniques include pulse and tone dialing. With common channel signaling, information is carried out-of-band. In ISDN, signaling includes the call establishment, call progress monitoring, call termination and enhanced telephone features provided typically by the D-Channel. See also *SS7*, *out-of-band signaling*, and *in-band signaling*.

SPID (service profile identifier)—In North America, the ISDN network parameter for logical terminal identification and tracking, provided by the ISDN provider. The voice SPID and data SPID identify a particular set of service or feature parameters. They are assigned by the ISDN service provider, in the form of a string of up to 20 characters, at subscription time. The SPID actually points to a specific location in central office memory where the relevant information is stored.

SS7 (Signaling System 7)—An ITU-T and ANSI standard for digital out-of-band signalling between central offices that provides much of the network switching intelligence to support many ISDN functions

stop bit—One of the variables used for timing in asynchronous data transmission. Depending on the devices, each character may be trailed by 1, 1.5, or 2 stop bits.

subscriber loop—The pair of wires that connect the end user to the telephone network. These wires provide ISDN service, but also require an NT1 at the enduser location as well as the LT at the network end. See also *local loop*.

supplementary services (SS)—ISDN functions beyond the basic requirements; includes videoconferencing,

fast dialing, call waiting, call forwarding, calling line ID.

SVC (switched virtual circuit)—A type of data transmission where the connection is maintained only until the call is cleared.

SVD (simultaneous voice and data)—A technology for letting a user send data via a modem, and use a handset to talk to another user at the same time over the same connection. The alternative, making a second call, can be expensive or even impossible. The uses for SVD are telecommuting, videoconferencing, distant learning, tech support, etc.

switched 56—A circuit-switched (full duplex digital synchronous data transmission) service that lets you dial a number and transmit

data to it at 56 Kbps. It is a relatively low cost service, widely used in North America for telecommuting, videoconferencing and high speed data transfers. Many phone companies are phasing out switched 56 in favor of ISDN service.

switched line—In communications, a physical channel established by dynamically connecting one or more discreet segments. This connection lasts for the duration of the call after which each segment may be used as part of a different channel. Contrast with leased line.

switched network—A network in which a temporary connection is established from one point via one or more segments.

synchronous transmission—The transmission of data which involves sending a group of characters in a packet. This is a common method of transmission between computers on a network or between modems. One or more synchronous characters are transmitted to confirm clocking before each packet of data is transmitted. Compare to Asynchronous Transmission.

T

T—Provides the connection between the NT1 and NT2. Can be internal to or external from the PABX. Provides the connection between the NT1 equipment and the TA or TE-1. Can provide both Primary Rate and Basic Rate services.

TA—See *terminal adapter*.

TCP/IP (Transmission Control Protocol / Internet Protocol)—A multi-layer set of protocols developed by the US Department of Defense to link dissimilar computers across dissimilar and unreliable LANs.

TEI (terminal endpoint identifier)—A unique number that is assigned to an ISDN terminal adapter at subscription time. The TEI is used by the central office to identify the various TAs connected to the ISDN network. The TEI number can be fixed (in the range of 0- 63, or dynamic, automatically assigned at the CO each time the TA is connected to the ISDN interface and powered up.

TE1 (Terminal Equipment Type 1)—A terminal device with a standard ISDN interface (an ISDN-compatible terminal).

TE2 (Terminal Equipment Type 2)—A terminal device with a nonISDN interface, such as RS232, RS449, V.35 or X.21. Can be a telephone, data terminal, or voice/data workstation, etc.

telecommunication service—A function, such as bearer service and teleservice, offered by an RPOA to its customer in order to satisfy a specific telecommunications requirement. See also *ISDN*, *RPOA*, and *bearer service*.

telematics—User-oriented ISDN information transfer services (e.g., teletex, videotex, facsimile).

Teleservices—A telecommunications service that provides the complete capability for communication between subscribers according to protocols agreed to by RPOAs. A set of ISDN features using communications links, including E-Mail and fax services.

Teletext—A telecommunications service that provides a one-way information retrieval service that uses unused portions of a TV channel bandwidth. A fixed number of text pages are repetitively broadcast for decoding by a decoder at the TV set that can select and display pages. See also *ISDN*.

terminal—The screen and keyboard device used in a mainframe environment for interactive data entry. Terminals have no *box*, which is to say they have no file storage or processing capabilities.

terminal adapter (TA)—An ISDN DTE device for connecting a non-ISDN terminal device to the ISDN network. Similar to a protocol converter or an interface converter, a TA connects a nonISDN device between the R and S interfaces.

tone dialing—One of two methods of dialing a telephone, usually associated with Touch-Tone® (push button) phones. Compare with *pulse dialing*.

TSR (terminate and stay resident)—A software program that remains active and in memory after its user interface is closed. Similar to a daemon in UNIX environments.

twisted pair wiring—A type of cabling with one or more pairs of insulated wires wrapped around each other. An inexpensive wiring method used for LAN and telephone applications, also called UTP wiring.

U

U reference point—A twisted-pair subscriber loop that connects the LT to the NT1. Normally a 2-wire BRI or PRI line is used, but a 4-wire BRI can also be used. In the US, the U Reference Point marks the separation point between CPE and the network.

UART (universal asynchronous receiver/transmitter)—An integrated circuit that transmits and receives data on the serial port. It converts parallel bytes into serial bytes for transmission, and vice versa, and generates and strips the start and stop bits appended to each character.

UTP (unshielded twisted pair) —Telephone-type wiring.

V

V.110—One of the terminal rate adaptation protocols for the ISDN B-channel. V. 110 is more hardware-intensive than the V.120 B-channel standard.

V.120—One of the terminal rate adaptation protocols for the ISDN B-channel. V.120 is more software-intensive than the V. 110 B-channel standard.

Videotex—A two-way information-retrieval service that can be accessed by terminals and by a TV set (with installed decoder). Allows interactive retrieval

of information pages from a central resource. See also *ISDN*.

virtual circuit—A logical connection. Used in packet switching wherein a logical connection is established between two devices at the start of transmission. All information packets follow the same route and arrive in sequence (but do not necessarily carry a complete address).

X

X.25—ITU-T's definition of a three-level packet-switching protocol to be used between packet-mode DTEs and network DCEs. X.25 corresponds with layer 3 of the 7-layer OSI model.

X.75—An ITU-T standard for linking X.25 packet-switched networks. X.75 defines the connection between public networks, i.e., for a gateway between X.25 networks.

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