SLTA-10 Adapter and PSG/3 User's Guide

Revision 3

ECHELON®

Corporation

078-0160-01E

Echelon Corporation
www.echelon.com

FCC NOTICE (for USA only)

Federal Communications Commission Radio Frequency Interference Statement

Warning: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the use is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by Echelon Corporation could void the user's authority to operate the equipment.

Safety

UL	Listed, per UL-1950
CSA (c-UL)	Certified, per C22.2 no 950
TUV	Certified, per EN 60950

CANADIAN DOC NOTICE

This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe B prescrites dans le réglement sur la brouillage radioélectrique édicté par le Ministére des Communications du Canada.

Preface

This document describes how to use the SLTA-10 Serial LonTalk® Adapter to connect a host processor, with an EIA-232 (formerly RS-232) serial interface, to a LONWORKS® network. The connection to the host processor can be made either directly or remotely through a pair of modems.

Content

This manual provides detailed information about the hardware and software for the SLTA-10 Adapter.

- Chapter 1 introduces the SLTA-10 Adapter and provides a quick overview.
- Chapter 2 describes the SLTA-10 Adapter hardware.
- Chapter 3 describes how to attach an SLTA-10 Adapter.
- Chapter 4 describes the configuration switches of the SLTA-10 Adapter.
- Chapter 5 describes the software for the SLTA-10 NSI mode.
- Chapter 6 describes the software for the SLTA-10 MIP mode.
- Chapter 7 discusses using the Windows® 95,™ Windows® 98,™ and Windows NT™ network driver and the SLTALink Manager software with the SLTA-10 NSI mode.
- Chapter 8 discusses using the DOS network driver with the SLTA-10 MIP mode.
- Chapter 9 discusses creating an SLTA-10 MIP mode network driver for any host.
- Chapter 10 describes initilization and installing as a node.
- Chapter 11 discusses using an SLTA-10 Adapter with a modem and provides specific instructions for setting up the SLTA-10 for remote dial-in access for network monitoring and service operations.
- Chapter 12 describes the DOS Host Connect Utility (HCU) for use with the SLTA-10 MIP mode.
- Chapter 13 explains how to use a programmable serial gateway.
- Chapter 14 is a troubleshooting section.
- Appendix A describes the Windows 3.1x DLL files for use with the SLTA-10 Adapter.

Related Manuals

The following Echelon documents are suggested reading for more information:

- The *LCA Object and Data Server Programmer's Guide* describes how to write a 32-bit Windows host application and installation tool that can be used with the SLTA-10 NSI mode.
- The *LONWORKS Host Application Programmer's Guide* describes how to write a host application that can be used with the SLTA-10 MIP mode.
- The *LonBuilder® User's Guide* describes how to develop LONWORKS applications with the LonBuilder Developer's Workbench.
- The *NodeBuilder® User's Guide* describes how to develop LONWORKS applications with the NodeBuilder Development Tool.
- Toshiba and Cypress have authored Neuron® Chip databooks containing specifications and literature that describe the architecture of the Neuron Chip.

Web Access

Engineering bulletins and data sheets supporting this product are available on the Echelon Web site. General information regarding Echelon, its business, and its products also is located on the site at http://www.echelon.com.

Contents

1

SLTA-10 Adapter Overview

The SLTA-10 Serial LonTalk Adapter (Models 73351, 73352, 73353, and 73354) is a network interface that enables any host processor with an EIA-232 serial interface to connect to a LONWORKS network. The SLTA-10 Adapter extends the reach of LONWORKS technology to a variety of hosts, including desktop, laptop, and palmtop PCs, workstations, embedded microprocessors, and microcontrollers.

The SLTA-10 Adapter has two modes of operation: NSI and MIP modes. The SLTA-10 NSI mode is compatible with LNS-based applications. The SLTA-10 MIP mode is compatible with legacy applications based on the LonManager® API or the HA host application software. The SLTA-10 MIP mode is a replacement for the SLTA/2 Serial LonTalk Adapter. An externally accessible DIP switch determines the mode of operation.

Introduction

The SLTA-10 Adapter is the latest addition to the SLTA product family. It is an EIA-232 (formerly RS-232) compatible serial device that allows any host with an EIA-232 interface and proper software to communicate with a LONWORKS network.

An SLTA-10 Adapter enables the attached host to act as an application node on a LONWORKS network. When used with a PC host and the LNS Developer's Kit for Windows software, the SLTA-10 Adapter can be used to build sophisticated network management, monitoring, and control tools for LONWORKS networks. The SLTA-10 adapter also can be used with legacy host applications such as the LonManager LonMaker installation tool, LonManager DDE Server, or applications based on the LonManager API.

An SLTA-10 Adapter can be connected to the host through a pair of modems and the telephone network, allowing the monitoring, control, or network management computers to be remote from the network. The SLTA-10 Adapter can be set up to answer incoming calls from a remote host. In addition, any node on the local network can initiate a telephone call to a remote host computer. A new feature, available only in the SLTA-10 NSI mode (see below), allows the SLTA-10 Adapter itself to initiate a phone call to a remote host computer.

Figure 1.1 illustrates a typical node based on an SLTA-10 Adapter. Chapter 11, *Using the SLTA-10 Adapter with a Modem*, shows an SLTA-10 Adapter connected to a host through the telephone network.

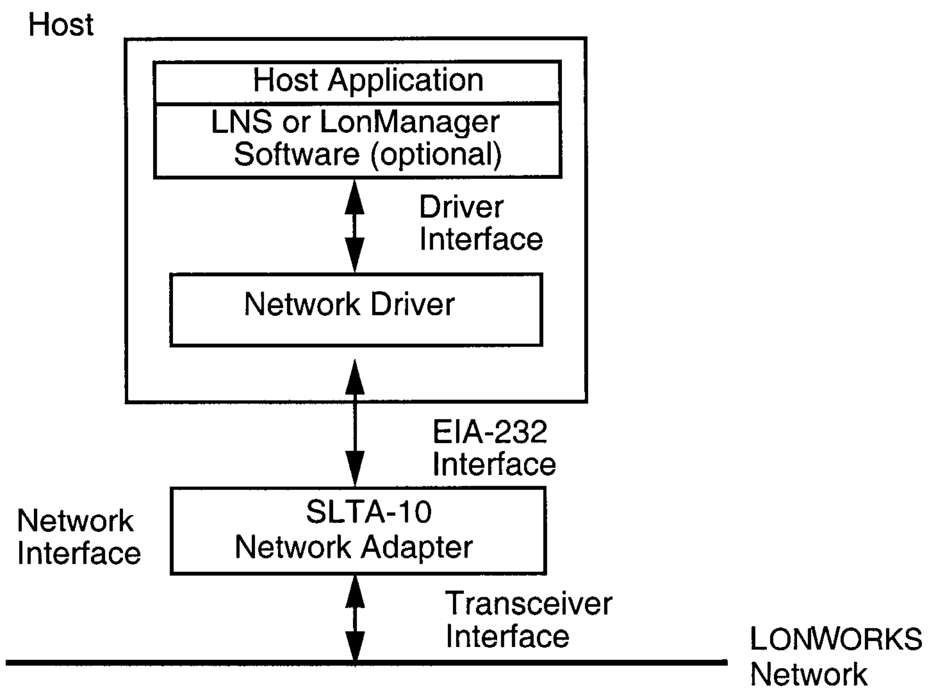


Figure 1.1 SLTA-10 Adapter Node Architecture with Local Host

Two Modes of Operation: SLTA-10 NSI and MIP Modes

The SLTA-10 Adapter provides both the network services interface (NSI mode) functionality for use with LNS-compliant applications, and network interface functionality (MIP mode) for use with LonManager API-based applications.

There are two separate firmware images in the SLTA-10 Adapter. The two separate images have different link layer protocols, different network drivers, different buffer capacity, and different functionality. The two modes of operation are the SLTA-10 NSI mode and the SLTA-10 MIP mode. The mode of operation is controlled by an externally accessible DIP switch that is read at power-up.

Table 1.1 illustrates the differences between the SLTA-10 NSI mode, the SLTA-10 MIP mode, and the SLTA/2.

Table 1.1 SLTA-10 NSI and MIP Modes and SLTA/2 Feature Comparison

Feature	***SLTA-10 NSI Mode***	***SLTA-10 MIP Mode***	***SLTA/2***
Supports LNS applications	YES	NO	NO
Supports LonManager API applications	YES	YES	YES
Available drivers	Windows NT Windows 95/98	DOS, UNIX, Windows 3.1x	DOS, UNIX, Windows 3.1x

Feature	***SLTA-10 NSI Mode***	***SLTA-10 MIP Mode***	***SLTA/2***
Software used to establish connections via modems	SLTALink Manager (TAPI application)	HCU (DOS application with source code)	HCU (DOS application with source code)
Who initiates calls from a remote network	SLTA-10 itself or "Helper / Dialer " node	"Helper / Dialer " node on network	"Helper / Dialer " node on network
Input power options	9-30VAC or DC or wall mount supply	9-30VAC or DC or wall mount supply	wall mount supply or internal battery
Configuration Switches	Externally accessible	Externally accessible	Internally accessible
Network Connector	Color coded, removable screw terminals (Weidmueller)	Color coded, removable screw terminals (Weidmueller)	RJ45
Processor Input Clock	10 MHz	10 MHz	5 MHz (10MHZ for TP/XF-1250)
Ready to wall mount	YES	YES	Bracket Required
Transceiver versions available	TP/FT-10 TP/XF-78 TP/XF-1250 TP/RS-485	TP/FT-10 TP/XF-78 TP/XF-1250 TP/RS-485	TP/FT-10 TP/XF-78 TP/XF-1250 TP/RS-485
To attach to a modem	Special null modem cable	Special null modem cable	Internal jumper change to become DTE
Supports sleep mode	NO	NO	YES
Message Tag 15 available	NO	YES	YES
Default Buffer Configuration	See Chapter 4	See Chapter 4	See SLTA/2 documentation

SLTA-10 NSI Mode Features

The most important new feature of the SLTA-10 NSI mode is the NSI functionality for use with LNS-compliant applications. Other important features available only in the SLTA-10 NSI mode include: SLTA-10 initiated dial-out, a Windows 95/98 driver, a Windows NT driver, a high performance link layer protocol, and the SLTALink Manager software. These features are not available in SLTA-10 MIP mode.

The improved hardware form factor applies to both modes of operation and is listed in Table 1.1.

In SLTA-10 NSI mode, an SLTA-10 Adapter supports applications based on both the LNS software and the LonManager API.

SLTA-10 MIP Mode Versus the SLTA/2

In SLTA-10 MIP mode, the SLTA-10 Adapter is a replacement for the SLTA/2 Serial LonTalk Adapter, with an improved form factor. The network connector on the SLTA-10 Adapter is the color-coded removable screw terminal (Weidmueller), instead of the RJ45 used on the SLTA/2 Adapter. The SLTA-10 Adapter input power options include 9-30VAC or DC, or a 9V wall mount supply. The SLTA-10 Adapter operates at 10MHz for all transceiver types; the SLTA/2 operates at 5MHz or 10MHz, depending on transceiver type. In addition, the SLTA-10 configuration DIP switches are externally accessible. The SLTA-10 enclosure has been improved to allow wall mounting, without requiring a bracket.

The SLTA/2 and the SLTA-10 MIP mode use the same drivers and link layer protocol.

The SLTA-10 Adapter Configurations

The SLTA-10 Adapter is available with the following transceiver and power supply options:

- *Transceivers*. The SLTA-10 Adapter is available with four LONWORKS channel options: TP/FT-10, TP/XF-78, TP/XF-1250, and TP-RS485. The FTT-10A (78kbps, free or bus topology), TPT/XF-78 (78kbps, bus topology) and TPT/XF-1250 (1.25Mbps, bus topology) transceivers use transformer-isolated, differential transmission.
- *Power supply*. 9V plug-in power supplies are available in U.S./Canada (Model 78010), U.K. (Model 78030), continental European (Model 78020), and Japanese (Model 78030) configurations. Plug-in power supplies are sold separately. Alternately, screw terminals are supplied for use with a 9 to 30VAC/DC power sources.

Software Availability

The SLTA-10 Adapter is not shipped with software.

Software for the SLTA-10 NSI mode is available with the LonMaker for Windows Integration Tool (Model 37000), on the LNS Developer's Kit for Windows CD (Model 34303), in the Connectivity Starter Kit (Model 58030-01), or from the Developer's Toolbox of the Echelon web site (http://www.echelon.com).

Software for the SLTA-10 MIP mode is distributed in the Connectivity Starter Kit (Model 58030-01) and from the Developer's Toolbox of the Echelon web site.

LNS Compatibility

When the SLTA-10 Adapter is connected directly to the PC host (i.e., no modems), the SLTA-10 Adapter uses a direct connection. For a direct connection, the SLTA-10 Adapter behaves like any other NSI, such as the PCLTA-10 Adapter or the PCC-10 PC Card. In this case, an SLTA-10 Adapter may be used without issue with applications based on any version of LNS starting with 1.0.

The SLTA-10 Adapter is also designed so that a PC host can be connected to the network through a pair of modems and the telephone network. In this scenario, the PC is a remote host. When the PC initiates the phone call to the SLTA-10 Adapter, the remote host is said to "dial-in to the network". When the SLTA-10 Adapter initiates a call to the PC, the SLTA-10 is said to "dial-out to the remote host". Once the phone connection is established, the application running on the remote host can perform network management, monitoring, or control activities.

Applications based on LNS 1.0 or 1.01 do not have full functionality with respect to the SLTA-10 Adapter and modems because LNS 1.0 and 1.01 have default system behavior that is incompatible with using the SLTA-10 Adapter through modems. For instance, an application based on LNS 1.0 and 1.01 terminates (i.e., shuts down) in a manner that interferes with one the automatic dial-out initiation techniques. In LNS 1.0 or 1.01 when an LNS host application is terminated, all host network variables and connections to these variables are removed from the LNS database. One way the SLTA-10 Adapter can initiate a phone call, or automatically dial-out, is based on a network variable update being sent to the SLTA-10 Adapter. Since the termination of the application on the PC host results in the removal of all network variable connections to the host, no network variable update can be sent to the SLTA-10 Adapter. Thus, one of the two mechanisms that support automatic dial-out is unavailable.

LNS 1.0 and 1.01 have no special knowledge of whether the SLTA-10 Adapter is remotely connected through a pair of modems. However, LNS versions starting with 1.5 and higher automatically detect that the SLTA-10 Adapter is remote at commissioning. Using a remote SLTA-10 Adapter affects the default system behavior by allowing the system to function as desired. Upon termination of an application based on LNS 1.5 or higher, the LNS host API will determine if the NSI uses modems and if there are any explicitly bound network variables on the host. If both of these conditions are met, LNS does not remove the connections or host network variables. In addition, LNS leaves the SLTA-10 Adapter configured. Thus, LNS 1.50 and later versions fully support the SLTA-10 Adapter accessed through a modem configuration.

In summary, LNS 1.0 and higher versions fully support using the SLTA-10 Adapter with modems. LNS 1.0 and 1.01 do not support the use of the SLTA-10 with modems, although direct connect interfaces are supported.

Note: A remote (via modems) LNS Server requires a dedicated SLTA-10 Adapter. Thus, some networks may require multiple SLTA-10 Adapters —one for the remote LNS Server and others to allow access for other PCs.

TAPI Compatibility

The SLTALink Manager software uses TAPI release 1.3 or higher. This is supported in Windows NT 4.0 and higher, but not in Windows NT 3.51. Thus, Windows NT 3.51 does not support the use of the SLTA-10 Adapter with modems; however, Windows NT 3.51 does support a direct connect interface.

2

SLTA-10 Adapter Hardware

This chapter provides a physical description of the SLTA-10 Adapter.

Mechanical Description

Figures 2.1 and 2.2 show the SLTA-10 Adapter in its enclosure. Figure 2.3 shows the SLTA-10 Adapter board without an enclosure.

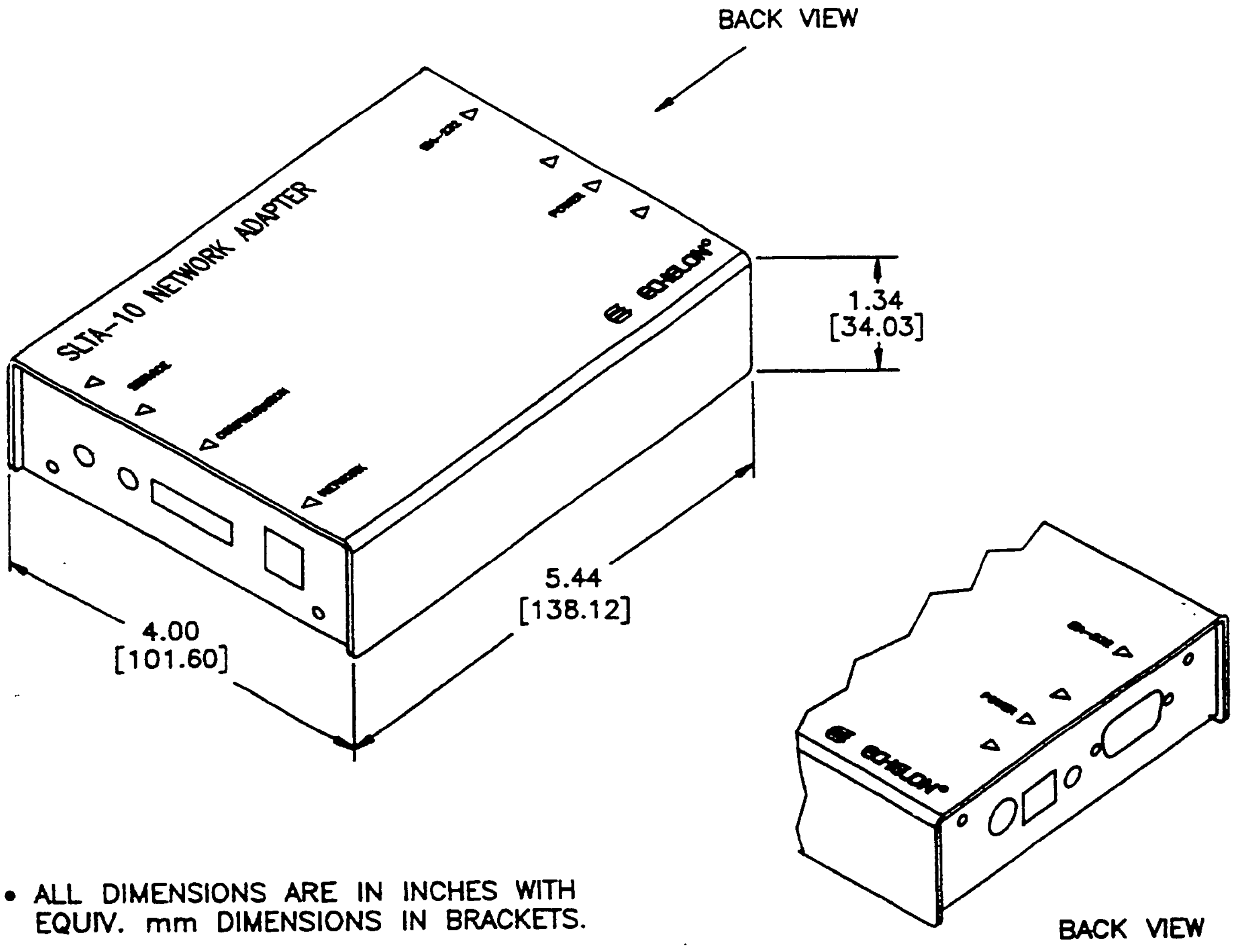


Figure 2.1 SLTA-10 Adapter Enclosure

Figure 2.2 shows a 1:1 view of the enclosure and may be used as a mounting template.

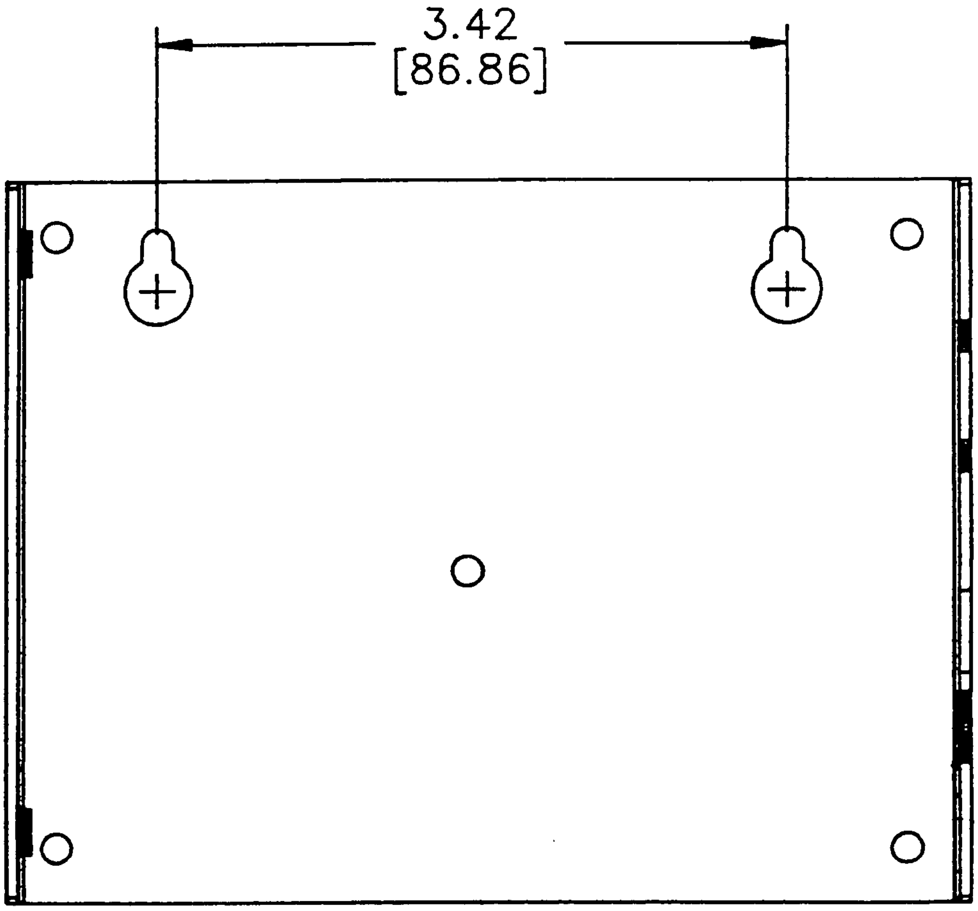


Figure 2.2 SLTA-10 Adapter Enclosure Keyhole View Mounting Slots

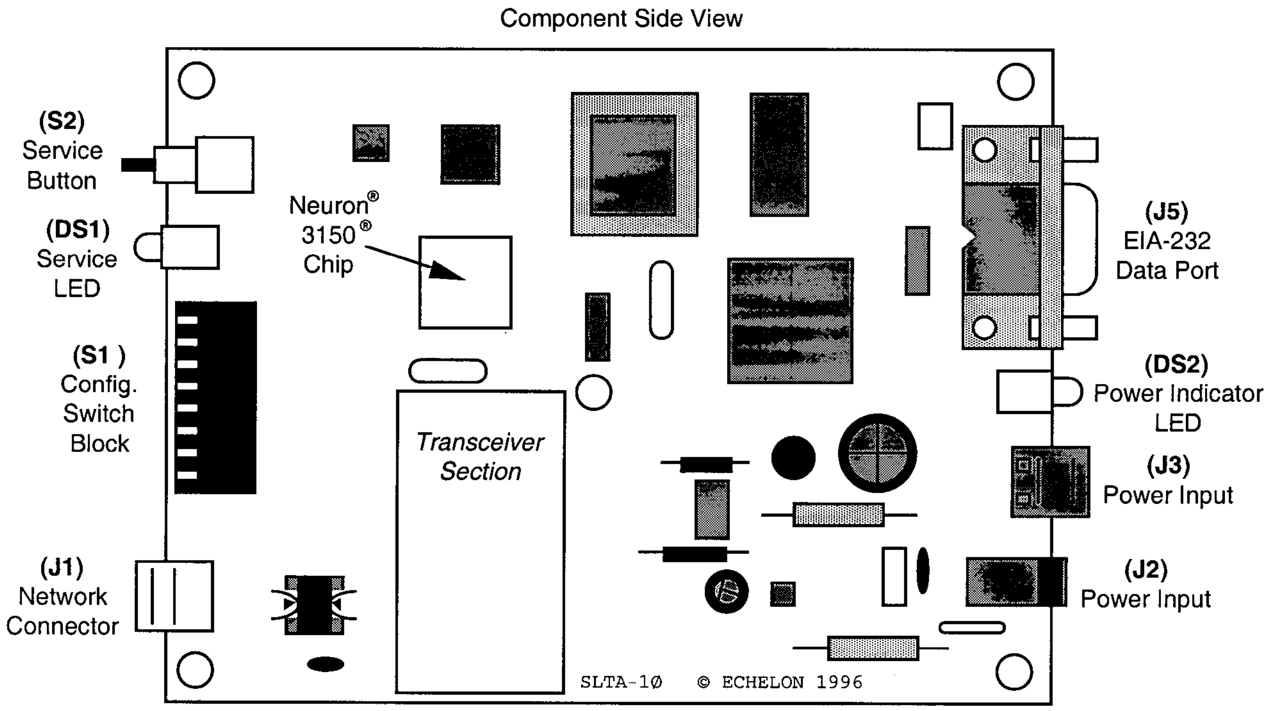


Figure 2.3 SLTA-10 Adapter Without Enclosure (Typical Component-Side View from Top).

Switches, Indicators, and Connectors

ESD Warning

This product contains components which are sensitive to static electricity. Before installing or removing the network or serial cables, touch earth ground with your hand to discharge any static electricity which may have accumulated.

Table 2.1 describes the external connections and switches/LEDs on the SLTA-10 Adapter.

Table 2.1 SLTA-10 Adapter Interfaces

Interface	***Function***
Service Button S2	Pressing this switch grounds the service request pin on the Neuron Chip within the SLTA-10 Adapter. While this switch is pressed, the service LED should light to maximum intensity. If Switch 3 (the Network Disable switch) on the switch block (S1) is in the ON/up position the service LED will light, but *no service message will be sent,* even if the SLTA-10 has been configured after the last power up.
Service LED DS1	(Yellow LED) Indicates that either the Service Button is being pressed or, if not: *on* The SLTA-10 firmware has detected an unrecoverable error and/or the SLTA-10 is Applicationless. Reboot the SLTA-10 Adapter from another network interface on the channel. *blinking* Node is unconfigured. *off* Node is configured or there is no power. Check LED.
EIA-232 Data Port J5	Connector for the EIA-232 Serial I/O port. Standard DB9 female connection.
Network Connector Two Position (Models 73351, 73352, 73353) Three Position (Model 73354) J1	Orange connector for attachment to a twisted pair channel. The mating socket provided is Weidmüller PN 128176 (two position) or 128186 (three position).

Interface	*Function*
Unregulated AC/DC Power Input Two-Position J3	Black connector for the power input. The mating plug (provided) is Weidmüller PN 125911.
Unregulated AC/DC Power Input Barrel Connector J2	Female 2.1 mm inside diameter and 5.5 mm outside diameter barrel input connector. For use with Echelon power supplies, models 78010, 78020, 78030, and 78040.
Power Indicator LED DS2	(Green LED) Indicates presence of input power to the SLTA-10 Adapter.

Connecting Power

Once the SLTA-10 Adapter is physically attached to the desired channel, power must be supplied via one of the power input connectors. The SLTA-10 Adapter may be ordered with a plug-in power supply, or may be used with any 9 - 30VAC/DC supply. Four plug-in power supply options are available for the SLTA-10 Adapter, depending on the country in which the SLTA-10 Adapter is used: USA/Canada, United Kingdom, Continental Europe, or Japan. The output voltage of these supplies is a nominal +9VDC at 500mA. Power consumption is typically <1 Watt, independent of input voltage.

Table 2.2 describes the basic characteristics of the four power supply types.

Table 2.2 Power Supply Characteristics

Country or Region	*Nominal Input Voltage*	*Input range nominal ±10%*	*Frequency*	*Input Connector*	*Echelon Model #*
USA/Canada	120 VAC	108-132 VAC	60 Hz	2-prong, NEMA 1-15P	78010
Continental Europe	230 VAC	207 - 253 VAC	50 Hz	2-prong, Euro Plug	78020
U.K.	230 VAC	207 - 253 VAC	50 Hz	3-prong, U.K. Plug	78030
Japan	100 VAC	90 - 110 VAC	50/60 Hz	2-prong, NEMA 1-15P	78040

Table 2.2 provides the specifications for power inputs to the SLTA-10 Adapter. The barrel connector input, J2, is a standard female power plug with a 2.1 mm inside diameter and 5.5 mm outside diameter, (LZR Electronics part number HP-114A, Radio Shack catalog number 274-1569, or equal). **A surge protector may be required between the AC mains and the power supply as neither the power supply nor the SLTA-10 Adapter include surge protection.**

Power supply jack J3 provides screw terminals via a Weidmüller (PN 11261) input connector (provided) for connection to a 9 - 30VAC/DC power supply.

Table 2.3 Two-Prong SLTA-10 Adapter Power Supply Requirements

Power	*Minimum*	*Nominal*	*Absolute Maximum*
Unregulated DC	+9 VDC	+12 VDC	+30 VDC
Unregulated AC	9 VAC	24 VAC	30 VAC

When power is connected, the yellow service LED will briefly flash and the green power indicator LED will turn on. Once an SLTA-10 Adapter is powered and configured, the service LED will remain off unless the service request switch is pressed.

Note: Do not attempt to power an SLTA-10 Adapter simultaneously from JP2 and JP3. Mechanical insertion of a connector into JP2 disables the input to JP3.

3

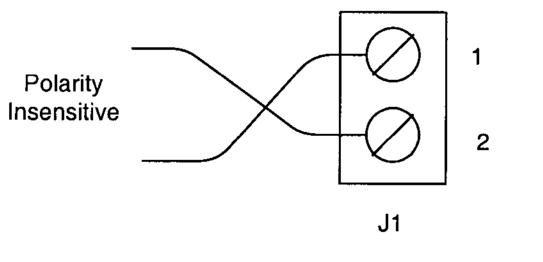
Cabling and Connections

This chapter demonstrates how to attach the SLTA-10 Adapter to a LONWORKS network, a PC, and a modem.

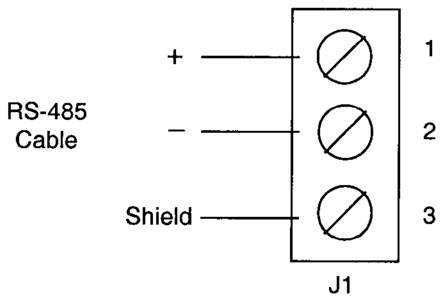
To connect an SLTA-10 Adapter to a modem, use a special null modem cable. The SLTA-10 Null Modem Cable (Model 73380) is available for purchase from Echelon. The cable specifications also have been included in this chapter. Note that most off-the-shelf null modem cables will not work in this configuration.

LONWORKS Network Connection

The SLTA-10 includes a removable screw terminal connector (J1) for the twisted pair LONWORKS network connection. The J1 should be connected as follows:



Models 73351, 73352, 73353



Model 73354

Attaching the SLTA-10 Adapter

EIA-232 devices are configured as either Data Circuit-terminating Equipment (DCE) or as Data Terminal Equipment (DTE). A DCE device connects to a DTE device, unless a null modem cable is used. Using a null modem cable, a DCE device connects to a DCE device and a DTE device connects to a DTE device. The SLTA-10 Adapter is a DCE device.

The standard configuration for a PC/AT EIA-282 serial I/O port is a DTE device. PCs usually take the 'terminal' role in communications. Modems should always be DCE devices. To connect an SLTA-10 Adapter to a PC, simply connect one end of the serial cable to the SLTA-10 Adapter, and the other end of the cable to the PC's serial port. To connect an SLTA-10 Adapter to a modem, a special null modem cable must be used. Note that most standard off-the-shelf null modem cables will not work in this configuration.

Echelon offers the Model 73380 SLTA-10 Null Modem Cable, which is a DB-9 male to DB-25 male null modem cable. This and other cables used with the SLTA-10 Adapter are described in detail in the chapter.

Attaching the SLTA-10 Adapter to a PC

Most PC serial I/O ports have a 9-pin male DB-9 connector, although some have a 25-pin male DB-25 connector. Most serial I/O ports are hard-wired as DTE devices.

If connecting to a PC or modem equipped with a DB-9 connector, then use a straight-through cable with one end terminated with a DB-9 male connector and the other end with a DB-9 female connector. Plug the male end into the SLTA-10 Adapter and the female end into the serial I/O port.

Table 3.1 PC DB-9 to DB-9 Connection

Signal Name	***PC Connector DB-9 Male***	***Cable DB-9 Female***	***Cable DB-9 Male***	***SLTA (DCE) DB9 Female***
RxD	Pin 2	Pin 2	Pin 2	Pin 2
TxD	Pin 3	Pin 3	Pin 3	Pin 3
Signal Ground	Pin 5	Pin 5	Pin 5	Pin 5

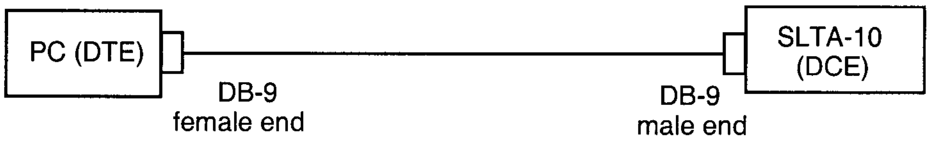


Figure 3.1 DB-9 to DB-9 Connection

If using a PC or modem equipped with a DB-25 connector, then use a cable equipped on one end with a DB-25 female connector and a DB-9 male connector on the other end. Plug the male DB-9 connector into the SLTA-10 Adapter and the female DB-25 connector into the PC.

Table 3.2 PC 25-Pin to DB-9 Connection

Signal Name	***PC Connector DB-25 Male***	***Cable DB-25 Female***	***Cable DB-9 Male***	***SLTA (DCE) DB-9 Female***
RxD	Pin 3	Pin 3	Pin 2	Pin 2
TxD	Pin 2	Pin 2	Pin 3	Pin 3
Signal Ground	Pin 7	Pin 7	Pin 5	Pin 5

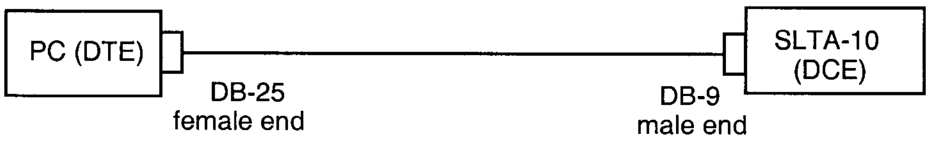


Figure 3.2 PC 25-Pin to DB-9 Connection

Attaching the SLTA-10 Adapter to a Modem

You must use a specific null modem cable to attach the SLTA-10 Adapter to a modem. See the following tables and figures for the correct cable.

Table 3.3 DCE Modem to SLTA-10 Adapter Connection (DB-9 to DB-9)

Modem Signal Name	***Cable DB-9 Male***	***Null Modem***	***Cable DB9 Male***	***SLTA-10 (DCE) DB-9 Female***
RxD—Pin 2	Pin 2	Pin 2-3	Pin 3	TxD—Pin 3
TxD—Pin 3	Pin 3	Pin 3-2	Pin 2	RxD—Pin 2
DCD—Pin1	Pin 1	Pin 1-4	Pin 4	DTR—Pin 4
DTR—Pin 4 RTS—Pin 7	Pins 4 & 7	Pins 4, 7 - 6	Pin 6	DSR—Pin 6
GND—Pin 5	Pin 5	Pin 5-5	Pin 5	GND—Pin 5

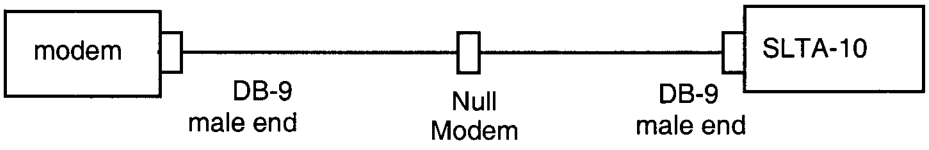


Figure 3.3 DCE Modem to SLTA-10 Adapter Connection (DB-9 to DB-9)

Table 3.4 DCE Modem to SLTA-10 Adapter Connection (DB-25 to DB-9)

Modem Signal Name	***Cable DB-25 Male***	***Cable DB9 Male***	***SLTA-10 (DCE) DB-9 Female***
RxD—Pin 3	Pin 3	Pin 3	TxD—Pin 3
TxD—Pin 2	Pin 2	Pin 2	RxD—Pin 2
DCD—Pin8	Pin 8	Pin 4	DTR—Pin 4
DTR—Pin 20 RTS—Pin 4	Pins 20 & 4	Pin 6	DSR—Pin 6
GND—Pin 7	Pin 7	Pin 5	GND—Pin 5

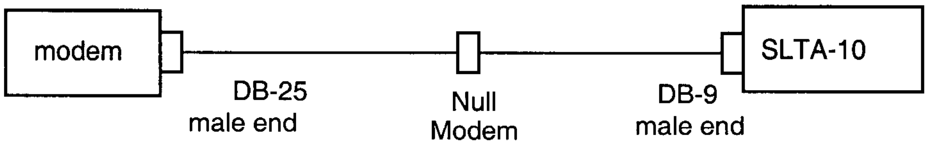


Figure 3.4 SLTA-10 Adapter Null Modem Cable (DB-25 to DB-9)

4

Hardware Configuration

This chapter describes how to install and configure an SLTA-10 Adapter.

Configuring the SLTA-10 Adapter Hardware

There are eight configuration switches on the SLTA-10 Adapter's switch block (S1). These inputs are read by the SLTA-10 firmware to configure or enable features. Figure 4.1 shows the factory default settings for the SLTA-10 Adapter. Changes to the switch configurations will not occur until the power is cycled on the SLTA-10 Adapter. The switches are read immediately after a power reset.

The NSI switch selects between the legacy SLTA-10 MIP mode and a serial Network Services Interface (NSI mode).

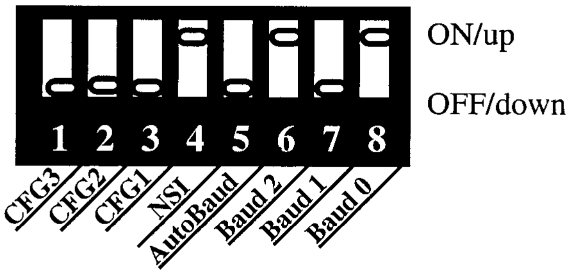


Figure 4.1 SLTA-10 Adapter Default Switch Settings

Configuration Options

Interface Link Protocol Control (Switch1 / CFG3)

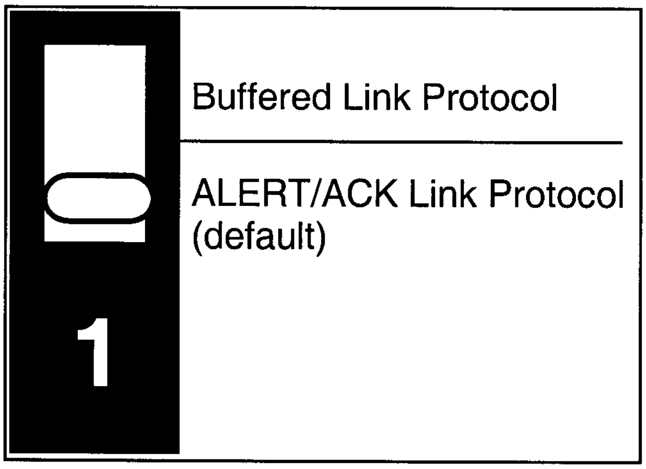


Figure 4.2 SLTA-10 Adapter Link Protocol Switch1 / CFG3

Switch1 / CFG3 controls the network interface link protocol used between the SLTA-10 Adapter and a local host, when in MIP mode. For NSI mode, leave this switch in the default position. Two link protocols are available for the SLTA-10 MIP mode: the SLTA-10 Adapter ALERT/ACK link protocol and the buffered link protocol.

The ALERT/ACK link protocol is designed for host computers that cannot accept asynchronously occurring streams of serial data at high speed. For example, a PC running DOS or Windows cannot guarantee receipt of all characters in an input stream appearing back-to-back on a COM port . ALERT/ACK link protocol (down position) is the default setting for the SLTA-10 Adapter. When the SLTA-10 Adapter uses the ALERT/ACK protocol and it wishes to send data to the host, it first sends a single ALERT character (hex 01). The host then responds with an ALERT ACK character (hex FE) to indicate its readiness to accept the rest of the data. The ALERT/ACK protocol places timing requirements on the host, and if these timing requirements are violated, a driver error occurs. After the host network driver has sent the ALERT ACK character, it enters a tightly controlled loop for accepting the remaining characters—usually with interrupts disabled. If this option is enabled (switch in down position), the ALERT/ACK protocol will also be used when the host wishes to send data to the SLTA-10 Adapter.

The buffered link protocol (up position) is designed for host computers and applications that can accept and buffer back-to-back serial data without losing characters. For example, most real-time operating systems and `/dev/tty` drivers in UNIX systems have this capability. In this case, the SLTA-10 Adapter simply sends the uplink message without any handshake with the host. The SLTA-10 Adapter does not support hardware handshake or XON/XOFF software flow control when directly attached to a host. If the buffered link protocol option is enabled (up position), the buffered protocol is also used when the host wishes to send data to the SLTA-10 Adapter. **The buffered link protocol should not be used when CFG2 is set to the *Remote Host* state (up position).** See *Buffered Link Protocol* in Chapter 9 for additional application restrictions when using the buffered link protocol.

Modem Support (Switch 2 / CFG2)

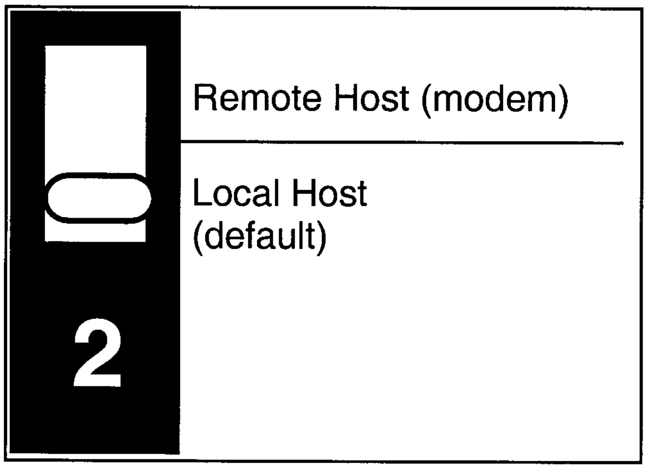


Figure 4.3 SLTA-10 Adapter Host Switch2 / CFG2

Switch2 / CFG2 controls the use of the SLTA-10 Adapter with a modem. If the SLTA-10 Adapter is connected directly to a host, then CFG2 should be set to the *Local Host* state (down position). This is the SLTA-10 Adapter default. If the SLTA-10 Adapter is connected to a modem, then CFG2 must be set to the *Remote Host* state (up position) and CFG3 must be set to ALERT/ACK (down position).

Network Disable (Switch3 / CFG1)

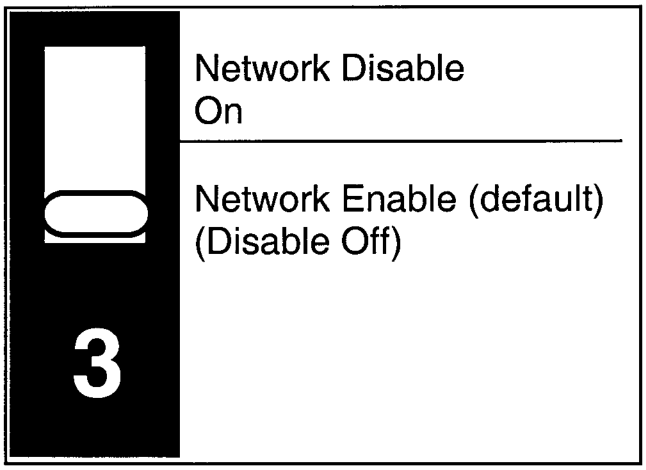


Figure 4.4 SLTA-10 Adapter Network Switch 3 / CFG1

Switch 3 / CFG1 enables (down position) or disables (up position) network communications after reset. If disabled, the SLTA-10 Adapter will not be able to communicate on the network after a reset until it receives an `niFLUSH_CANCEL` command from the host.

The SLTA-10 Adapter prevents network communications by entering a `FLUSH` state. This state causes the SLTA-10 Adapter to ignore all incoming network messages and prevents all outgoing network messages, *even service pin messages*. In the disabled state, if the service pin is pressed the service LED will light but no service message will be sent. This `FLUSH` state is provided to prevent any other network management tools from performing network management functions on the SLTA-10 Adapter before the SLTA-10 Adapter's host has a chance to perform any of its own network management functions. This state is canceled with the `niFLUSH_CANCEL` command from the host.

An SLTA-10 Adapter network driver may automatically enable network communications when the SLTA-10 Adapter is opened. For example, by default, the DOS network driver enables network communications by automatically sending the `niFLUSH_CANCEL` command when the SLTA-10 Adapter is opened and when it receives an uplink message from the SLTA-10 Adapter indicating that it has been reset. If the host application needs to configure the SLTA-10 Adapter before enabling network communications, the `/Z` option on the DOS network driver command line must be used to leave network communications disabled after the SLTA-10 Adapter is opened. When the `/Z` option is specified and CFG1 is set to *Network Disable On*, the host application itself must explicitly send the `niFLUSH_CANCEL` command after reset.

The Windows 95/98 or NT network drivers do not provide a `/z` option. When using these network drivers, network communication will proceed without any action by the host application if Switch3/CFG1 is in the *Network Enable* position. Otherwise, if Switch3/CFG1 is in the *Network Disable On* position, the host application must explicitly send the `niFlush_CANCEL` command.

If CFG1 is set to *Network Enable* (down position), the SLTA-10 Adapter will enable network communications after a reset by going directly to the NORMAL state, thus allowing communications without requiring the niFLUSH_CANCEL command.

If the SLTA-10 Adapter is used with a modem, and the application requires the SLTA-10 Adapter to dial out to a host in response to a message from the network, then CFG1 must be set to *Network Enabled.*

If the modem is set to receive incoming calls only, then the host can disable the FLUSH state after the connection is established, in which case CFG1 can be set to either position. Table 4.1 summarizes these options:

Table 4.1 SLTA-10 Adapter Network Disable Switch Configuration

Network Disable Input	***DOS Driver '/Z' Option***	***When SLTA-10 Adapter Enables Network Communications***
Disabled (up position)	Specified	Host application command
Disabled (up position)	Not specified (default)	Opening network driver
Enabled (default) (down position)	Don't care	Immediately after reset

Serial Network Services Interface (Switch4 / NSI)

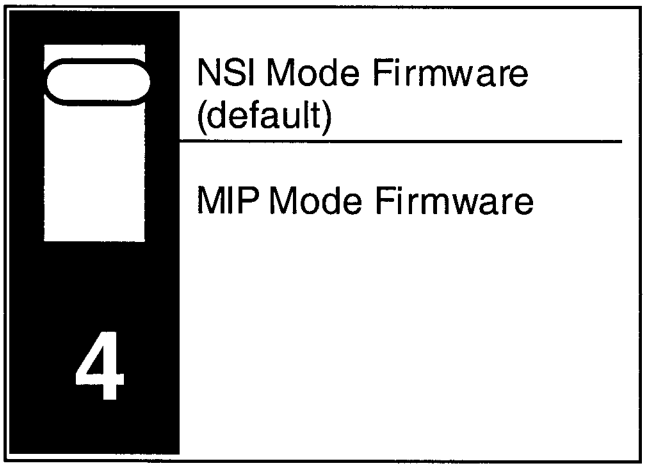


Figure 4.5 SLTA-10 Adapter Firmware Switch 4 / NSI

The SLTA-10 Adapter has an SLTA-10 NSI-mode firmware switch which is Switch4 / NSI. It is factory set in the up position for use of the SLTA-10 NSI mode firmware. The down position is for the MIP mode firmware.

Autobaud (AB)

The switch (5) labeled AB on the SLTA-10 Adapter is used to select automatic baud rate detection—the autobaud feature. **Autobaud must not be used when the SLTA-10 Adapter is used with a modem**. When autobaud is enabled, the SLTA-10 Adapter matches the serial bit rate of a local host. When powered, the SLTA-10 Adapter looks for a '0' byte from the host. The SLTA-10 Adapter cycles through all the serial bit rates until a '0' is recognized. To initialize the SLTA-10 Adapter, the host must transmit eight binary zeroes (or ASCII NULs), spaced at least 50ms apart. The SLTA-10 Adapter will try all of its bit rates until the zero character is recognized correctly, and will respond with an ALERT ACK character (hex FE) when it selects the matching serial bit rate. The SLTA-10 Adapter DOS network driver sends this sequence automatically if the autobaud option (`/A`) is specified. The default for an SLTA-10 Adapter is *Autobaud Disable*.

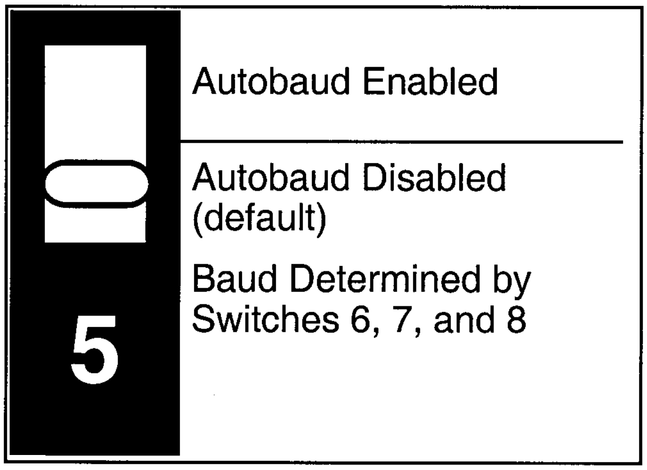

Autobaud Enabled
Autobaud Disabled (default)
Baud Determined by Switches 6, 7, and 8
5

Figure 4.6 SLTA-10 Adapter Autobaud Switch 5 / AB

If the `/A` option is specified for the DOS network driver, the driver sends the autobaud sequence every time the driver is opened. However, if the AB option is enabled, the driver must re-send the autobaud sequence every time the SLTA-10 Adapter cycles power.

For the Windows 95/98 or NT network driver, there is no `/A` option. Using these drivers, the autobaud sequence is attempted following power up if *Autobaud Enabled* is selected, otherwise (the default) autobaud will not be attempted.

Serial Bit Rate (Switches(6..8) / BAUD(2..0))

Switches 6 to 8, named BAUD[2..0], are used to set the SLTA-10 Adapter serial bit rate. This setting is only used if autobaud operation is disabled. There are eight available bit rates. The SLTA-10 Adapter is configured for 38,400 bps with autobaud disabled by default.

All data are transmitted using 1 start bit, 8 data bits, no parity bits, and 1 stop bit.

The `/B` option is used to specify the serial bit rate to the DOS network driver.

For the Windows 95/98 or NT network driver, there is no `/B` option. When using these drivers, the serial bit rate is configured using the SLTALink Manager as explained in Chapter 7.

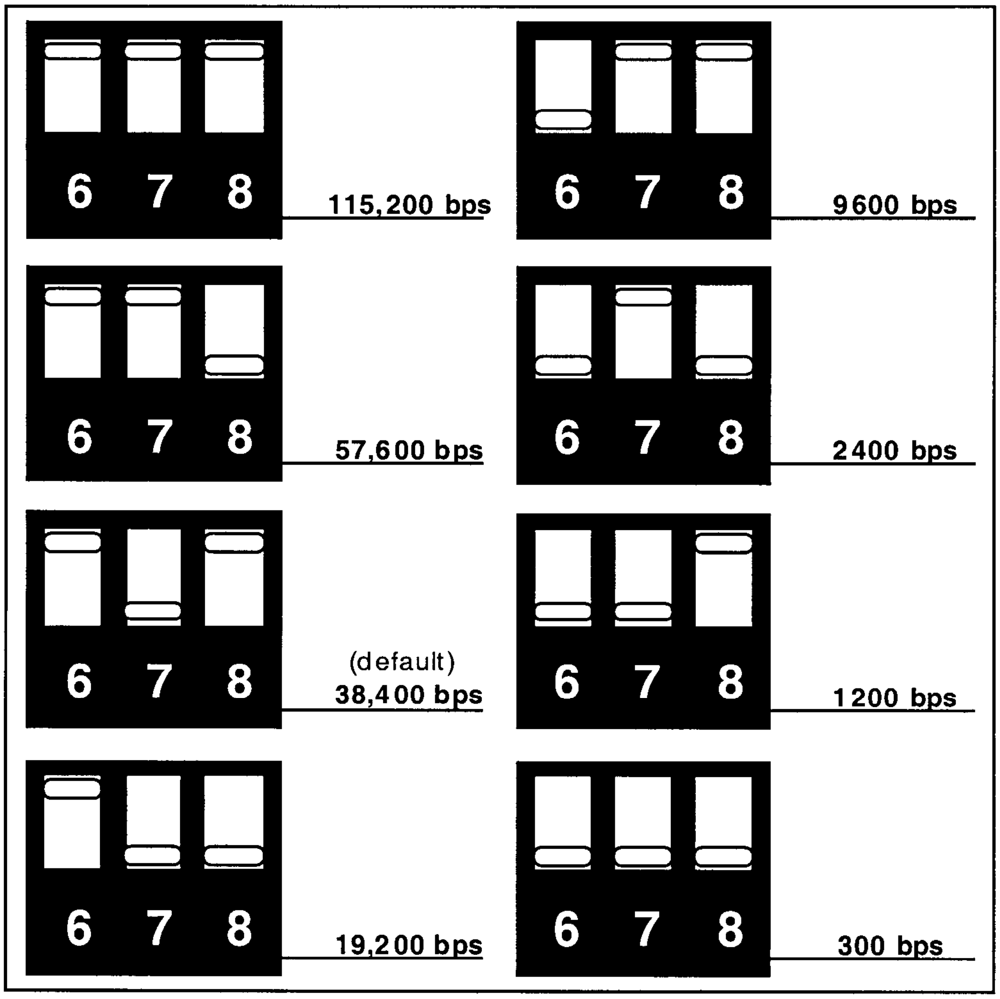


Figure 4.7 SLTA-10 Adapter Serial Baud Rate Switches 6, 7, and 8 / BAUD[2..0]

Table 4.2 SLTA-10 Adapter Autobaud Switch Configuration

Autobaud Switch	***BAUD Switches***	***'/A ' Option on DOS Driver***	***'/B ' Option on DOS Driver***
down position	Specifies actual baud rate	Don't care	Specifies actual serial bit rate. Must match switch-selected baud rate
up position	Don't care	Must be specified	Specifies actual baud rate

SLTA-10 Adapter Buffers

The types of messages passed between the host and the SLTA-10 Adapter are determined by EEPROM configuration options. These options are described under *Network Interface Configuration Options* in Chapter 3 of the *LONWORKS Host Application Programmer's Guide.* The *Network Disable Option* affects whether or not the SLTA-10 Adapter can send and receive application messages.

The buffer configuration parameters can be changed at any time by sending *Write Memory* network management messages to the SLTA-10 Adapter, either from a host (using local network management messages) or over the network from a network management tool. See the *Neuron Chip Data Book*, Appendix A, for details of the data structures within the Neuron Chip that control the partitioning of RAM for buffers. The following tables summarize the memory usage of the default configurations for the respective two firmware versions resident on the SLTA-10 Adapter. The tables also list the maximum size of the buffer memory pool. If the SLTA-10 Adapter is configured to use more bytes than are available in the pool, it will behave erratically since the RAM is used by the SLTA-10 firmware.

Table 4.3 SLTA-10 Adapter Default EEPROM Configuration

Configuration Parameters	***Default Setting***
Initial State	Unconfigured
Explicit addressing	Enabled
Network variable processing	Host Selection
Program ID string	"SLTA10" (Mip Mode) 80-00-01-01-03-00-xx-3C (NSI Mode)

Table 4.4 SLTA-10 Adapter MIP mode Default Buffer Configuration

MIP-mode Buffer Parameter	***Default Count***	***Default Size in Bytes***	***Default Total Bytes***
Receive transaction buffers	8	13	104
Transmit transaction buffers	2	28	56
Application input buffers	15	255	3825
Application output buffers	7	255	1785
Network input buffers	31	255	7905
Network output buffers	2	255	510
Priority app. output buffers	5	255	1275
Priority net. output buffers	2	255	510
Total bytes used for buffers			**15970**

The NODEUTIL node utility application, available on Echelon's web site, can be used to modify the MIP mode buffer configuration from a PC host. See the README.TXT file included with NODEUTIL for details.

By default, the SLTA-10 NSI-mode program ID consists of 8 bytes of program identification information (80-00-01-01-03-00-xx-3C, where 'xx' is determined by the transceiver being used). **The host application must change this program ID to indicate its application.** This is done automatically in LNS by the LCA Object Server. If not using the LCA Object Server, the host application needs to send local write-memory network management messages to change the program ID. See the *LNS Host API Programmer's Guide* for further information.

Table 4.5 SLTA-10 Adapter NSI-mode Default, and Minimum, Buffer Configuration

NSI-mode Buffer Parameter	*Default Count*	*Default Size in Bytes*	*Default Total Bytes*
Receive transaction buffers	16	13	208
Transmit transaction buffers	2	28	56
Application input buffers	3	255	765
Application output buffers	3	255	765
Network input buffers	2	66	132
Network output buffers	2	66	132
Priority app. output buffers	3	255	765
Priority net. output buffers	2	66	132
Total bytes used for buffers			**2955**

5

The SLTA-10 NSI Mode Software

This chapter describes the Windows 95/98 or Windows NT software used with the SLTA-10 NSI mode. This software is available with the LonMaker for Windows Integration Tool (Model 37000), in the Connectivity Starter Kit (Model 58030-01), as part of the LNS Developer's Kit for Windows (Model 34303) and on the Echelon web site (www.echelon.com).

Skip this Chapter if you are using the SLTA-10 MIP mode.

SLTA-10 NSI Mode Software Overview

The SLTA-10 Adapter is not shipped with any software. The Windows NT driver and SLTALink Manager software are available with the LonMaker for Windows Integration Tool (Model 37000), in the Connectivity Starter Kit (Model 58030-01), as part of the LNS Developer's Kit for Windows (Model 34303) and on the Echelon web site (www.echelon.com).

The SLTA-10 NSI mode set-up installs three pieces of software:

- the SLTA-10 NSI mode Windows 95/98 or NT Driver,
- a "stub" driver to run legacy DOS and Windows 3.1x applications, and
- the SLTALink Manager software.

The SLTA-10 Adapter includes firmware that moves the upper layers of the LonTalk Protocol from the Neuron Chip within an SLTA-10 Adapter and onto a host processor. This firmware allows the SLTA-10 Adapter to be used by a host application to send and receive LonTalk messages. The firmware in the SLTA-10 Adapter is loaded in ROM and cannot be reprogrammed.

Using the SLTA-10 NSI mode, the host application may be one of two types. The first type of host application is an LNS-based application, developed with the LNS Developer's Kit for Windows. The second type of application is a legacy DOS or Windows 3.1x application. Under Windows NT, these applications make use of the "stub" driver declared in the `config.sys.os` files, which in turn accesses the Windows NT driver. Under Windows 95/98, Windows 3.1x applications should use the DOS driver in conjunction with WLDV.DLL. Echelon does not support 32-bit Windows applications that are not based on the LNS software accessing the Windows 95/98 or NT drivers.

Windows 95/98 and Windows NT Software Installation Procedure

Prior to installation, ensure that the computer is running the Windows 95/98 or NT Operating System (Windows NT version 3.51 or higher for a direct connect interface; Windows NT version 4.0 or higher for use with modems). The SLTA-10 software cannot be installed from DOS, or a DOS shell, nor can it be installed on Windows 3.1 or Windows 3.11.

1. Before installing the software, make sure that you have logged in as Administrator (for Windows NT only).
2. Close all open programs.
3. Insert the installation diskette into the PC.
4. Click the Start button on the Windows task bar and select the run command. (If using with Windows NT 3.51: Within Program Manager, choose the Run command from the File menu.)

5. When prompted for a program name, enter the following:

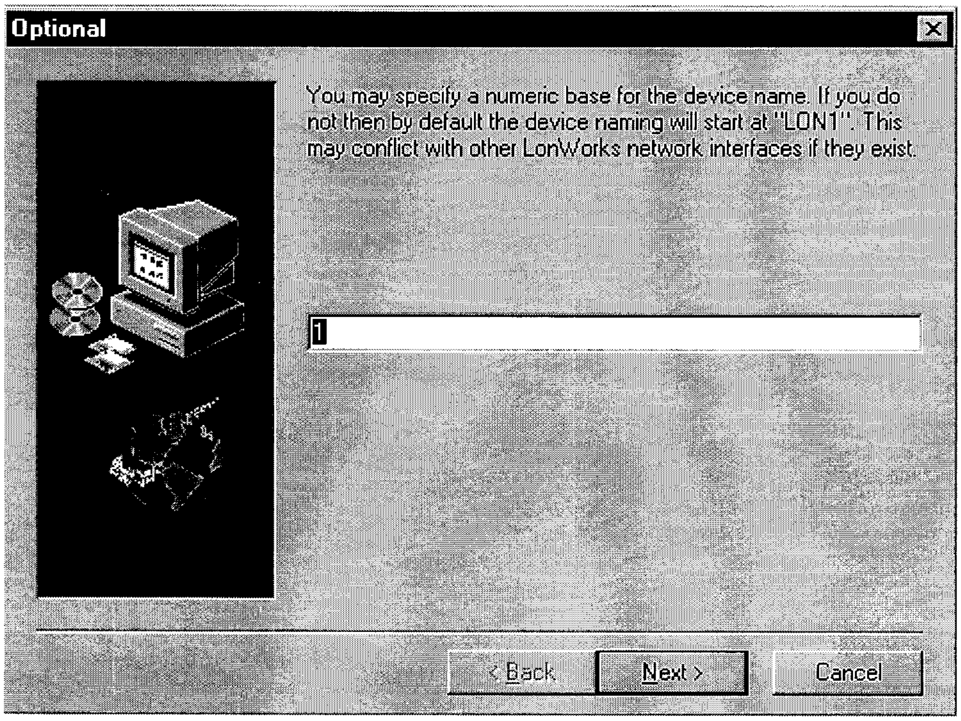
```
A:\SETUP.EXE
```

If necessary, replace `A:` with the drive letter which corresponds to the drive containing the SLTA-10 NSI mode installation diskette.

6. When prompted click the button marked "Next >".

7. When prompted for a destination directory, enter the desired installation directory. By default this directory is `c:\lonworks`, unless previous LONWORKS products have been installed and have registered a different path in the Windows Registry. The path may be modified using the "Browse" button.

8. The next screen presented is shown in figure 5.1. This will determine the LONWORKS naming convention used for the SLTA-10 adapter.


Optional

You may specify a numeric base for the device name. If you do not then by default the device naming will start at "LON1". This may conflict with other LonWorks network interfaces if they exist.

1

Figure 5.1 LONWORKS Device Naming Convention

9. Clicking the "Next" button concludes installation. At the prompt to restart the computer, remove the SLTA-10 NSI mode installation diskette and restart the computer. **Note that the Windows operating system will not recognize the SLTA-10 adapter until the computer is restarted.**

Windows 95/98 and NT Software Installation Results

The Windows 95 and NT installation software loads a selection of new files and updated Echelon files to different locations on the PC's hard drive. The function and location of these files can be found in `readme.txt`.

6

The SLTA-10 MIP Mode Software

This chapter describes the SLTA-10 MIP mode software shipped with the Connectivity Starter Kit (Model 58030-01) and on the Echelon web site at www.echelon.com. This software is an updated version of the SLTA/2 adapter software.

Echelon does not provide a 32-bit Windows driver for the SLTA-10 MIP mode.

Skip this Chapter if you are using the SLTA-10 NSI mode.

SLTA-10 MIP Mode Software Overview

The SLTA-10 Adapter is not shipped with any software. The SLTA-10 MIP mode software and drivers are supplied in the Connectivity Starter Kit and must be ordered separately. The software includes ANSI C source code for HA, a sample host application for MS-DOS that can be used as a basis for a user-developed host application on other host platforms. This application provides examples of sending and receiving network variable messages, as well as allowing a node based on an SLTA-10 Adapter to be installed and bound by a network management tool such as the LonManager LonMaker Installation Tool or the LonBuilder network manager.

A network driver for DOS permits the SLTA-10 Adapter to be used with DOS applications. Source code for a DOS network driver is provided as a basis for a user-developed network driver for other hosts or operating systems. On a separate diskette, DLL software is provided to make it easier to use the network driver under the Microsoft® Windows 3.1x operating system.

An executable program and source code is also provided for a Host Connection Utility (HCU), which may be used to initiate and terminate the host to SLTA-10 Adapter connection when the SLTA-10 Adapter is used with a remote host. An example written in Neuron C is also provided as a basis for user-developed nodes on a LONWORKS network that need to initiate outgoing calls to a remote host.

The SLTA-10 Adapter includes firmware that moves the upper layers of the LonTalk Protocol off the Neuron Chip within an SLTA-10 Adapter onto a host processor. This firmware allows the SLTA-10 Adapter to be used by a host application to send and receive LonTalk messages. The host application may be a custom application as described in the *LONWORKS Host Application Programmer's Guide*. The host application may also be a network management or monitoring application based on the LonManager API, LonManager LonMaker installation tool, or LonManager DDE Server. The firmware in an SLTA-10 Adapter is fixed in ROM and cannot be reprogrammed.

Installing the SLTA-10 MIP Mode Adapter Software

The SLTA-10 Adapter software is supplied in the Connectivity Starter Kit as a diskette. The SLTA-10 DOS driver operates under DOS, Windows 3.1x, and Windows 95/98 operating systems. To install the SLTA-10 Adapter software, follow these steps:

1. Place the diskette in one of the disk drives of your PC. This will typically be the `A:` or `B:` drive. Under the Windows 95/98 operating system, open a DOS console.

2. Start the automatic installation procedure by entering:

```
A:INSTALL [ENTER]
```

Substitute your disk drive name for the `A:` if you are using a different drive.

3. You will be asked to enter the name of your LONWORKS installation directory. `C:\LONWORKS` is the default.

The SLTA-10 Adapter software will be installed in the SLTA sub-directory of your LONWORKS directory, with the exception of the DOS network driver LDVSLTA.SYS. This file will be installed in the BIN sub-directory of your LONWORKS directory. To install the DOS network driver into your CONFIG.SYS file, follow the instructions in Chapter 8.

The SLTA directory will contain the following files:

- **Read-Me File**. The README.TXT file includes a list of all the files on the distribution disk, and also includes any updates to the documentation that occurred since the SLTA-10 Adapter documentation was printed.
- **DOS Network Driver Sources**. The SLTA-10 Adapter DOS network driver source code is contained in the LDVSLTA directory. These files can be used as the basis for creating drivers for hosts other than PCs running DOS (see also the UNIX network driver sources). See Chapter 8 for a description of the SLTA-10 Adapter DOS network driver and Chapter 9 for a description of how to write an SLTA-10 Adapter network driver for other hosts. See Chapter 4 of the *LONWORKS Host Application Programmer's Guide* for a description of the services that must be supplied by a LONWORKS network driver.

  The source files to build the DOS driver are:

LDVSLTA.CFG	Configuration file for Borland C.
MAKEFILE	Make file script for Borland C.
MDV_TIME.C	Code to manage the PC timer.
MDV_TIME.H	External interface definitions for the timer handler.
MSD_DEFS.H	Data structure and literal definitions.
MSD_DIFC.C	DOS driver interface functions.
MSD_DRVR.H	DOS driver interface and literal definitions.
MSD_EXEC.C	Main open, close, read, and write processing.
MSD_FRST.C	Module to be linked first in the network driver.
MSD_IRQC.ASM	Serial I/O interrupt procedure.
MSD_LAST.C	Module to be linked last in the network driver.
MSD_RAW.C	Direct serial I/O (modem) processing.
MSD_SEGD.ASM	Defines data segment register for driver.
MSD_SIO.C	PC/AT UART interface processing.
MSD_TXRX.C	Single byte link layer processing.
MSD_UART.H	Defines PC/AT UART registers.

- **External Interface Files**. External interface files included for use by network management tools are contained in the SLTA directory. External interface files are included for the transceivers available for the SLTA-10 Adapter. See *Binding to a Host Node* in Chapter 3 of the *LONWORKS Host Application Programmer's Guide* for a description of how to use these files to bind to an SLTA-10 Adapter node. Appendix B of the *LONWORKS Host Application Programmer's Guide* provides a detailed description of how to modify these files to incorporate network variables and message tags. These interface files are provided in version 3 formats. External interface files in version 3 format are contained in the SLTA2\XIF_V3 directory.

The SLTA directories contain at least the following files:

NSLTA125.XIF	For SLTA-10 Adapter with a TP/XF-1250 transceiver.
NSLTA78K.XIF	For SLTA-10 Adapter with a TP/XF-78 transceiver.
NSLTAFT1.XIF	For SLTA-10 Adapter with a TP/FT-10 transceiver.

- **Sample Host Application**. A sample host application is contained in the HA directory. See Appendix A of the *LONWORKS Host Application Programmer's Guide* for a description of the example. The following files are included:

README.TXT	A description of the sample host application.
HA.EXE	An executable version of the sample host application for DOS. The SLTA-10 Adapter DOS network driver must be installed to run this application.
HA.C	The main program for the example.
NI_MSG.C	A general purpose network interface library that can be used with any host application.
APPLCMDS.C	Functions to handle application layer network variable commands
NI_CALLB.C	The host-bound network management dispatcher.
APPLMSG.H	Application message handler function prototypes.
HA_COMN.H	The HA common declarations.
NI_CALLB.H	The definitions for the network management dispatcher.
APPLMSG.C	Functions to handle application network variable and explicit messages.
HAUIF.C	Command-line user interface for the example.
IOCTL.C	I/O control function for Microsoft C.
LDVINTFC.C	Device interface driver.
LDVINTFC.H	Include file for device driver interface.
NI_MSG.H	Definitions for network interface message structures.
NI_MGMT.H	Definitions for network management message structures used by the example.
HAUIF.H	Definitions for the host application example user interface.
MAKEFILE	A make file script for Borland C.
MSOFT.MAK	A make file script for Microsoft C.
HA_V3.XIF	An external interface file which may be used to bind the example with LonBuilder.

`HA_TEST.NC`	A Neuron C program which may be loaded into a Neuron emulator and bound to the sample host application for testing.
`DISPLAY.H`	A Neuron C include file to drive the Gizmo 2 I/O module for the test example.

- **Host Connect Utility**. A sample host connection utility is contained in the `HCU` directory, with source code. See Chapter 12 for details. The files supplied are:

`HCU.EXE`	Executable file for the Host Connection Utility.
`HCU_MAIN.C`	The main C source program.
`HCU.CFG`	Configuration file for Borland C.
`MAKEFILE`	Make file script for Borland C.
`MSD_DRVR.H`	Driver definition include file.

- **Neuron C Connection Example**. A sample Neuron C program is contained in the `NC_APPS` directory. This program shows how a node on a network connected to the SLTA-10 Adapter can dial out and connect to a remote host computer. The files supplied are:

`DIALOUT.NC`	Neuron C source program to dial out with the SLTA-10 Adapter.
`GIZSETUP.NC`	An example Neuron C program for configuring the SLTA-10 Adapter. Configures the EEPROM directories of an SLTA-10 Adapter using the Gizmo 2 I/O module as the user interface.
`SLTA_ANM.H`	Definitions of SLTA-specific network management messages.

Installing the Windows 3.1x DLL Software

A second diskette, labeled "LONWORKS Network Driver Interface for Windows 3.1x", contains the 16-bit Windows Dynamic Link Library (DLL) files. These files may be used when developing a host application to run under Microsoft Windows 3.1x. The file `WLDV.DLL` should be copied to your Windows directory (typically `C:\WINDOWS`). The files `LDV.H` and `LON.H` should be copied to a directory in the include file search path of your C compiler. The file `WLDV.LIB` should be copied to a directory in the library search path of your application linker. See Appendix A for information on using the Windows DLL.

Other Drivers

A UNIX network driver and source code for the SLTA-10 MIP mode is available on the Echelon web site (http://www.echelon.com).

Chapter 9 discusses creating a SLTA-10 MIP mode driver for any host.

7

Using the Windows 95/98 or NT Driver and SLTALink Manager with SLTA-10 NSI Mode

This chapter describes the SLTALink Manager software, which establishes and configures local and remote links from the host PC to the SLTA-10 Adapter in NSI mode. A local link requires a direct cable connection from the host PC to the SLTA-10. A remote link requires a pair of modems: one attached to the SLTA-10 Adapter and the other attached to the host PC. The SLTALink Manager software controls a remote SLTA-10 via a pair of modems through Windows' Telephony Application Programming Interface (TAPI) services under Windows 95/98 and NT 4.0 or later.

The SLTALink Manager determines when a standard driver open call in a host application requires dialing and handles these cases. Thus, the host application does not need to know if the network services interface is a local SLTA-10 or a remote SLTA-10 Adapter.

NOTE: Remote SLTA-10 Adapters cannot be used with Windows NT 3.51 because Windows NT 3.51 does not include the 32-bit TAPI services used by the SLTALink Manager software.

Skip this Chapter if you are using the SLTA-10 MIP mode.

Software Overview

The SLTALink Manager is a standalone application that can monitor a modem line, answer an incoming phone call, associate the incoming call's SLTA-10 Adapter (and hence its network) with a LON device, and then launch a pre-determined application for that particular network or SLTA-10 Adapter. Combined with a properly designed LNS host application, the SLTALink Manager lets a LONWORKS network establish a connection to a remote PC through a pair of modems based on an event that occurs locally to the network.

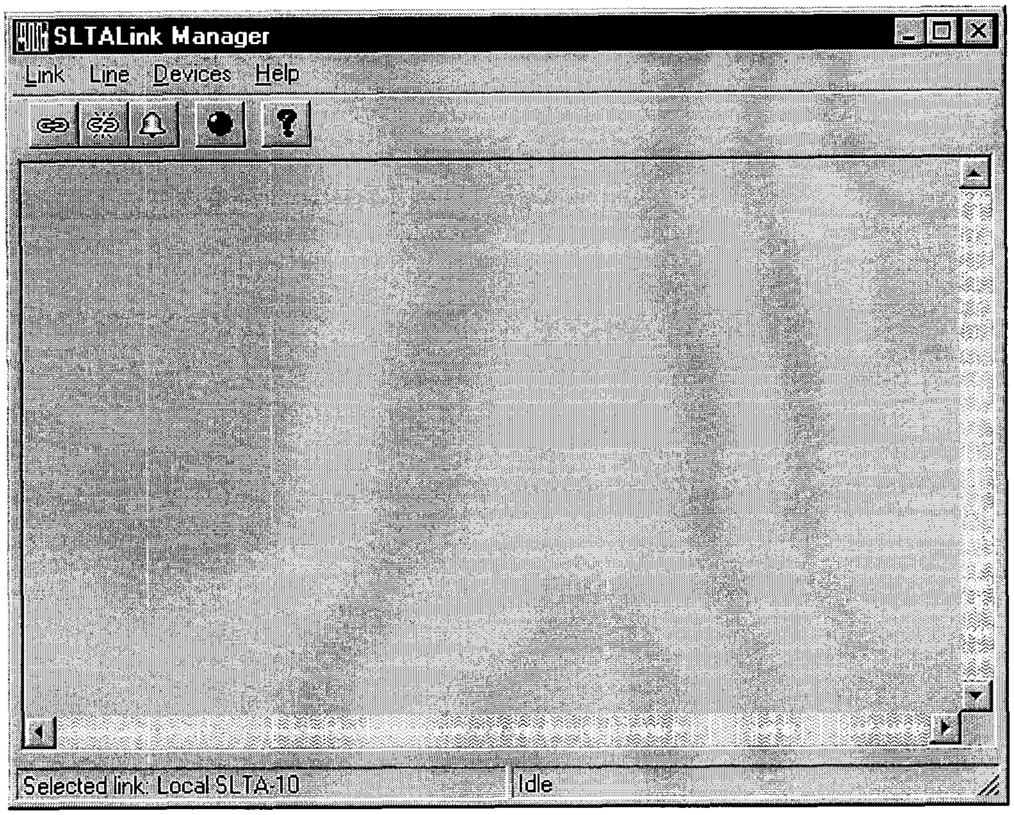
The SLTALink Manager provides a graphical user interface for creating, editing, and diagnosing "links". Each link represents a particular SLTA-10 Adapter and its network. A link identifies several important aspects of the set-up, including the type of connection (a remote connection via modems or a local, direct connection), the COM port, the SLTA-10 Remote Identifier (see below), the baud rate of the serial port on the SLTA-10 Adapter, and the dial-in password, if any. In addition, the link indicates if a security callback is required and may be associated with a host application. The link information is stored in a .s10 file, located by default in the `c:\lonworks\bin\slta10` folder.

The SLTALink Manager application can associate a link with a LON device name and then interface with the SLTA-10 NSI mode driver. The SLTALink Manager handles automatically dialing into the network from the PC host, providing the ability for applications with no knowledge of modems or phone numbers to run remotely through a pair of modems. The SLTALink Manager application can be used to connect to or disconnect from a remote SLTA-10 Adapter. In addition, the SLTALink Manager has a simple, programmatic way to interact with the SLTA-NSI mode. This programmatic interface allows an application to cause the SLTA-10 to perform a number of functions, such as dial a phone number or hang up. The SLTALink Manager also includes many diagnostic functions.

The SLTALink Manager includes many diagnostic functions.

NOTE: Remote SLTA-10 Adapters cannot be used with Windows NT 3.51 because Windows NT 3.51 does not include the 32-bit TAPI services used by the SLTALink Manager software.

Upon invocation of the SLTALink Manager software (`SLTALINK.EXE`), the main screen appears, shown in figure 7.1.



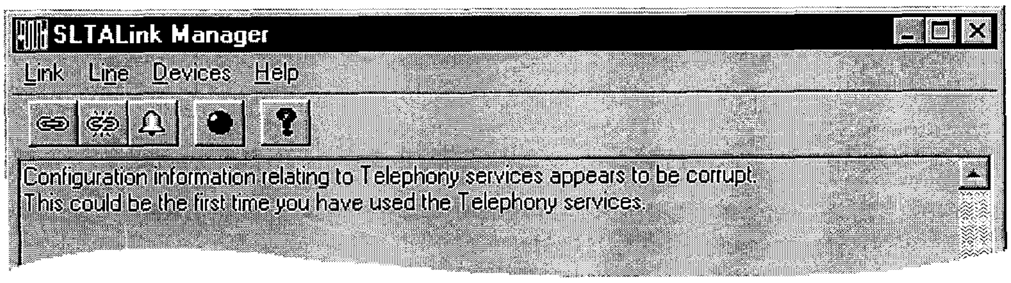
Selected link: Local SLTA-10

Idle

Figure 7.1 SLTALink Manager Main Screen

Establishing a Communications Line for Dialing in to a Network

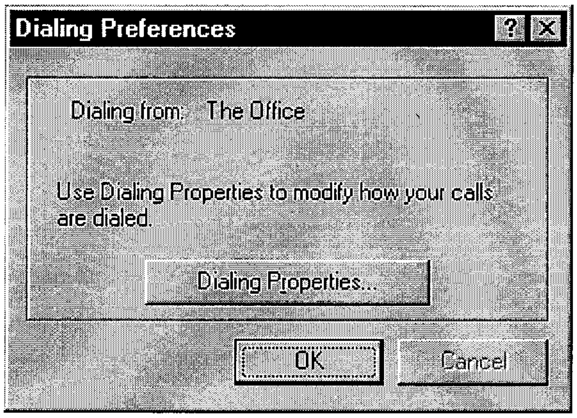
Establishing a communications line is the first task to be completed. Figure 7.2 displays the message that appears when Dialing Preferences is chosen from the Line menu. This message will only appear when telephony information has not been provided. This case usually occurs if the computer has never been configured to use a modem.



Configuration information relating to Telephony services appears to be corrupt.
This could be the first time you have used the Telephony services.

Figure 7.2 First Time Use Message

This message in figure 7.2 may not be visible due to being covered by the SLTALink Manager Dialing Preferences window. Moving the Dialing Preferences window should reveal the message—if it exists. This leftmost window, shown in figure 7.3, will display "???" for the "Dialing from:" indicator if there has been no dialing location created/chosen.



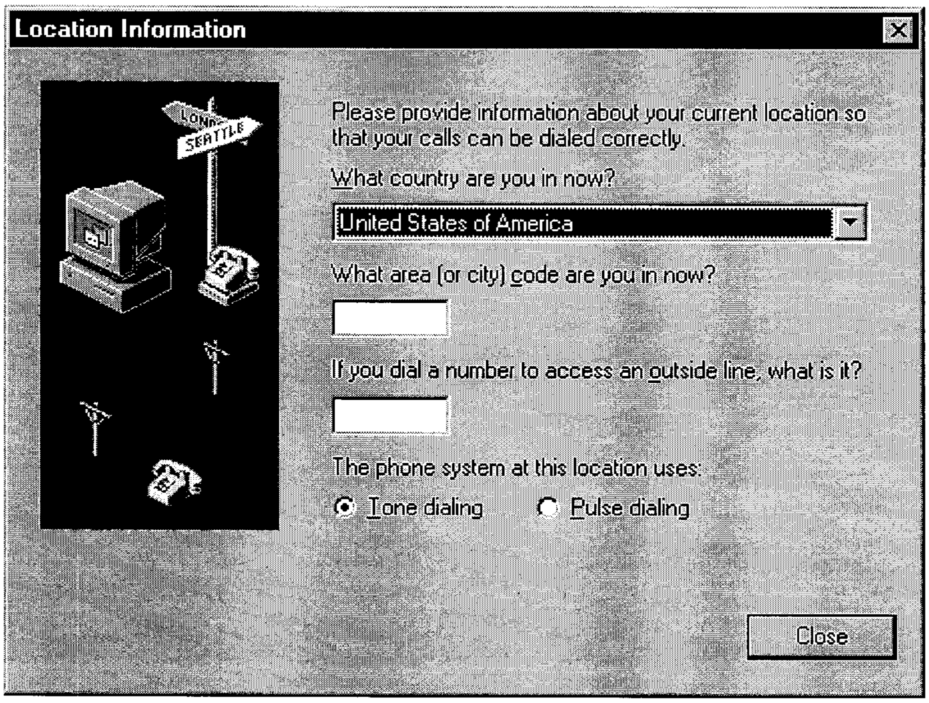
Dialing Preferences

Dialing from: The Office

Use Dialing Properties to modify how your calls are dialed.

Figure 7.3 SLTALink Manager Dialing Preferences Window

Clicking on Dialing Properties will bring-up the Windows Location Information window (figure 7.4) if the "Dialing from:" indicator reads "???", or if TAPI information has been previously entered — as shown in figure 7.3 as "Dialing from: The Office" — the Windows Dialing Properties window (figure 7.5) will be displayed instead. The Dialing Properties window is a tabbed subset of the Windows Telephony Control Panel.



Location Information

Please provide information about your current location so that your calls can be dialed correctly.

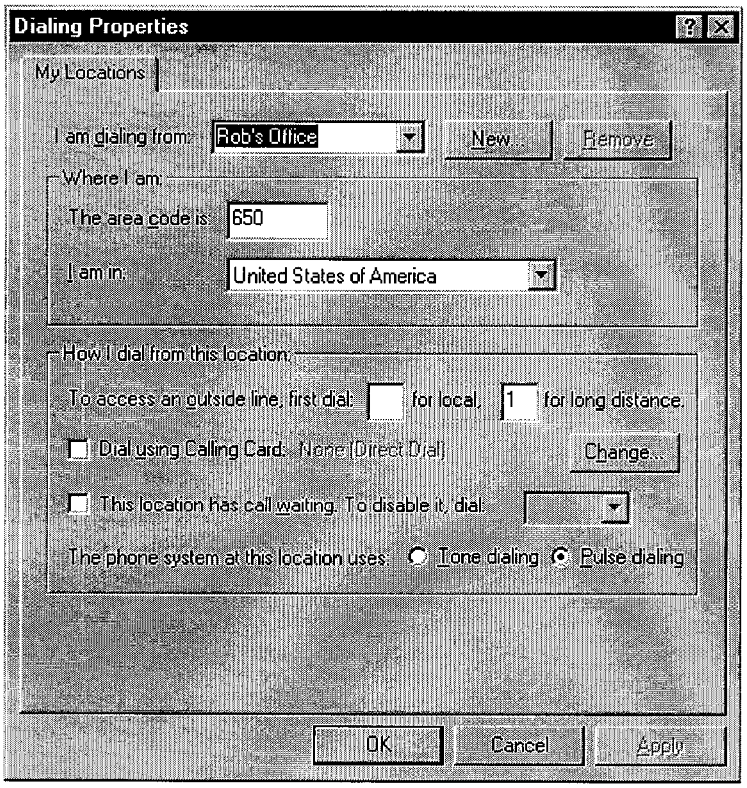
What country are you in now? United States of America

What area (or city) code are you in now?

If you dial a number to access an outside line, what is it?

The phone system at this location uses: [✓ Tone dialing] Pulse dialing

Figure 7.4 Windows Location Information Window



I am dialing from: Rob's Office

Where I am:

The area code is: 650

I am in: United States of America

How I dial from this location:

To access an outside line, first dial: for local, 1 for long distance.

☐ Dial using Calling Card: None (Direct Dial)

☐ This location has call waiting. To disable it, dial:

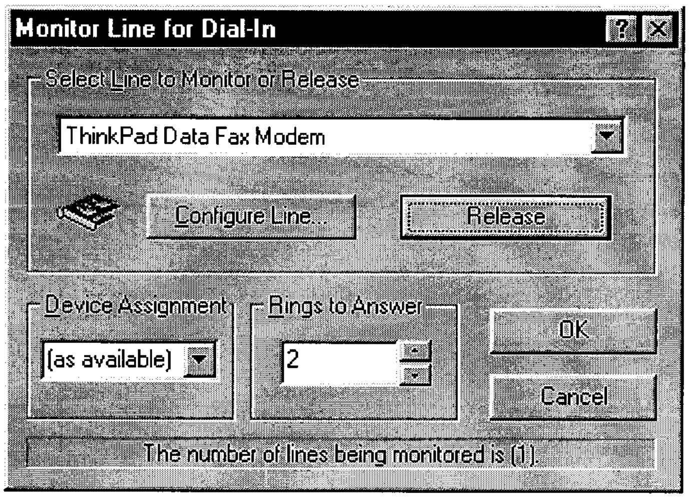
The phone system at this location uses: ○ Tone dialing ● Pulse dialing

Figure 7.5 Windows Dialing Properties Window

Establishing a Communications Line for Calls Dialed out to the PC

The next step is to select a line/modem to monitor for incoming calls. Figure 7.6 shows the Monitor Line window that is displayed when “Monitor for SLTA dial-in” is chosen from the Line menu.

Multiple phone lines or modem can be monitored (for receiving incoming calls) at the same time by the SLTALink Manager software.



Monitor Line for Dial-In

Select Line to Monitor or Release: ThinkPad Data Fax Modem

Device Assignment: [as available]

Rings to Answer: 2

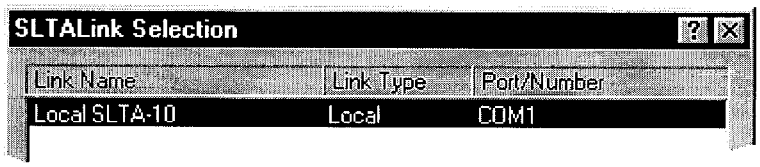
The number of lines being monitored is (1).

Figure 7.6 SLTALink Manager Monitor Line Window

The option list box will display the list of modems which have been set-up for use on this computer. The list can be created/modified by using the Windows Modem Control Panel. Select the line/modem to be used for incoming calls, then click OK.

Establishing Remote and Local Network Sites

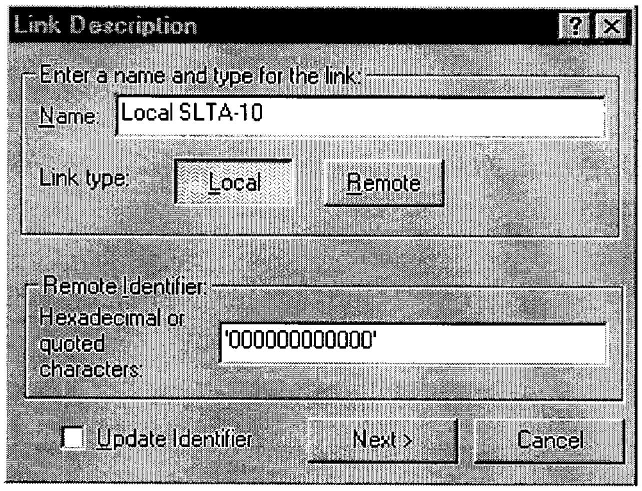
Choosing Select/Action from the Link menu will display a screen similar to the screen shown in figure 7.7. Figure 7.8 shows the default local setup.



SLTALink Selection

Link Name	Link Type	Port/Number
Local SLTA-10	Local	COM1

Figure 7.7 Completed SLTALink Selection Window



Link Description

Enter a name and type for the link:

Name: Local SLTA-10

Link type: Local

Remote Identifier:

Hexadecimal or quoted characters: '000000000000'

Update Identifier: ☐

Figure 7.8 Default SLTALink Selection

Select “Local SLTA-10” and click Edit. This action will present a window allowing the ability to customize the connection—including changing it from Local to Remote, or modifying the name.

SLTALink Configuration Script Formats

The SLTALInk Configuration dialog can accept a script file for importing values to the dialog’s user interface. Following this step, the configuration values can then be applied tot he SLTA-10 by clicking Apply.

Individual configuration items are processed on a line-by-line basis. All values are not required to be in the script file, and any duplicated assignments are simply overwritten.

Any line may start with a semi-colon, which is treated as a comment line. Line length is limited to 80 characters. Assignments are structured as follows:

keyword=value (note that there are no blank spaces between the components).

Argument strings do not need to be quoted. Keywords are case-insensitive. Edit the script file as a simple text file with carriage returns and line feeds terminating each line.

The acceptable assignments are:

Keyword Format	**Argument Description**
Password=password string	Password: Up to 8 characters.
Callback=switch value	Callback enable: Either a ‘1’ or a ‘0’ for enabled or disabled
HangupTimer=minutes value	Hangup timer: A number between 0 and 255.
ModemInit=string	Modem initialization string: A string whose length will be limited by the available EEPROM pool space in the SLTA.
ModemDialPrefix=string	Modem dial prefix: A string whose length will be limited by the available EEPROM pool space in the SLTA.

DialDir1=string to
DialDir5=string
	Dial Directories 1 through 5: A string whose length will be limited by the available EEPROM pool space in the SLTA.

NVConnect=two digits	NV Auto-connect: Either two digits, or not digits if disabled. The first digit represents the starting dial directory number and the second digit represents the last dial directory.

NSIConnect=two digits	NSI Auto-connect: either two digits, or no digits if disabled. The first digit represents the starting dial directory number, the second digit represents the last dial directory number.
ClearEEPool=switch value	Either a '1' or a '0' to enable or disable clearing of the EE pool before applying.

Example

```
; An SLTA-10 Configuration Script.
Password=BIG DOG
Callback=1
HangupTimer=5
GuardTimer=20
ModemInit=ATE0V0&C1&D2S0=1M0
ModemDialPrefix=ATDT
DialDir1=14155557001
DialDir2=14155557002
DialDir3=12155557003
Dialdir4=
Dialdir5=
NVConnect=
NVConnect=1 2
```

Name of Link

The name of the link should be descriptive enough to clearly define to users the connection and remote location.

Remote Identifier

The Remote Identifier is used to identify a specific link when a dial-in to the computer occurs. It represents the remote SLTA-10 Adapter in a 12-byte string of characters or hexadecimal numbers. This value here should match the value stored in the remote SLTA-10 Adapter. It can be entered here as a string in single quotes, or as a series of hexadecimal numbers separated by dashes.

If this field is blank or all zeroes (00-00-00-00-00-00-00-00-00-00-00-00) then the Remote Identifier will be captured and stored here the next time this connection is made.

If this field is all FFs (FF-FF-FF-FF-FF-FF-FF-FF-FF-FF-FF-FF) then any Remote Identifier will be accepted. The identifier will not be stored on the PC. This is known as the wildcard Remote Identifier. The question mark (?) is also accepted as the wildcard Remote Identifier. The SLTALink Manager software translates "?" to all FFs.

The Update Identifier checkbox indicates that the remote identifier will be read from the SLTA-10 Adapter by the SLTALink Manager and the new value will be stored in the .s10 file the next time this link is used.

The SLTALink Manager software allows a user to create two links with different names but the same Remote Identifier. However, when a network dials-out to a PC with multiple links each with the Remote Identifier, the user has no control over which link is selected, which could result in undesired behavior.

Link Type

The type of link specifies whether the SLTA-10 is directly connected to the PC (Local), or if the SLTA-10 is at a different location and must be accessed via a set of modems (Remote).

Configuring the Modem Line

Clicking on "Configure Line" will cause the selected modem's property window to appear. The property window will reflect the options available to the driver of the modem such as volume control and dial-tone detection.

TAPI services will handle the structuring of the call based on the Location Information (see figure 7.4).

SLTA Password

The Password box allows the user to enter the password for a remote SLTA-10 Adapter. Up to eight characters may be entered. If entered, the password will be sent to the remote SLTA-10 adapter when a connection is made.

The password is not encrypted when stored on the host computer.

Invoking an Application

The SLTALink Manager provides a space to enter the startup application for this link. This may be a full executable path name, or the name of an application that can be found in the system's search path. Command line arguments may also added — including the special macros for link connection variables:

%LINKNAME%	Expands to the name of the link, enclosed in quotes.
%DEVNAME%	Expands to the device name used by LONWORKS 32-bit applications to access the logical device. This serves the same purpose as %DOSNAME% does for DOS.
%NSSNAME%	Expands to the device name used by LonWorks LNS application, for SLTA-10s this will be "SLTALON*n*".
%DOSNAME%	Expands to the DOS device name for the logical device, provided the virtual device driver (VDD) is installed, which would be "LON*n*".
%ID%	Expands to the remote identifier. This is expressed as either a quoted ASCII string, or as a series of hexadecimal numbers if the identifier contains non-ASCII data.

%RESULT%	Expands to an unquoted word that represents the success or fail reason of the connection.

The startup application will be launched when a dial-in occurs for this link, or optionally, when a manual connection is made to the link. It will **not** start up if the link is connected to due to an “auto-connect” case.

Enabling a Callback

If a remote SLTA-10 adapter has callback enabled then it will expect a callback command whenever someone dials in to it. Check the Enable box if you need to enable the callback feature.

The callback command includes a directory index that points to a phone number stored in the remote SLTA-10 adapter. If callback is enabled then one of the remote directory numbers (“Address 1” though “Address 5”) can be selected to be used to call the host back.

See *Characteristics of a Well-Designed System* below for a description of how to successfully implement callback.

Configuration

Use the following screen to configure your SLTA-10 Adapter.

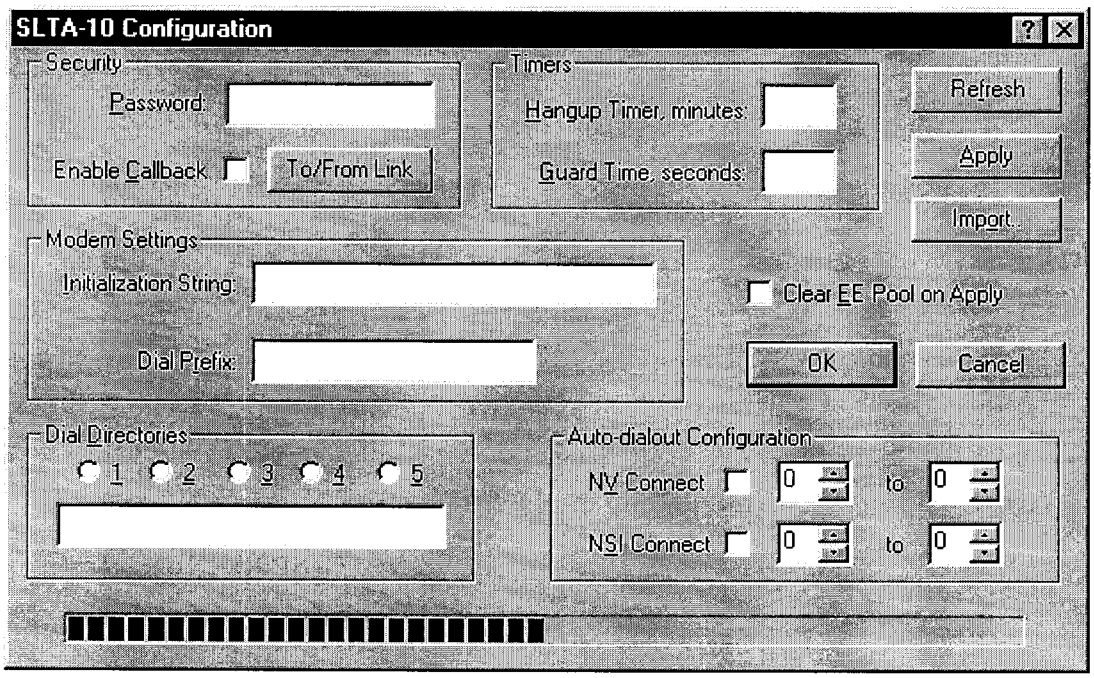


Figure 7.9 Configuration Screen

Security

Password

The SLTA Adapter may be configured to accept incoming calls and connect the network to the host. Incoming callers may be required to provide a password before the SLTA adapter will connect them to the network.

Enable Callback

Check this box if you need to enable callback.

If a remote SLTA has callback enabled then it will expect a callback command whenever someone dials in to it. The callback command includes a directory index that points to a phone number stored in the remote SLTA.

Timers

Hangup Timer, minutes

Provides a space to enter a hangup timer value for the SLTA. This must be within the range of 0-255, for 0 (disabled) to 255 minutes.

The hangup timer controls how many minutes of inactivity must pass before the SLTA hangs up (disconnects the modem).

Guard Time, seconds

Provides a space to enter a guard time value for the SLTA, in seconds. This must be within the range of 0-255.

The guard timer controls how long to wait before attempting to dial the next number for the auto-connect case.

Modem Settings

Initialization String

Provides a space to enter a modem initialization /configuration string for the SLTA. This string is sent to the modem whenever the SLTA is reset and it is not currently connected. Special characters may be embedded in the string:

!	Causes a carriage return to be sent.
~	Causes a 500ms pause.

The carriage return is not required at the end of the string.

Dial Prefix

Provides a space to enter a modem dial prefix for the SLTA. This controls the characters sent to the modem before the actual phone number is sent. The default is "ATDT" for tone dialing.

!	Causes a carriage return to be sent.

~	Causes a 500ms pause.

The carriage return is not required at the end of the string.

Clear EE Pool on Apply

Check this box to clear the SLTA's EEPROM pool before applying the configuration. This will force the clearing and re-programming of the strings that use the EEPROM pool: The Modem Initialization and Dial Prefix strings, and the Dial Directories. If not checked then only the SLTA's strings that have been changed will be updated.

Use this feature if you are increasing the size of one string and decreasing the size of another in one step.

Dial Directories

Provides a space to enter the dialout directory numbers, as strings. To chose which directory entry to edit, simply select one of the buttons above.

!	Causes a carriage return to be sent.

~	Causes a 500ms pause.

The carriage return is not required at the end of the string.

Auto-dialout Configuration

NV Connect

Check this box to enable the Network Variable update auto-connect feature. When enabled, the SLTA will attempt to connect to a remote host whenever the SLTA is not connected and a non-broadcast host-bound NV update message is pending.

The SLTA starts with the directory number first specified on the right. If this attempt fails then the next directory number is used, until the last directory number has been used. To use a single number simply specify the same directory number in both fields.

NSI Connect

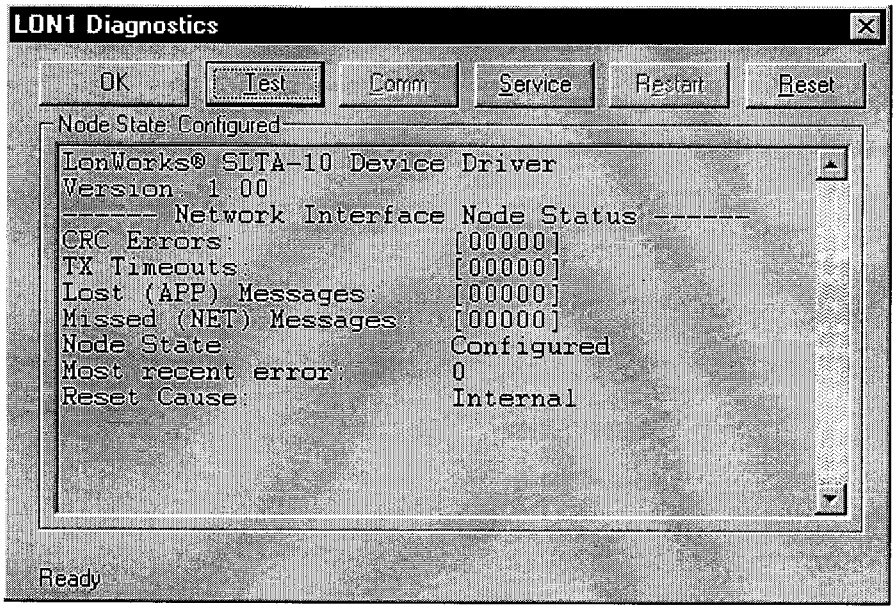
Check this box to enable the Network Services (NSI) auto-connect feature. When enabled, the SLTA will attempt to connect to a remote host whenever the SLTA is not connected and a host-bound NSI message is pending.

The SLTA starts with the directory number first specified on the right. If this attempt fails then the next directory number is used, until the last directory number has been used. To use a single number simply specify the same directory number in both fields.

Diagnostics

A number of Diagnostic and testing services are provided via the Diagnostic Screen, accessed through the Devices menu (see figure 7.10). The Test button retrieves status and error counts from the SLTA-10 Adapter. The Service button will cause the SLTA-10 Adapter to broadcast a service pin message on the network. The reset button causes a reset of the Neuron Chip in the SLTA-10 Adapter, but does not clear the Neuron Chip's system image.

Some buttons are left for future releases of additional features.



```
LonWorks® SLTA-10 Device Driver
Version: 1.00
------ Network Interface Node Status ------
CRC Errors:                 [00000]
TX Timeouts:                [00000]
Lost (APP) Messages:        [00000]
Missed (NET) Messages:      [00000]
Node State:                 Configured
Most recent error:          0
Reset Cause:                Internal
```

Figure 7.10 Diagnostic Screen

The SLTALink Manager Programmatic Interface

`SLTALINK.EXE` executes as a single process. If you try and run another copy of it, it will defer itself to the original process. However, command line arguments may be passed in this manner which will direct the existing process to perform certain types of tasks. These command line options are:

"Linkname" A link name is required for all actions. If the link name alone is passed then that link will be connected to. It must be enclosed in double quotes, since the link name can have embedded spaces.

```
C:\lonworks\bin\sltalink.exe "Remote"
```

/D	This causes the specified link to be disconnected. `C:\lonworks\bin\sltalink.exe "Remote" /D`
/# "number"	This overrides the phone number for the link. If you have checked the "Use Country Code and Area Code" option for this link then the number must be in the 'canonical' format without a '+' sign and enclosed in double quotes. A canonical number is defined as a country code followed by a space, followed by an area code or city code enclosed in parenthesis, followed by a space and the rest of the phone number. TAPI will take this and decide how to translate it before performs the dial-out, based on your dialing preferences. Even if the call is local you should include the area code / city code. This is the same format as the number that appears in the link selection dialog under the Port/Number column. Example: "1 (800) 555-1213" If you have **not** checked the "Use Country Code and Area Code" option then the number will be used un-translated for dial-out. In this case you probably won't specify a canonical number. `C:\lonworks\bin\sltalink.exe "Remote" /# "1 (650) 555 1213"`
/P "passwd"	This overrides the password for the link. It must be enclosed in double quotes. `C:\lonworks\bin\sltalink.exe "Remote" /P "passwd"`

Always include a space between each element of the command line arguments.

Using the DOS "Stub" Driver

The DOS stub driver, which is added as part of the install, allows DOS and Windows 3.1x applications to run on top of the SLTA-10 drivers for Windows 95/98 and NT. The following line is required in the `CONFIG.SYS` or `CONFIG.NT` file that is loaded on startup:

```
DEVICE=%SystemRoot%\system32\PCLTDOS.SYS /Dn
```

This makes the device 'LON*n*' available for DOS applications.

When LON*n* is opened by an application and the SLTALink Manager has been configured to associate LON*n* with a particular link, the SLTALink Manager will auto-connect to the SLTA-10 Adapter locally or remotely. That is, the SLTALink Manager automatically dials-in to the network defined by the link if required.

Characteristics of a Well-Designed System

Well understood strategies used with the SLTA-10 Adapter and the SLTALink Manager for the following system functions are essential for reliable system design: Call Initiation, Call Termination, and Monitoring.

Call Initiation

The four scenarios for call initiation are: dial-in to the network only, dial-out to the remote PC only, dial-in / dial-out, and callback.

Dial-In to the Network Only

In the most straight-forward case, a user launches an application. The application opens the driver, which is associated with a particular link. The SLTALink Manager application dials the phone number in the link (or the phone number the application passes down to the SLTALink Manager perhaps to a generic link) and establishes the connection. Similarly, the user could select the link from within the SLTALink Manager and cause a manual connection. At this point, either the SLTALink Manager would launch the pre-determined application from the information stored in the link file or the user could manually launch the application. In all of these cases, the user is assumed to initiate the call. The user could be a human operator or another application that initiates a dial-in based on a clock, for example.

For the dial-in only scenario, the system strategy issues primarily have to do with associating the link or phone number with the application. Where there are only one or two links, this is very easy. When one PC host can be connected to many different networks, we offer two standard solutions. The first is to have the user navigate the SLTALink Manager's GUI. Under the Link menu, the Select item lists approximately 40 links (of the 1000 possible). The second solution is a monitoring application that programmatically interacts with the SLTALink Manager to send down the appropriate phone number, perhaps to a generic out-going link.

Dial-Out to the Remote PC Only

The three common approaches for initiating a dial-out are: sending a network variable update to the SLTA-10 Adapter, sending an AddMyNSI message to the SLTA-10 Adapter, or sending an explicit message from a "Helper/Dialer" node on the network.

In the first case, the remote host application needs to have an explicitly-bound input network variable and the SLTA-10 Adapter's NSI mode EEPROM must be configured correctly. See the configuration section in this chapter or go to Chapter 11 for more information on configuring the SLTA-10's EEPROM. See also *Call Termination* below.

In the second case, the remote host PC is assumed to have the NSS engine and a second NSI on the network (perhaps a service technician with a laptop running a PCC-10 card) is required to send the AddMyNSI message. Also, SLTA-10 Adapter's NSI mode EEPROM must be configured correctly.

In the third case, a custom Neuron Chip application must be written.

All three cases could be used with the same SLTA-10 Adapter.

In the dial-out only case, besides the call initiation, the SLTALink Manager must be able to launch the appropriate application – with the correct database and device driver name. One system solution is to create a separate link for each SLTA-10 Adapter. Each link then stores the Remote Identifier of its SLTA-10 Adapter after the first connection. Upon connection, the appropriate application and command line arguments stored in the link get launched. A second viable approach is to create a generic link that uses the wild card as a Remote Identifier to launch a generic application using command line arguments to specify the appropriate network or database and device driver name. These arguments are available and described above under *Invoking an Application.*

Note: if the device driver information used in the application does not match the device driver name being used by the link, the newly launched application can open a second device driver – which may result in an attempt to dial-in to the network. Since the modem is still presumably in use with the original dial-out call to the host PC, the second call will fail. The result is a system-level failure.

Dial-In / Dial-Out

These scenarios are the combinations and permutations of the above. However, it needs to be pointed out that not all dial-in strategies can co-exist with all dial-out strategies. For example, if the dial-out strategy involves having the SLTALink Manager match the incoming call to the wild card Remote Identifier and if the dial-in strategy requires a separate link for each SLTA-10 Remote Identifier, then it is possible that a call initiated from the network will be received by the SLTALink Manager and will be matched with the link created for the dial-in case. The correct application may not be launched and a system-level failure may occur.

Callback

The SLTA-10 Adapter callback functionality works as follows: A call is initiated from some remote PC to an SLTA-10 Adapter on a network, which must have its NSI mode EEPROM configured to require callback. The SLTA-10 Adapter answers; the remote PC identifies to the SLTA-10 Adapter one of the SLTA-10 Adapters directory entries to use for the callback. An SLTA-10 configured to require a callback will not accept any other direction from the host at this time. The original call is terminated, and the SLTA-10 Adapter calls the phone number indicated in its directory. Note: this does NOT need to be the phone number of the original remote PC that initiated the call. Typically, the SLTALink Manager on the remote host dialed answers the call and launches the appropriate application.

Several possible system-level failures include:

- The original remote host expects to receive the callback, but the directory index reflects the phone number of another remote host.
- The original remote host application opens an LNS database and initiates the first call. The callback is directed back to the original remote host PC. The

SLTALink Manager on this PC receives the callback just like any other normal dial-out call and launches the application contained in the link. At this point there may be two copies of the application open. Depending on sharing configuration, the second application may fail because appropriate LNS database in already opened.

To prevent these failures, Echelon recommends that the initial call should either be a manual connection from within the SLTALink Manager or the initial call should originate from a "dummy" application that terminates itself without opening the LNS databases.

Call Termination

The four scenarios for call termination include: termination of the host application, application controlled hang-up, a manual disconnect in the SLTALink Manager, and time-out. In all of these cases, the important system-level issues involve making sure that the termination strategy is compatible with the call initiation strategy.

The behavior of an application at termination is not always known. By default, applications based on the Object Server of LNS 1.5 and higher should exhibit two types of behavior. First, if the interface adapter is an SLTA-10 Adapter in NSI modem using modems and there are explicitly bound network variables to the host application, then at the LNS application's termination the host network variables and their connections should not be removed from the LNS database. This behavior facilitates the use of the first case described under *Dial-Out to the Remote PC Only* where a network variable update addressed to the SLTA-10 Adapter's NSI mode results in a call being initiated. Second, if the interface adapter is not an SLTA-10 Adapter in NSI modem using modems or there are no explicitly-bound network variables to the host application, then at the LNS application's termination, any host network variables and their connections are removed from the LNS database and the other nodes in the network. In addition, if the interface does not host the LNS database, upon termination of the LNS application the interface is deconfigured.

The second behavior described would be desirable in the event that multiple remote host PCs needed to be able to dial-in to the same network. As long as no explicitly-bound network variables were left when the host applications terminated, then several remote PCs could share one SLTA-10 Adapter. Note: this assumes that the LNS Server exists somewhere on the network and is not located on one of the remote PCs sharing the single SLTA-10 Adapter.

Both an application controlled hang-up (using the `SLTALINK.EXE` programmatic interface) and a manual disconnect in the SLTALink Manager will terminate the phone call; however, neither results in the termination of the host application. In these scenarios the host application remains running as the call can be re-established by the host application itself, by a manual connect in the SLTALink Manager, or a dial-out initiated on the network. The disadvantage of these system solutions is that they do not scale well to monitoring multiple networks on one PC. The result is many applications continually and concurrently running on the same PC. Also, one possible system failure to avoid is that the SLTALink Manager settings may result in multiple copies of the host applications.

By default, the SLTA-10 NSI mode will terminate a phone call after three minutes with no traffic going across the modems. As with the application-controlled hang-up and the manual disconnect in the SLTALink Manager, this scenario does not result in the application terminating. This scenario therefore carries the same advantages and disadvantages as those described in the previous paragraph.

Monitoring: Application Termination Strategy

There are three strategies for terminating the remote LNS monitoring application.

The first strategy is to require user intervention to shut down or terminate the application. No special software must be written for this case. For the dial-in to a network scenario when the call is user initiated, the user is presumably available to shut down or terminate the application. In the dial-out case, the requirement of user intervention to terminate the application means that every call from a network is seen by an user. If the network is sending alarms, user intervention is highly desirable.

The second approach requires a node on the network to send a network variable update to the host when the network no longer requires the host application to be up and running. When the host application receives this network variable, it should enter a shut-down routine. This approach places the responsibility on the network to determine when the host application is needed and requires a hook in the monitoring application, but provides a level of automation when dial-out is used.

The third approach is the most blunt. In this scenario, the remote host application terminates itself either after completing a series of actions or based on a timer. We do not recommend this scenario for the general scenario, but it has certain appeal for some applications. For example, a connection may be established through dial-in or dial-out based on a timer. The host application could then take a series of measurements from the network, log them to a file, and then terminate itself.

Monitoring: Missing Messages after a Dial-Out

In general, the message that triggers a dial-out from the SLTA-10 on the network to a remote PC host is lost.

When a network variable update is sent to the SLTA-10 Adapter and no phone connection is currently up and running, the SLTA-10 Adapter is typically configured to dial-out to the host. On the remote PC host, the incoming call is answered by the SLTALink Manager application. The SLTALink Manager then reads the Remote Identifier in the SLTA-10 Adapter and searches through all the .s10 files for a match. The SLTALink Manager application then typically launches the application listed in the link with optional command line arguments available, for example, to open the correct LNS database with the correct device name. The process of opening the LNS application results in the buffers of the SLTA-10 Adapter being over-written; thus, the original message is lost. Since this message network variable update is by definition important enough to warrant establishing a connection to the host, a system strategy is required so that this data reaches the host.

The two basic system strategies are: (1) to have the node on the network continue to send out the network variable update until the host application sends a message to the node telling it to stop, or (2) to have the host application seek out the information upon being launched. The first approach places the burden on nodes in the network;

the second approach places the burden on the host application. The first is more direct and is likely to result in the information getting to the host more quickly. The second approach has the primary advantage that no special Neuron Chip application code is required; also, since the call initiation and host application launch may require minutes, the time it takes the host application to poll several network variables is not significant. In the best scenario, upon being launched the host application would first check with a datalogging node on the network that records alarms and also the system state, mode, or health information.

Monitoring: LNS Application Design Issues

A well-designed LNS monitoring application using the SLTA-10 Adapter through modems should use the correct version and layer of LNS, should handle initialization of the application with the correct LNS database and device driver name, and should have a phone call session termination and an application termination strategy.

The remote monitoring application is based on LNS Object Server of LNS 1.5 or higher. Applications based on the LNS 1.0 and LNS 1.01 do not behave well by default and do not allow for certain dial-out scenarios. Applications written at the NSS layer are not supported for use with the SLTA-10 Adapter across a pair of modems.

The remote monitoring application should open the appropriate LNS and device driver. Specifically, the mapping of the Remote ID to the LNS database should be handled by the application. We suggest using the command line arguments with the information available from the SLTALink Manager. Note LNS capacity keys may need to be hard-coded in the monitoring application.

Finally, the LNS application needs to implement a termination strategy that meets the needs of the application and the system.

Good Practices / Schemes that Work

Use these guidelines to avoid the system-level failures detailed above:

- When expecting the SLTA-10 Adapter to dial-out from the network to a remote PC, dedicate one SLTA-10 Adapter to dial-out and always have that SLTA-10 Adapter connect to the same remote PC. Make sure that the NSI EEPROM is configured correctly. See figure 7.11.
- If an LNS-based application is connected to the network through modems, dedicate one SLTA-10 Adapter in the network to handle dial-out and dial-in with this PC that has the LNS server. Make sure that the SLTA-10 adapter's EEPROM is configured correctly. See figure 7.12.
- Several PCs can share one SLTA-10 Adapter as long as the calls are all initiated on the remote PC hosts (i.e., dial-in only) and each remote LNS application removes the bound connections to its host before terminating. See figure 7.13.

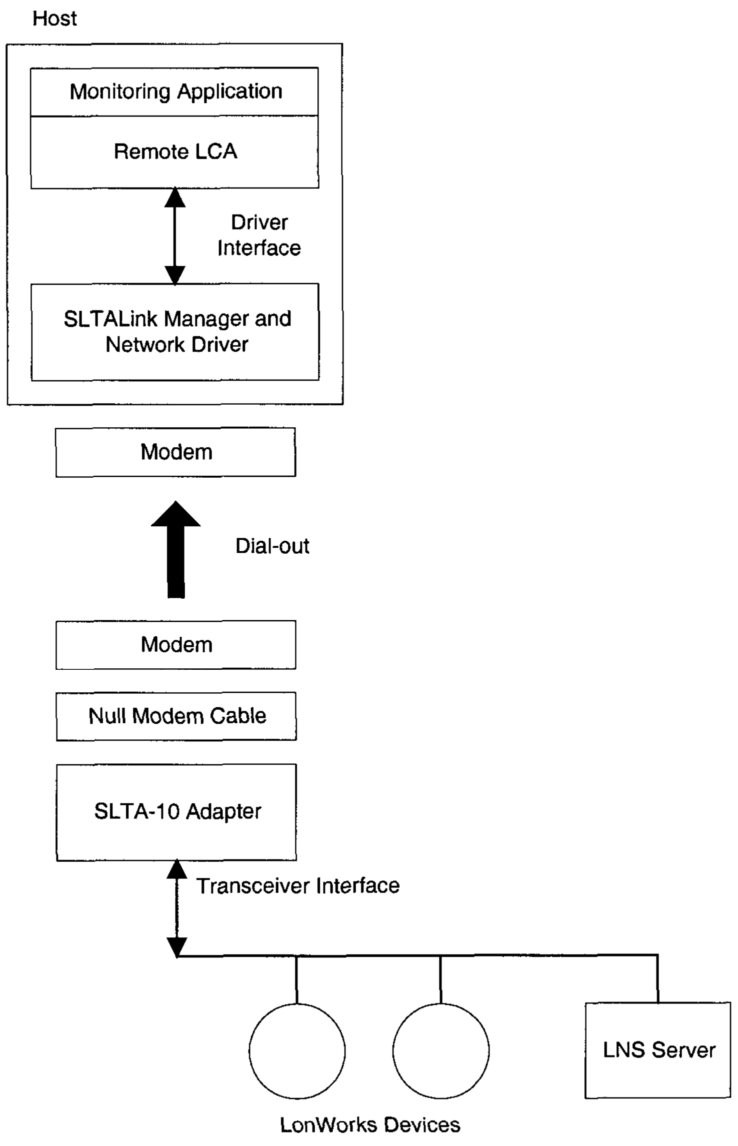


Figure 7.11 Dedicated SLTA-10 Adapter using Dial-out

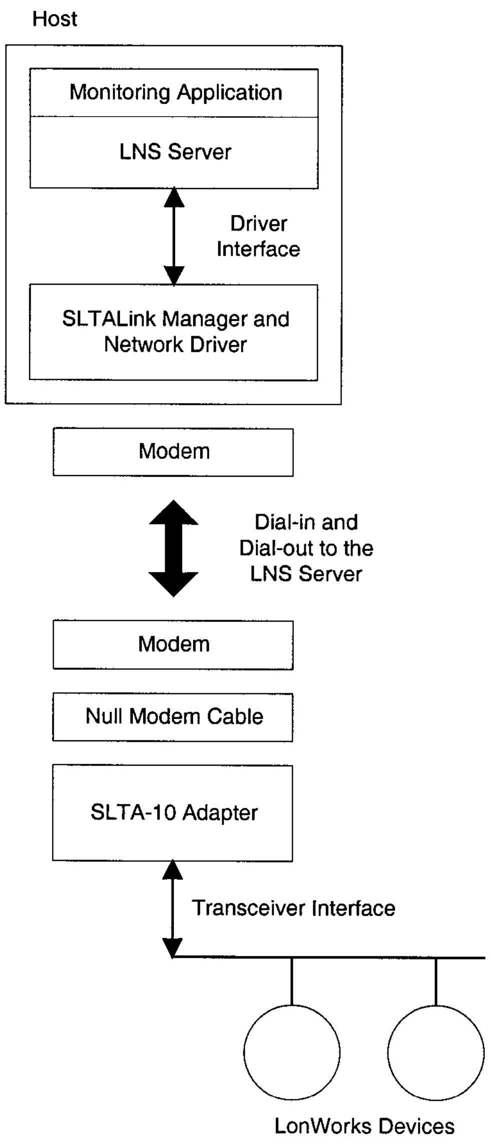


Figure 7.12 Dedicated SLTA-10 Adapter hosting the NSS

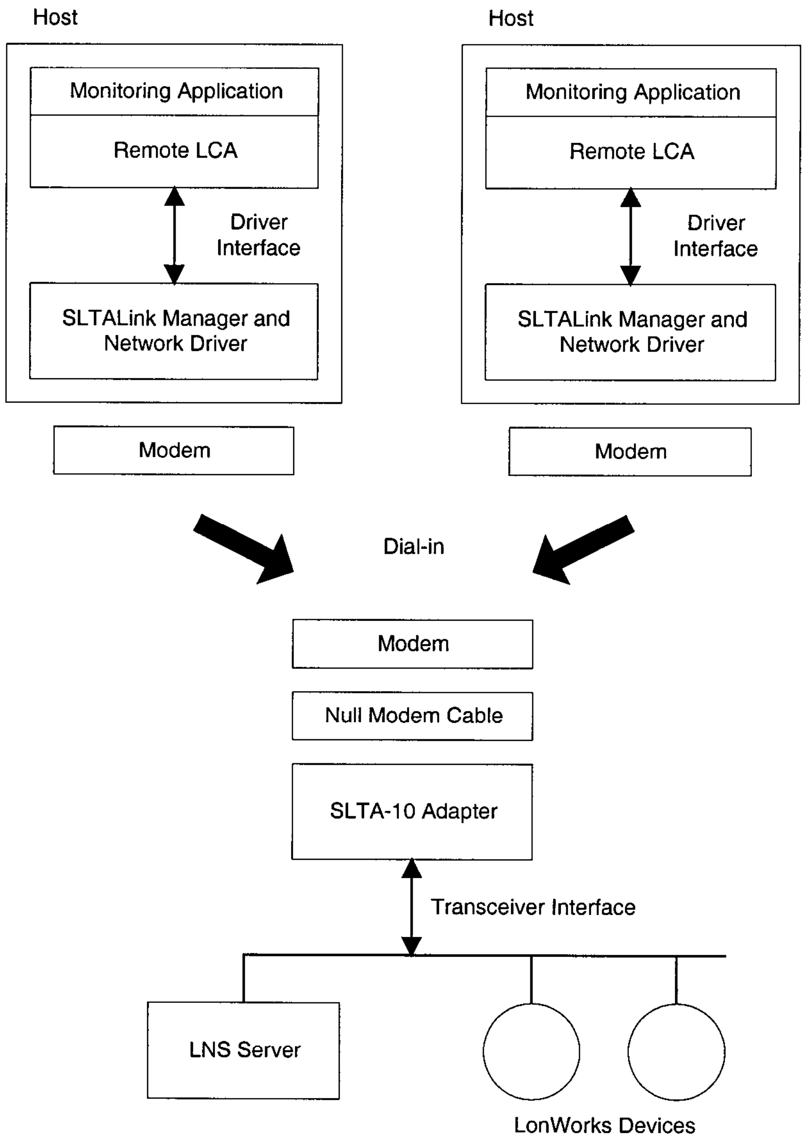


Figure 7.13 Shared SLTA-10 Adapter using Dial-in

8

Using the DOS Driver with SLTA-10 MIP Mode

This chapter describes the DOS network driver supplied with the Connectivity Starter. The driver also is available from the Developer's Toolbox on Echelon's web site at www.echelon.com. The DOS network driver provides a device-independent interface between a DOS or Windows 3.1x host application and the SLTA-10 Adapter in MIP mode. The driver is configurable to use one of four PC/AT serial ports, COM1 through COM4, at one of eight serial bit rates.

Skip this chapter if you are using the SLTA-10 NSI mode.

Installing the SLTA-10 MIP Mode Driver for DOS

The DOS driver is supplied on the floppy diskette included with the Connectivity Starter Kit. The latest version of this driver may be obtained from the Echelon web site.

The SLTA-10 MIP mode network driver for DOS is installed by adding a `DEVICE` command to the DOS `CONFIG.SYS` file. Edit the `CONFIG.SYS` file to include the line:

```
DEVICE=C:\LONWORKS\BIN\LDVSLTA.SYS [options]
```

Substitute your drive and directory name if other than `C:\LONWORKS\BIN`. Reboot the PC after adding this line to load the driver. For example, the following command would be used with a locally attached SLTA-10 Adapter in MIP mode installed on COM2 as device LON1 running at 115,200 bps with autobaud enabled:

```
DEVICE=C:\LONWORKS\BIN\LDVSLTA.SYS /P2 /D1 /B115200
```

Warning! The /A option must be present in the `CONFIG.SYS` entry if the SLTA-10 Adapter AutoBaud Switch5/AB is in the Enabled, UP position, or the SLTA-10 Adapter will not function correctly. The /A option also may be left in the `CONFIG.SYS` entry if the SLTA-10 Adapter Autobaud switch is in the disabled (default), DOWN position.

The available options for the SLTA-10 MIP mode network driver for DOS are described in the following sections.

Buffer Options

`/O`*nn* Sets the number of output (downlink) buffers within the driver to <*nn*>. The buffer sizes within the driver are pre-set to accommodate 255 byte packets. The SLTA-10 Adapter in MIP mode has application output buffers that may be increased to as large as 255 bytes. There must be at least 2 buffers and the maximum allowed number for <*nn*> is limited by the size of the buffer (258) times the total number of input and output buffers within the driver. The entire buffer space plus the driver code itself cannot exceed 64Kbytes. The size of the driver code itself is 9Kbytes. The number of output buffers required is determined by the characteristics of the host application. If the host application always waits for an outgoing message completion before sending another message, then only two buffers are required. If the host application is set up to overlap transactions, more buffers may be required. In this case greater parallelism may be achieved at the expense of host application code complexity.

`/I`*nn* Sets the number of input (uplink) buffers within the driver to <*nn*>. The buffer sizes within the driver are pre-set to accommodate 255 byte packets. The SLTA-10 Adapter has application output buffers may also be increased to as large as 255 bytes. There must be at least 2 buffers and the maximum allowed number for <*nn*> is limited by the size of the buffer (258) times the total number of input and output buffers within the driver. The entire buffer space plus the driver code itself cannot exceed 64Kbytes. The number of input buffers required is determined by the expected incoming traffic and the capability of the host application to process it. If the incoming traffic is bursty, more input buffers are required. If the application cannot process incoming traffic fast enough, the input buffer pool will fill up with unprocessed packets. In that case, the SLTA-10 Adapter will not be able to pass any new data to the host, and the input application buffers in the SLTA-10 Adapter will start to fill up. Once that occurs, messages will be lost, possibly causing incoming LonTalk transactions to be retried, and eventually causing the sender of the message to receive a failure indication.

Serial Bit Rate Options

/B*nnnnnn*

Sets the serial bit rate to <*nnnnnn*>. The available serial bit rates are listed below.

Available serial bit rates are:

1200, 2400, 9600, 14400, 19200, 38400, 57600, 115200.

This rate represents the serial bit rate between the PC and the SLTA-10 Adapter when using a direct serial connection, and between the PC and the modem when using a remote connection. For remote connections, the PC-to-modem serial bit rate, telephone line speed, i.e., modem to modem serial bit rate, and the modem-to-SLTA-10 Adapter serial bit rate may be different. The PC-to-modem serial bit rate is controlled by the network driver on the PC using the /B option; the telephone line speed is selected by the modems based on modem configuration; and the modem-to-SLTA-10 Adapter serial bit rate is controlled by the hardware configuration of the SLTA-10 Adapter as described in Chapter 4 (autobaud cannot be used in this configuration).

For local connections with the SLTA-10 Adapter Autobaud option disabled, the serial bit rate specified by this driver option must match the rate specified by the configuration switches.

/A

If you are using the default hardware configuration (autobaud disabled), the autobaud option (/A) ***does not need to*** *be enabled .*

Enables the autobaud feature. This provides the autobaud sequence whenever the driver is opened. The default setting for the driver is *Autobaud Disabled.* If the Autobaud input on the SLTA-10 Adapter hardware is enabled, then this option must be specified. As described in Chapter 4, the default setting for the AB switch on the SLTA-10 Adapter is disabled, so the /A option does not need to be specified with the default hardware configuration. This option may not be used with the modem support (/M) option.

DOS Device Options

/P*n* Sets the serial port to <*n*> where <*n*> is 1-4 for COM1 - COM4. The default is COM1.

/D*n* Defines the device unit number as <*n*>, where <*n*> is between 1 and 9, so that the DOS device name is "LON1" through "LON9". The default is 1 for "LON1". This option can be used to support multiple network interfaces on a single PC. For example, this device name is passed as a parameter to `lxt_open()` when using the LonManager API. When invoking the sample host application `HA`, the device may be specified with the `-D` option, for example:

```
HA -DLON2
```

/U*n* Sets the serial port interrupt request number (IRQ) to a non-standard value <*n*>, where <*n*> is between 1 and 7. If the serial port in use is COM3 or COM4, you may want to use a unique, unused IRQ for that port. Many serial ports and internal modems allow the selection of a non-standard IRQ such as IRQ2 or IRQ5.

/C Enables communications interrupt chaining. Some PCs may incorporate up to four serial ports. If supported by the serial hardware, COM1 and COM3 may share the same interrupt (as do COM2 and COM4). This option may enable the driver to support the shared interrupt by "chaining" to the interrupt vector that was in place when the driver was loaded. This option is not necessary if your system does not use COM3 or COM4, or if COM3 or COM4 use a different interrupt request number. When installing two SLTA-10 Adapter network drivers on a system on COM1 and COM3 (or COM2 and COM4 with the same interrupt request number), the last installation of the driver should use this option. Here is an example of a `CONFIG.SYS` file entry for such a system.

```
DEVICE=C:\LONWORKS\BIN\LDVSLTA.SYS /B38400 /A /P1
DEVICE=C:\LONWORKS\BIN\LDVSLTA.SYS /B38400 /A /P3 /C
```

Table 8.1 Hardware Configurations COM Ports

Device	I/O Address	Interrupt (*)
COM1	0x3F8	4
COM2	0x2F8	3
COM3	0x3E8	4
COM4	0x2E8	3

(*) May be changed with the `/U` option

Timing Options

/R*nn*	Defines the flush/retry count in 55ms intervals. This value is used in error states for re-transmitting requests and for terminating receive flushes when input errors occur. Normally, this option should not be specified.
/W*nnn*	Includes a delay of <*nnn*> microseconds when transmitting downlink. This parameter can be used to pace the rate at which bytes are transmitted downlink to the SLTA-10 Adapter, and may be required for high-performance network management tools. The delay is executed following the transfer of each data byte to the host's UART, and only after the first 15 bytes have been sent. Since the SLTA-10 Adapter employs a 16-byte deep FIFO buffer in its UART, the first group of bytes sent do not need to be paced. The pacing delay will have no effect unless it is greater than the actual period it takes to transmit a single byte at the given serial bit rate. The time taken to transmit a byte is 173 μs at 57,600 bps, and 86 μs at 115,200 bps. This option should be used at 115,200 bps if messages greater than 16 bytes are to be transmitted. A value of `/W120` is suggested. This option is not required at the serial bit rate of 38,400bps or slower.
/Z	By default, the SLTA-10 MIP mode firmware disables network communications after a reset by entering a `FLUSH` state. This state causes the SLTA-10 Adapter to ignore all incoming messages and prevents all outgoing messages, even service pin messages. The SLTA-10 MIP mode network driver for DOS automatically enables network communications when the SLTA-10 Adapter is opened and when it receives an uplink message from the SLTA-10 Adapter indicating that it has been reset. However, the host application itself must explicitly enable network communications if the `/Z` option is specified and the Switch3/CFG1 input is set to *Network Disable* (UP position). See Chapter 4 for more information.
	Host applications which need to configure the SLTA-10 Adapter prior to enabling network communications should use this option. This option should not be used with the LonManager API, LonManager LonMaker Installation Tool, or the LonManager DDE Server. More information about the `niFLUSH_CANCEL` message is provided in the *LONWORKS Host Application Programmer's Guide.*

Network Interface Protocol Options

/F	Enables the full interrupt mode of the driver. If this option is <u>not</u> specified, the driver will disable interrupts for the duration of each link-layer transfer. This ensures that no data will be lost due to other system interrupts, and is acceptable at high serial bit rates. The driver will use interrupts for the first byte of each uplink interface buffer. When the uplink interrupt is received, the driver reads the rest of the message without interrupts via polled I/O. Interrupts are disabled during the uplink transfer. This assures that no other system interrupts will occur resulting in lost uplink data frames. Downlink transmissions are sent directly via polled I/O of the serial

	port from the write function call. The host write functions will not return until the message has been sent downlink. When using the ALERT/ACK link protocol, interrupt latency is not a problem, since the SLTA-to-host protocol includes an acknowledgment of the start of the message. The driver employs timeouts in order to prevent lockout of the write function, and timeouts for clearing various states of the transmitter/receiver when line errors occur.
	When operating at lower serial bit rates, it becomes less desirable to disable interrupts for long periods. The trade-off with using the full interrupt mode is that other system interrupts may cause loss of data in the serial port's UART. If the `/F` option is specified, the driver uses interrupts for every uplink and downlink byte transferred. Downlink messages are buffered from the device write function and are sent downlink under interrupt control. Uplink messages are received under interrupt control and are buffered also. This option should be used for serial bit rates of 9,600 bps or slower.
/M	Enables modem support and the reliable transport protocol. This option must be specified if the host is to communicate with the SLTA-10 Adapter via a modem connection. The SLTA-10 Adapter must be configured with Switch2/CFG2 input in the *Remote Host* setting (UP position). When connected, the selected SLTA-10 Adapter and Host network interface link protocol is in effect. When disconnected the only allowable link layer traffic is of the 'modem direct' type, where ASCII strings are being exchanged between the host and the modem, for example, AT commands to dial out. Any other network interface traffic is not allowed when disconnected from the SLTA-10 Adapter. Calls to the read function will result in no network interface data messages (`LDV_NO_MSG_AVAIL`), and any call to a write function that needs to communicate with the SLTA-10 Adapter via the modems will result in a No Output Buffers Available error (`LDV_NO_BUFF_AVAIL`). Once the connection is made, normal network interface traffic may resume.
	This option also enables the reliable transport protocol. This protocol includes the addition of a message sequence number and the end of message ACK/NACK code. See Chapter 4 for a description of this protocol.
/N	Disables the ALERT/ACK network interface link protocol, and enables the buffered network interface link protocol. Network interface messages are sent without waiting for the ALERT ACK response. Both sides of the interface (the SLTA-10 Adapter and the driver) must have the same setting. This option should not be used with the */M* option.
/Q	Allows modem responses to be sent uplink to the host. When the telephone link is disconnected, these messages are ASCII strings with the network interface command type `niDRIVER` (0xF0). If `/Q` is specified, the host application must be able to handle messages, such as `NO CARRIER`, that might come from the modem itself if problems occur in the connection.

/x Disables the buffer request protocol. When this option is enabled, the driver requests the buffer count from the SLTA-10 Adapter using the `niSBUFC (0xE7)` command whenever the interface is opened, or when the interface is reset, and reports an niRESET to the host. The driver keeps track of the number of available output buffers in the SLTA-10 Adapter by examining both uplink and downlink messages. This option prevents the use of one message type: A local network management command not using a request/response service. Normally this type of message is not used. One exception could be the `Set Node Mode: Reset` command, which would result in the node resetting and the buffer management recovering on its own anyway. Otherwise, if this type of message is used, no uplink response would occur and the driver could not track the fact that a new output buffer has been made available.

Table 8.2 Configuration Switches and DOS Driver Options

Input	***Input State***	***Driver Option***
Switch2/CFG 2	Local Host; No Transport Protocol	`/M` not specified
Switch2/CFG 2	Remote Host; Reliable Transport Protocol	`/M` specified
Switch1/CFG 3	ALERT/ACK Link Protocol	`/N` not specified
Switch1/CFG 3	Buffered Link Protocol	`/N` specified

Calling the Network Driver from a Host Application

The SLTA-10 MIP mode network driver for DOS supports the `open`, `close`, `read`, `write`, and `ioctl` DOS calls. See Chapter 4 of the *Host Application Programmer's Guide* for more details.

When the SLTA-10 MIP mode network driver for DOS is loaded during execution of the `CONFIG.SYS` file, it does not attempt to communicate with the SLTA-10 Adapter.

When the network driver is opened with the DOS `open` call, it establishes communications with the SLTA-10 Adapter. The network driver returns an error if this fails, for example, if the SLTA-10 Adapter is disconnected, powered down, or configured incorrectly. If the open call succeeds, the driver enables network communications by clearing the SLTA-10 Adapter `FLUSH` state, if configured to do so.

The DOS `read` call is defined to return the number of bytes read from the device. Some LONWORKS standard network drivers return 0 if there are no uplink messages available. DOS reports this as an end-of-file condition and prevents further reads from succeeding. However, the SLTA-10 Adapter driver returns a length of 2, and sets the first byte of the caller's buffer (the cmd/queue byte) to 0 to indicate that there is no uplink message available.

Normally, the DOS `read` and `write` calls are not used with LONWORKS standard network drivers. This is because any error from the network interface will display the familiar `Abort, Retry, Fail?` error message from DOS, unless the caller has installed a critical error device handler. Therefore, DOS applications using a network device typically call direct entry points into the driver. This also allows more detailed error status to be returned to the application. The addresses of these entry points are obtained by calling the `ioctl()` function of the driver.

This function call is used as follows:

```
int ioctl(int handle, int func, void far *argdx, int argcx);
```

- `handle` is an integer returned by an earlier successful call to `open()`, specifying the LONWORKS network driver `LONn` to be opened.
- `func` is the value 2, meaning that the application is reading information from the driver. For LONWORKS standard DOS network drivers, the information returned is the network interface direct call structure.
- `argdx` is a pointer to a caller-declared structure that will contain the direct entry points into the driver. See the structure `direct_calls` in the file `NI_MSG.C` in the supplied example host application for usage.
- `argcx` is the size of the structure.

Function code 2 is supported by network drivers for DOS to return three direct entry points into the driver code. The network driver for the SLTA-10 Adapter supports an additional option to function code 2, as well as function code 3, which is used to manage the modem control state of the driver. These options are not used when the SLTA-10 Adapter is connected directly to a host. They are provided primarily for use while establishing communications with a remote host. For example, the host connect utility (HCU) described in Chapter 12 of this manual uses these functions.

Host applications that only communicate to the SLTA-10 Adapter via an already-established telephone connection do not need to concern themselves with these functions. If you wish to establish or take down telephone connections during the execution of your host application, use the source code of HCU as a guide.

When function code 2 is used, `argdx` points to the `direct_calls` structure defined for all LONWORKS standard network drivers for DOS. If `argcx` is 13, the size of the standard direct calls structure, then three direct entry point addresses are returned as usual. If `argcx` is 4 (the size of the structure `ioctl_get_dcd_s`), then the state of the modem's DCD line is returned as a `TRUE` or `FALSE` value. Note that the status field is 16 bits in this structure, but 8 bits in the direct calls structure.

```
struct ioctl_get_dcd_s {
      unsigned ioctl_stat;  // 16 bit status
      unsigned dcd_state;   // Data Carrier Detect (TRUE or FALSE)
}
```

Function code 3 is used when the application wishes to write information to the driver. For the SLTA-10 Adapter driver, `argdx` points to the following structure, and `argcx` is its size:

```
struct ioctl_o_info_s {
    unsigned  ioctl_stat;     // 16 bit status
    unsigned  sub_command;    // use enum sub_command
    unsigned  mode;
    unsigned  mode_aux;
}
enum sub_command {
    SUBC_set_opt    = 1,      // set driver options
    SUBC_set_DTR    = 2,      // set DTR line
    SUBC_set_baud   = 3,      // set serial bit rate
};
```

There are three sub-commands, used to set the various modes of the driver, the state of the DTR (Data Terminal Ready) line to the modem, and serial bit rate of the serial interface.

When sub-command 1 is used, the `mode` field in the structure is a bit mask defining which of the driver modes is to be changed, and the `mode_aux` field specifies bits defining the new states of those modes. It is possible to set more than one of the modes by OR'ing the following bit-masks together:

0x0001	Enables modem support.
0x0002	Allows modem responses to host - same as the `/Q` option.
0x0004	Forces direct modem mode. In this mode, the network driver is communicating directly with the modem.
0x0010	Enables the buffered link protocol and disables the ALERT/ACK link protocol - same as the `/N` option.
0x0020	Enables the reliable transport protocol.

The `/M` option corresponds to 0x0021.

Sub-command 2 is used to set the state of the DTR line. In this case, the DTR signal is enabled (on) if the `mode` field is true.

Sub-command 3 is used to set the serial bit rate of the serial interface. The `mode` field determines the new bit rate as follows: 0:14,400; 1:1,200; 2:2,400; 3:9,600; 4:19,200; 5:38,400; 6:57,600; 7:115,200.

Using the SLTA-10 MIP Mode under Microsoft Windows 3.1x

In order to use the SLTA-10 MIP mode network driver for DOS under Microsoft Windows 3.1x, an interface based on the DOS Protected Mode Interface (DPMI) must be provided. This type of interface, in the form of Windows DLL software, is supplied with the Connectivity Starter Kit, as well as with the LonManager API for Windows and LonManager DDE Server. The interface software is called WLDV.DLL. See Appendix A for information on using the Windows 3.1x DLL directly.

9

Creating an SLTA-10 MIP Mode Driver

This chapter describes the process of building a network driver for a host that is to be connected to an SLTA-10 Adapter in MIP mode. This chapter also includes a description of the network interface protocol for the SLTA-10 MIP mode. The network interface protocol defines the format of the data passed across the EIA-232 interface, and varies depending on the configuration of the SLTA-10 Adapter and the network driver. If a LONWORKS standard network driver is used, the format of the data passed between the driver and the application is defined by the network driver protocol and is independent of the network interface protocol; the driver is responsible for providing the necessary translations. This chapter will therefore be of interest only to those needing to develop a network driver for a host other than DOS, Windows, or UNIX.

Skip this Chapter if you are using the SLTA-10 NSI mode.

Purpose of the Network Driver

The network driver provides a hardware-independent interface between the host application and the network interface. By using network drivers with consistent calling conventions, host applications can be transparently moved between different network interfaces. For example, the standard SLTA-10 MIP mode DOS network driver, together with the Windows 3.1x DLL software, allows DOS and Windows 3.1x applications, such as those based on the LonManager API, to be debugged using the network driver for the LonBuilder Development Station. These applications can later be used with the network driver for the SLTA-10 Adapter, without modifying the host application.

A LONWORKS standard network driver must supply the functions defined under *Network Driver Services* in Chapter 4 of the *LONWORKS Host Application Programmer's Guide*. The Windows 3.1x DLL software is described in Appendix A.

Example Network Drivers

The Connectivity Starter Kit includes source code for an example DOS network driver; the Echelon web site contains source code for an example UNIX network driver. The DOS driver is used for both DOS and Windows 3.1x applications. See the comments in the source code of the network drivers for an explanation of how the network drivers work. These drivers can be used as templates for a LONWORKS standard network driver. The DOS network driver is compatible with the LonManager APIs for DOS and Windows, the LonManager LonMaker installation tool, and the LonManager DDE Server. A sample host application for DOS is also supplied. The functions `ldv_open()`, `ldv_read()`, `ldv_write()`, and `ldv_close()` form a suitable operating-system independent definition for the network driver. These functions support multiple network interfaces, and hide the DOS-specific aspects of the DOS network driver.

The UNIX network driver is a source library that uses the UNIX serial device driver. It also supports the `ldv_open()`, `ldv_read()`, `ldv_write()`, and `ldv_close()` functions.

Implementing an SLTA-10 MIP Mode Network Driver

The network driver manages the physical interface with the SLTA-10 Adapter, implements the network interface protocol, performs flow control, manages input and output buffers, and provides a read/write interface to the host application.

Figure 9.1 illustrates how the network driver fits into the host application architecture.

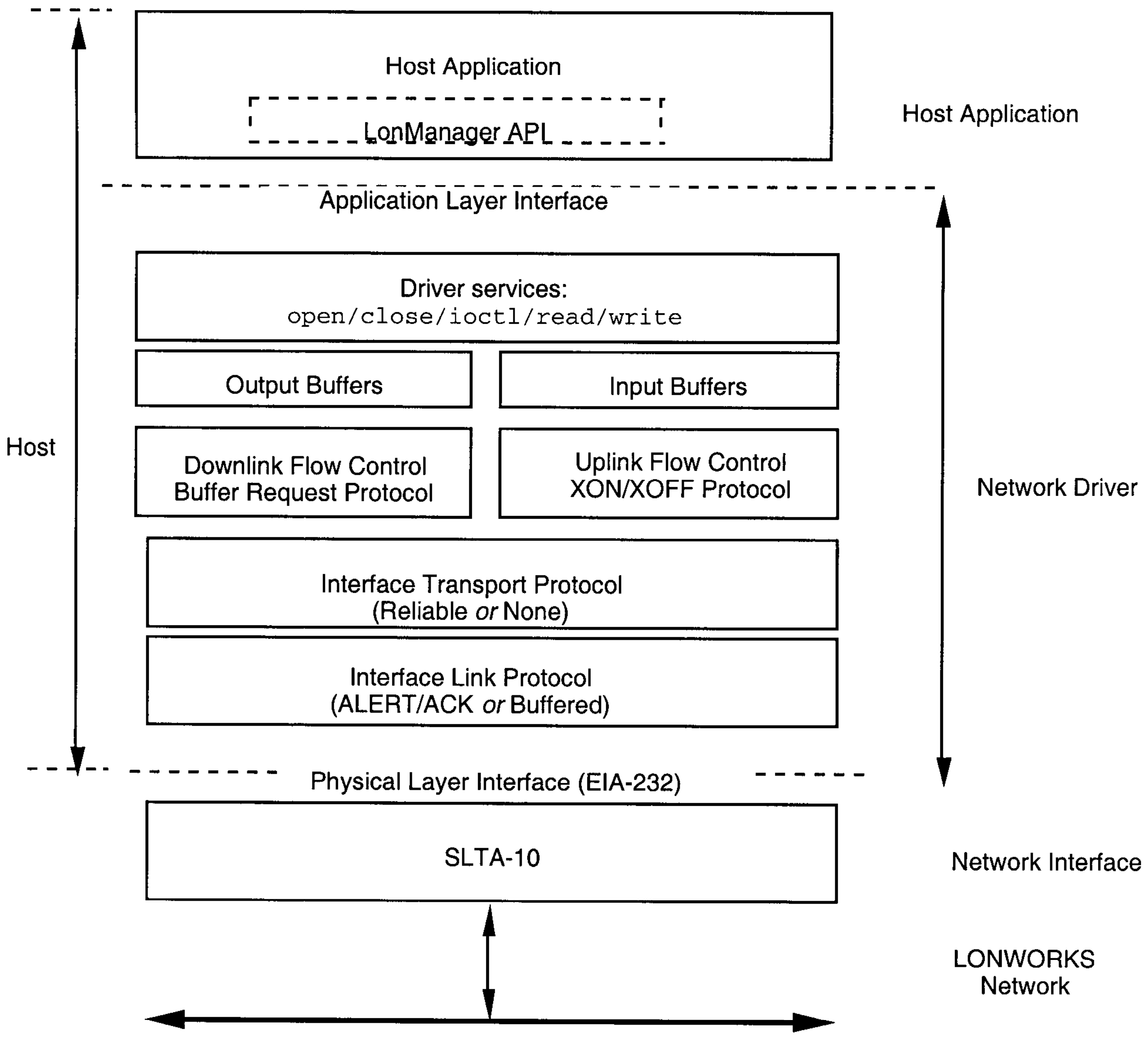


Figure 9.1 Host Application Architecture

To implement an SLTA-10 MIP mode network driver for a host other than DOS, Windows, or UNIX, follow these steps:

1 Implement and test low-level serial I/O. Serial I/O may be performed directly to the host's UART as is done in the DOS network driver, or may be performed by a serial I/O driver on the host as is done by the UNIX network driver. Serial I/O should be interrupt driven for better performance.

The UNIX network driver uses the UNIX serial port driver for all low-level serial I/O and interrupt support. This simplifies the driver and also simplifies porting between different versions of UNIX. The serial device is opened by the `ldv_open()` function and closed by the `ldv_close()` function. Data are read from and written to the serial device using the UNIX `read()` and `write()` system calls.

The UNIX network driver includes a `ldv_post_events()` function that should be called periodically from the client application in order to assure that the SLTA-10 Adapter traffic is being processed.

The DOS network driver serial I/O functions are implemented by `MSD_SIO.C`, `MSD_UART.H`, and `MSD_IRQC.ASM`. These files may all be replaced as long as the required serial I/O functions in `MSD_SIO.C` are provided. The definitions of the UART registers are in `MSD_UART.H`. The DOS serial I/O interrupt service routines are in `MSD_IRQC.ASM`.

The DOS network driver uses the DOS system timer tick interrupt (vector 0x1C) and the serial I/O device interrupt for the relevant COM port to perform background processing of the serial network interface. The driver hooks into these interrupt vectors and executes driver code whenever the LON(n) device is opened. Flags internal to the driver prevent the interrupt code thread from interfering with the normal application foreground execution of functions within the driver.

The `smip_int_main()` function in the DOS network driver services the serial port connected to the network interface. The function `tick_int_main()` services the timer tick interrupt every 55 msec.

Both network drivers are fully buffered for both outgoing and incoming messaging. Read and write functions work with circular buffers within the driver. The host interrupt service routine handles the other ends of these buffer queues.

Both network drivers only support a single set of output buffers. An elaboration on this design could implement a set of priority output buffers. The write function could determine into which of the two buffer sets to place messages, and the driver service function could service the priority buffers first.

2 Implement and test timer support functions. Timer support may be provided by a hardware timer as is done in the DOS network driver, by a system service as is done in the UNIX network driver, or by implementing a background software task. The UNIX network driver uses a once per second signal that is handled by the `second_service()` function. The DOS timer functions are implemented by `MDV_TIME.C` and `MDV_TIME.H`.

3 Implement and test the host side of the network interface protocol. The network interface protocol is implemented by the `rx_process()` and `tx_process()` functions in the UNIX driver, and by the functions in `MSD_TXRX.C` for the DOS network driver.

4 Implement and test raw modem I/O if you need to support a modem interface. Raw I/O manages the serial interface to the modem when the modem is not connected to a host and is used for modem initialization and control. The raw I/O interface is implemented in `MSD_RAW.C` for the DOS network driver, and is not implemented in the UNIX network driver.

5 Implement and test the buffer request states, buffer management, and read/write interfaces. These functions are implemented by `MSD_EXEC.C` for the DOS network driver. The read/write interface is implemented in the `ldv_read()` and `ldv_write()` functions for the UNIX network driver

The following files are unique to a DOS driver and would probably not be used in a port to another host: `MSD_DRVR.H`, `MSD_DIFC.C`, `MSD_FRST.C`, `MSD_LAST.C`, `MSD_SEGD.ASM`.

Network Interface Protocol

The network driver implements the host side of the network interface protocol, providing an easy-to-use and interface-independent read/write interface to the host application. The network interface protocol is a layered protocol that includes the following layers:

- **Presentation Layer**. Defines packet formats for network variables and explicit messages. This is the only layer visible to the host application. The remaining layers are managed by the network driver.
- **Session Layer**. Manages flow control, buffer requests, and grants.
- **Transport Layer**. Ensures end-to-end reliability between the host and the SLTA-10 Adapter.
- **Link Layer**. Controls access to the serial link.
- **Physical Layer**. EIA-232 interface.

The physical layer is defined by the EIA RS-232 standard. The link, transport, session, and presentation layers are described in the following sections.

Link Layer Protocol

The default interface link layer protocol is the *ALERT/ACK protocol*. This protocol may be used when the host is a microcontroller or microprocessor such as a PC running DOS or Windows. The alternative interface link protocol is the *buffered protocol*. This protocol is used with computer hosts that can asynchronously buffer an entire packet. All data are transmitted using 1 start bit, 8 data bits, no parity bits, and 1 stop bit.

ALERT/ACK Link Protocol

The DOS network driver uses the ALERT/ACK link protocol by default (i.e. the `/N` option is not specified). See Chapter 8 for a description of the network driver options. The UNIX network driver uses the ALERT/ACK link protocol if the `alert_ack_prtcl` variable is set to `TRUE` in the source code (this is not the default). The Switch1/CFG3 input of the SLTA-10 Adapter, as described in Chapter 4, must be in the *ALERT/ACK* state (DOWN position).

When using this protocol, all transfers between the SLTA-10 Adapter and the host consist of serial data streams that start off with the link-layer header sequence described in figure 9.2. Whenever one device, either the SLTA-10 Adapter or the host, needs to send a command or message, the sender starts the sequence by transmitting the ALERT byte (value 01 hex). When this byte is received by the receiver, that device responds by transmitting the ALERT ACK byte (value FE hex). This low level handshaking process prevents the sender from transmitting the rest of the sequence before the receiving device is ready. Once the ALERT ACK byte is received by the sender it sends the rest of the message without any other interactions.

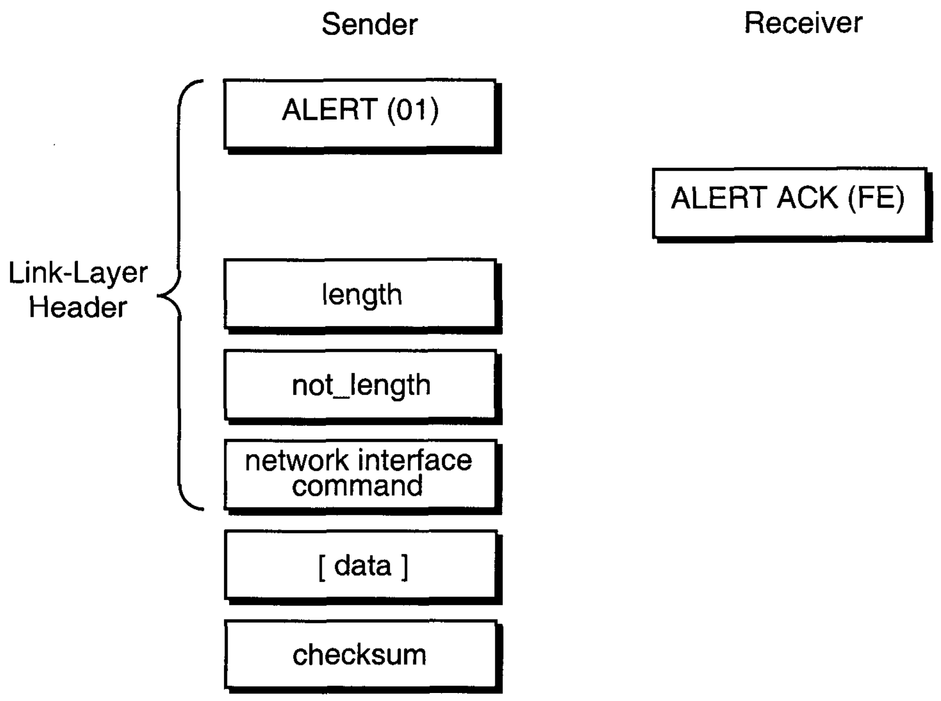


Figure 9.2 SLTA-10 Adapter ALERT/ACK Link Protocol

The link-layer header contains a length byte followed by a one's complement of the length byte. These values are always validated by the receiver before accepting the rest of the message. Following the length bytes is the network interface command. See Appendix D of the *Host Application Programmer's Guide* for a description of the command byte structure. If the message contains a data field it follows the command byte. Finally, a checksum terminates the sequence.

The length byte value describes the length of the network interface command byte plus the length of the data field. This value will always be at least 1. The checksum is a two's complement of the sum of the command byte and all of the bytes in the data field, if it exists. Checksum errors detected by the host will cause an error to be reported to the application, and checksum errors detected by the SLTA-10 Adapter will cause the message to be ignored.

The SLTA-10 Adapter places the following requirements on the rate of the received serial data stream. When receiving, the maximum wait period for the length byte following the transmission of the ALERT ACK byte is 100ms (or 1 second when attached to a modem). All subsequent bytes received must occur within 100ms after the previous byte, otherwise the SLTA-10 Adapter receive process will abort. Likewise, the SLTA-10 Adapter uses a wait period of 100ms (or 1 second when attached to a modem) before aborting for the reception of the ALERT ACK when transmitting a message. If the ALERT ACK is not received in time, the SLTA-10 Adapter repeats the process by transmitting another ALERT byte.

The SLTA-10 Adapter cannot support a full duplex communications process between it and the host. The network driver included with the SLTA-10 Adapter takes this into account. Data frames transmitted to the SLTA-10 Adapter while it is in the process of sending uplink messages will be lost if more than 16 bytes are sent to the SLTA-10 Adapter.

Buffered Link Protocol

The DOS network driver uses the buffered link protocol when the `/N` option is specified. See Chapter 8 for a description of this option. The UNIX network driver uses the buffered link protocol if the `alert_ack_prtcl` variable is set to `FALSE` in the source code (this is the default). The Switchl/CFG3 input of the SLTA-10 Adapter, as described in Chapter 4, must be in the buffered protocol state (UP position).

When using this protocol, the link-layer header contains a length byte followed by a one's complement of the length byte. These values are always validated by the receiver before accepting the rest of the message. Following the length bytes is the network interface command. See Appendix D of the *Host Application Programmer's Guide* for a description of the command byte structure. If the message contains a data field it follows the command byte. Finally, a checksum terminates the sequence.

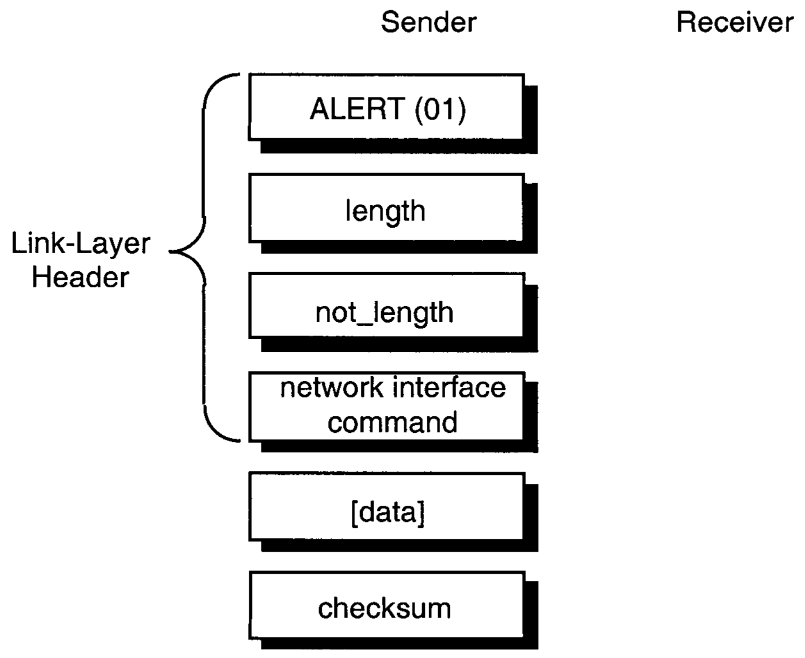


Figure 9.3 SLTA-10 Adapter Buffered Link Protocol

The length byte value describes the length of the network interface command byte plus the length of the data field. This value will always be at least 1. The checksum is a two's complement of the sum of the command byte and all of the bytes in the data field, if it exists. Checksum errors detected by the host will cause an error to be reported to the application, and checksum errors detected by the SLTA-10 Adapter will cause the message to be ignored.

This protocol is used when the host is capable of accepting asynchronously occurring input data without losing characters. The host is also relieved of the obligation of responding to an ALERT character within 50 ms. This protocol may therefore be used by an application-level handler calling an interrupt-driven buffered serial device driver. Drivers with these characteristics are typically provided with real time operating systems such as VRTX or time-sharing operating systems such as UNIX or VMS. In this case, these drivers should be set up for binary data communications without software flow control.

The buffered link protocol should not be used when the SLTA-10 Adapter is attached to a modem.

The buffered link protocol can only be used on multitasking operating systems such as UNIX if the host application executes often enough to empty any incoming buffers. For example, if the SLTA-10 Adapter is receiving 70 packets per second, and each packet is 25 bytes, the host will receive 1750 bytes per second. If the host has a serial input buffer of 256 bytes, the buffer will fill within 150 milliseconds if the host application is preempted. If the host application is preempted for longer than 150 milliseconds, incoming data will be lost due to lack of serial buffer space. In this case, the ALERT/ACK protocol should be used, or the buffer space increased to handle the worst case traffic during the maximum preemption period.

Transport Layer Protocol

When used with a local host, the SLTA-10 Adapter assumes a reliable connection and does not use a transport layer protocol. When used with a remote host, the SLTA-10 Adapter assumes that the link may not be reliable and enables the reliable transport protocol. The reliable transport protocol adds an ACK/NACK transport protocol to the network interface protocol. A sequence number is also added to the link-layer header. This protocol can therefore recover from checksum errors on the host to SLTA-10 Adapter link.

The reliable transport protocol is enabled on the SLTA-10 Adapter with the *Remote Host* option selected by the Switch2/CFG2 input as described in Chapter 4. The reliable transport protocol is enabled on the DOS network driver with the `/M` option as described in Chapter 8. The reliable transport protocol is not supported by the UNIX network driver.

The link-layer header contains an ALERT (0x01) byte, a sequence number, and a length byte followed by a one's complement of the length byte. These values are always validated by the receiver before accepting the rest of the message. Following the length bytes is the network interface command. See Appendix D of the *Host Application Programmer's Guide* for a description of the command byte structure. If the message contains a data field it follows the command byte. Finally, a checksum terminates the sequence.

The ALERT/ACK link protocol should be used with remote hosts. With this protocol, the sender will start the sequence by transmitting the ALERT byte. When this byte is received by the receiver, that device responds by transmitting the ALERT ACK byte (value FE hex). This low level handshaking process prevents the sender from transmitting the rest of the sequence before the receiving device is ready. Once the ALERT ACK byte is received by the sender it sends the rest of the message without any other interactions.

The length byte value describes the length of the network interface command byte plus the length of the data field. This value will always be at least 1. The checksum is a two's complement of the sum of the command byte and all of the bytes in the data field, if it exists. If the receiver receives a message in sequence, with a valid checksum, it responds with an ACK (0x06). Otherwise it responds with a NACK (0x15), requesting a re-transmission.

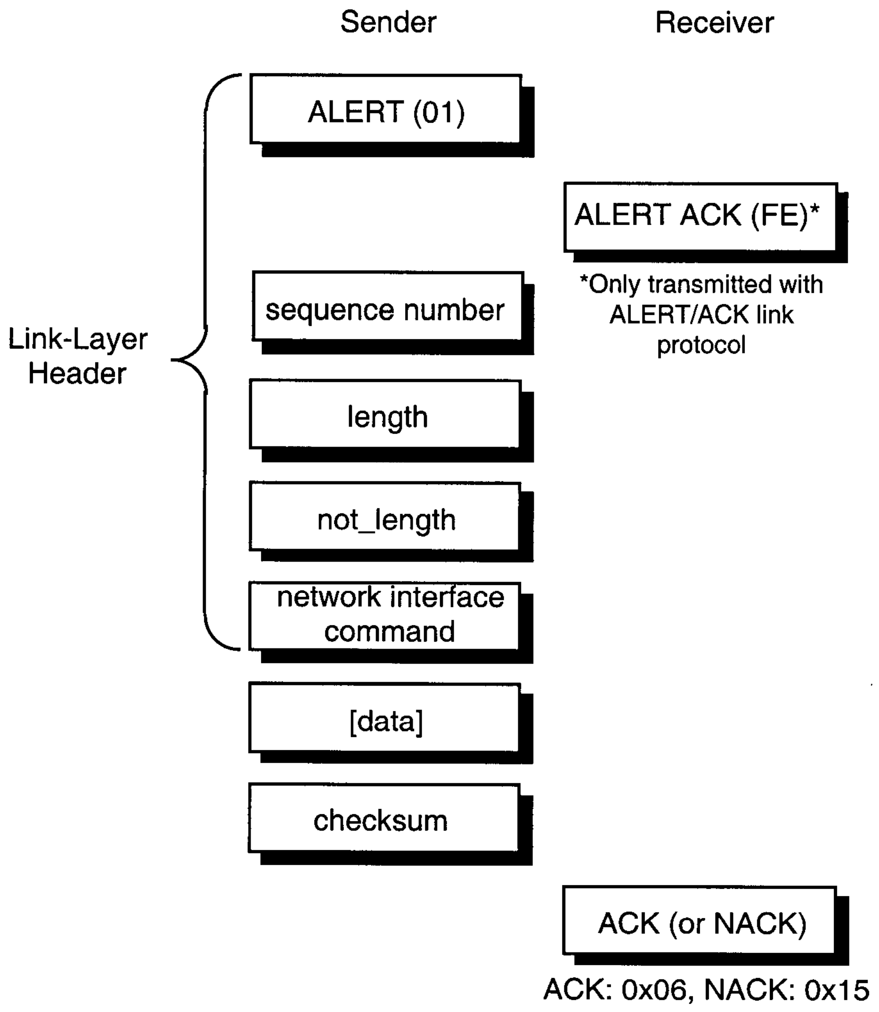


Figure 9.4 SLTA-10 Adapter Reliable Transport Protocol

SLTA-10 Adapter Timing Data

Certain aspects of the SLTA-10 Adapter link and transport layer protocols implement fail-safe timeouts in order to control the time spent waiting for protocol states to change when errors occur.

Downlink Byte-to-Byte Receive Timeout

The downlink byte-to-byte receive timeout is the maximum allowable period between the end of a single byte data frame sent downlink to the SLTA-10 Adapter, to the end of the next single byte data frame sent downlink to the SLTA-10 Adapter. This period is 100ms in local host mode and 1 second in remote host mode. When this timeout occurs, the SLTA-10 Adapter discards the downlink buffer and returns to the NORMAL state. If the reliable transport protocol is enabled, the SLTA-10 Adapter also sends a NACK byte after this timeout.

Uplink Message Life

The uplink message life is the maximum allowable period between the SLTA-10 Adapter sending an ALERT byte to the host and the host responding with an ALERT ACK byte. This period is 100ms in local host mode and 1 second in remote host mode. When this timeout occurs, the SLTA-10 Adapter will resend the ALERT byte. This process is repeated until 3 seconds have elapsed, after which the uplink message is discarded. This timeout only applies to the ALERT/ACK link protocol and is not used for the buffered link protocol.

ACK/NACK Receive Timeout

When using the reliable transport protocol, the SLTA-10 Adapter will wait for the ACK or NACK byte to be sent downlink following the end of the uplink transmission of a message. This period is 1 second, after which the SLTA-10 Adapter will re-send the uplink message.

Uplink Timeout Message Retry Count

When using the reliable transport protocol the SLTA-10 Adapter will re-send uplink messages whenever the ACK/NACK timeout period has elapsed. This retry process is limited to 5 retries, after which the uplink message is discarded. There is no retry limit applied to re-sends due to the reception of the NACK byte.

Session Layer Protocol

The network interface link and transport protocols described above are used for all host-to-SLTA communications. Layered on top of these protocols is a downlink buffer request protocol and an uplink flow control protocol.

Downlink Buffer Request Protocol

The network driver receives application buffers from the host application, translates them to interface buffers, and passes the interface buffers to the SLTA-10 Adapter. There are two types of downlink commands from the host to the SLTA-10 Adapter—commands that can be executed directly by the SLTA-10 Adapter, and commands that need to be buffered in the SLTA-10 Adapter.

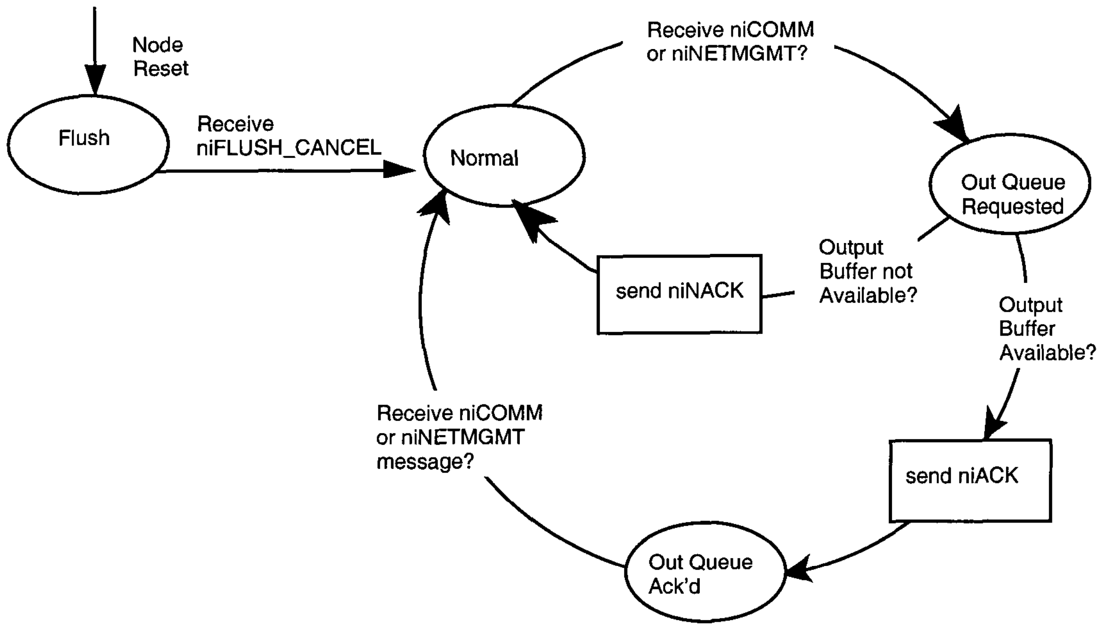
Downlink commands that are executed directly by the SLTA-10 Adapter are:

`niRESET`, `niFLUSH_CANCEL`, `niONLINE`, `niOFFLINE`, `niFLUSH`, `niFLUSH_IGN`, `niPUPXOFF`, `niPUPXON`, `niSLEEP`, and `niSSTATUS`.

See the *Host Application Programmer's Guide*, Appendix D, for a description of these commands.

The niSStatus command, when sent downlink, will cause the SLTA-10 Adapter to respond with a niSStatus command plus one byte of data. In MIP mode, this byte of data contains the settings of configuration switches, with BAUD0 being the least significant bit. In NSI mode, this byte of data contains 011 in the least significant bits followed by the XID information, making the SLTA-10 Adapter NSI mode consistent with the PCNSI Adapter.

Downlink commands that are buffered in the SLTA-10 Adapter are `niNETMGMT` (for network management commands to be executed by the SLTA-10 Adapter itself) and `niCOMM` (for messages to be sent out on the network, including network variables, explicit messages, and network management messages addressed to other nodes). For these two commands, a buffer request protocol is used to ensure that the SLTA-10 Adapter has a free application buffer for the data. The network driver must first request an output buffer before sending the interface buffer. The network driver must hold the buffers in an output queue until the SLTA-10 Adapter is ready to receive them. The network driver takes the SLTA-10 Adapter through 3 states to request a buffer and send the interface buffer. Figure 9.5 summarizes the downlink state transitions.



Note: niNETMGMT commands are allowed in the Flush state.

Figure 9.5 SLTA-10 Adapter Downlink Flow Control States

Following is the sequence of events for transferring an niCOMM or niNETMGMT command downlink to the SLTA-10 Adapter:

1. The SLTA-10 Adapter is initially in the NORMAL state.
2. The network driver requests an output buffer by sending a link-layer header (see figures 9.2 and 9.3) with a niCOMM or niNETMGMT command and the appropriate queue value (niTQ, niTQ_P, niNTQ, niNTQ_P). The data portion of the interface buffer is not sent with the buffer request. This puts the SLTA-10 Adapter in the OUTPUT QUEUE REQUESTED state.
3. If an output buffer is not available, the SLTA-10 Adapter responds with a niNACK (0xC1) command. The SLTA-10 Adapter returns to the NORMAL state, and the driver starts again at step 2.
4. When an output buffer is available, the SLTA-10 Adapter responds with a niACK (0xC0) command. The SLTA-10 Adapter is now in the OUTPUT QUEUE ACKNOWLEDGED state. While in this state, the network driver can only transfer downlink LonTalk messages, uplink source quench commands (niPUPXOFF), uplink source resume commands (niPUPXON), or reset commands (niRESET) since the SLTA-10 Adapter is waiting for a message in this state. All other network interface commands sent downlink will be ignored, and will return the SLTA-10 Adapter to the NORMAL state.
5. Upon receiving the niACK acknowledgment, the network driver transfers the entire interface buffer to the SLTA-10 Adapter. This

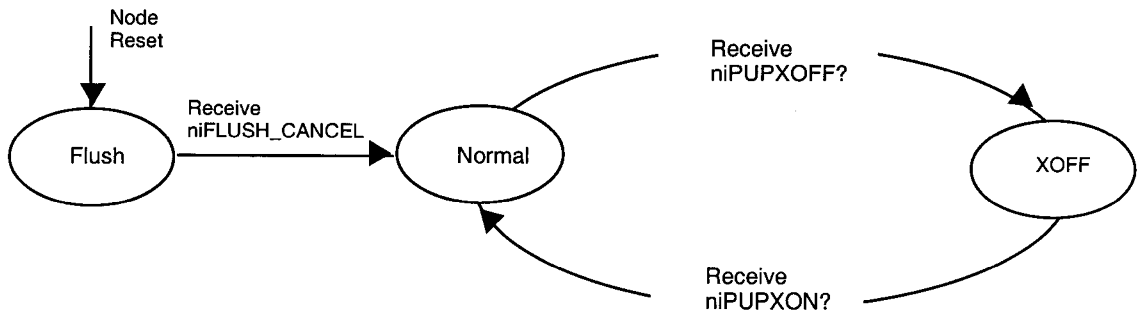
buffer has the same command and queue value sent in step 2, and also contains the data and checksum. Upon completion of this transfer, the SLTA-10 Adapter returns to the NORMAL state.

The network driver must preserve the continuity of the type of buffer request and the type of message sent downlink. For example, if the network driver sends the niCOMM+niTQ_P command requesting a priority output buffer, and follows this with a message transfer with the non-priority niCOMM+niTQ command, the SLTA-10 Adapter will incorrectly store the message in a priority output buffer, the type originally requested.

Uplink Flow Control Protocol

Uplink traffic may be incoming LonTalk messages, output buffer request acknowledgments, completion events, or local commands. The network driver translates the interface buffers to application buffer format and stores the buffers in a queue until the host application is ready to read them.

There is no buffer request protocol for uplink traffic. The network driver is normally assumed to have sufficient buffers. The network driver can suspend or resume uplink traffic when no network driver input buffers are available by sending the *Uplink Source Quench* (niPUPXOFF) command to the SLTA-10 Adapter. This prevents the STLA from sending any LonTalk messages uplink. When the network driver senses that network driver input buffers are available, it sends the *Uplink Source Resume* (niPUPXON) command to resume uplink transfers. Figure 9.6 summarizes the uplink state transitions.



Note: Responses to niNETMGMT and niSSTATUS commands are allowed in the Flush state.

Figure 9.6 SLTA-10 Adapter Uplink Flow Control States

The host may chose to sidestep the downlink buffer request protocol. In this case, the complete message is sent downlink without any buffer request step. If the SLTA-10 Adapter has a free output buffer, then the message will be transferred into the SLTA-10 Adapter successfully. If not, there will be no indication and the message will be lost. The exception to this case is when using the transport layer protocol, in which case the SLTA-10 Adapter will send the NACK to the host, which should force the host to re-send the message. Otherwise, in order to use this feature successfully, the host driver must manage the number of available output buffers within the

SLTA-10 Adapter. This feature has been added to the DOS driver for the SLTA-10 Adapter.

Presentation Layer Protocol

The network driver exchanges LonTalk packets with the host application at the presentation layer. The LonTalk packet enclosed in a command of type `niCOMM` or `niNETMGMT` is described in detail in the *Host Application Programmer's Guide*. It is summarized here for convenience.

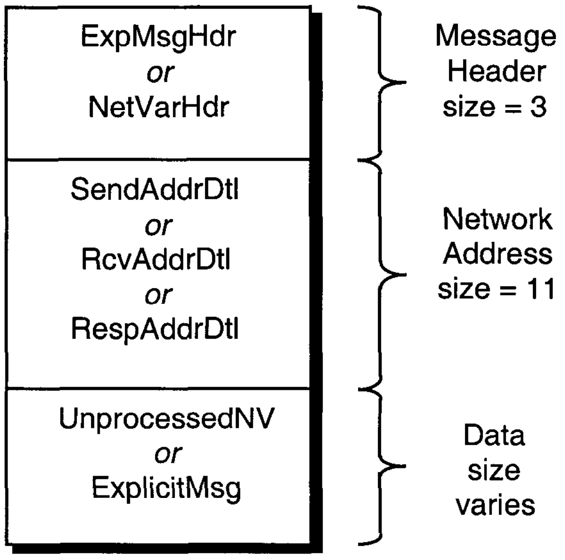


Figure 9.7 Application Buffer Format

The SLTA-10 firmware is configured with explicit addressing enabled, and therefore the 11-byte network address field is always present in an uplink or downlink buffer. The firmware is also configured with host selection enabled, so the data field of the buffer is either an unprocessed network variable or an explicit message.

10

Initialization and Installation

This chapter describes initializing, communicating with, and installing the SLTA-10 Adapter as a network node.

Initializing an SLTA-10 Adapter

After an SLTA-10 Adapter and its host processor are powered, the host application must initialize the SLTA-10 Adapter. When an SLTA-10 Adapter is initially powered-up or reset, it disables network communications by entering the `FLUSH`, unconfigured state, unless the Switch3/CFG1 input is set to *Network Enable.* The `FLUSH` state prevents the SLTA-10 Adapter from responding to network management messages before the host application has initialized the SLTA-10 Adapter. The unconfigured state prevents the SLTA-10 Adapter from responding to application messages before the node has been installed in a network. The host application will not be able to send or receive application messages until after it cancels the `FLUSH` state and the SLTA-10 Adapter leaves the unconfigured state.

An SLTA-10 Adapter leaves the unconfigured state when it is installed in a network and assigned an address in one or two domains on that network. There are two ways this can happen. If the SLTA-10 Adapter is used as a network interface for a network management tool, then the network management application itself normally configures the network interface. For example, a network management application based on LNS will configure the network interface (in this case a SLTA-10 Adapter in NSI mode) when the network interface device is opened. Also, a network management application based on the LonManager API or the LonMaker installation tool will configure the network interface when the network interface device is opened. In this case the PC running the network management application sends a local message to the SLTA-10 Adapter to change its state to configured.

Alternatively, the SLTA-10 Adapter may be installed in a network by some other network management tool. In this case, the network management tool sends a message to the SLTA-10 Adapter across the network to change its state and to assign it an address.

Once the SLTA-10 Adapter is in the configured state, it will retain that state and its address assignment across power-cycles, because that information is stored in the internal EEPROM. However, if Switch3/CFG1 is set to *Network Disable*, the `FLUSH` state must be canceled each time the SLTA-10 Adapter is reset.

If the host application attempts to send a message while the SLTA-10 Adapter is in the `FLUSH` state, the SLTA-10 Adapter will return a failed response for acknowledged messages and a success response for unacknowledged messages. The message will not be sent in either case.

If the host application attempts to send a message while the SLTA-10 Adapter is in the `NORMAL`, unconfigured state, the SLTA-10 Adapter will always return a success response even though the message will not be sent.

To initialize an SLTA-10 Adapter, follow these steps (for more detail, see the *LONWORKS Host Application Programmer's Guide*):

1 Reset the SLTA-10 Adapter from the host application by sending the `niRESET` command. If installed correctly, the SLTA-10 Adapter will respond with an uplink `niRESET` message upon completion of the reset. The first message from an SLTA-10 Adapter after power-up will also be an uplink `niRESET` message informing the host that the SLTA-10 Adapter has reset.

2 Cancel the FLUSH state in the SLTA-10 Adapter. LNS applications automatically handle this, and it is done automatically by the SLTA-10 MIP mode DOS network driver after an open command or uplink niRESET if the /Z flag is not specified. The FLUSH state can be manually canceled by sending the niFLUSH_CANCEL message. The FLUSH state can also be disabled by a configuration switch on the SLTA-10 Adapter as described earlier in this chapter.

3 Install the network interface in one or two domains using the *Update Domain* network management message. This may be done by a network management tool across the network, or may be done directly by the host application by sending the *Update Domain* message as a local network management command.

4 Change the state of the network interface to configured. This may be done by a network management tool across the network, or may be done directly by the host application by sending the *Set Node Mode* network management message.

Installing an SLTA-10 Adapter on a Network

An SLTA-10 Adapter attached to a network appears as a standard LONWORKS node to other nodes on the network. The SLTA-10 Adapter node is logically installed on a network with a network management tool. Installation scenarios are described in the *LONWORKS Installation Overview* engineering bulletin (number 005-0006-01). Unique installation requirements of host applications are described in Chapter 3 of the *LONWORKS Host Application Programmer's Guide.*

Installing with LNS, the LonMaker for Windows Integration Tool, or the LNS DDE Server

With an LNS-based application, the SLTA-10 Adapter is initialized automatically as part of the system open. Prior to the system open, the application selects the desired network interface. See the Chapter 3 *Initializing and Terminating LCA Applications* in the *LCA Object and Data Server Programmer's Guide* for code fragments.

Installing with the LonBuilder Tool

An SLTA-10 Adapter node can be installed on a development network using the LonBuilder Network Manager. Chapter 6 of the *LonBuilder User's Guide* describes how to define and install nodes in a development network using the LonBuilder Network Manager. A prerequisite to creating application node target hardware and node specifications is to define the channels that will be included in the network as defined under *Defining Channels* in Chapter 10 of the *LonBuilder User's Guide.* Select the standard transceiver type compatible with the transceiver on your SLTA-10 Adapter node.

When creating a hardware properties definition for a custom node to represent the SLTA-10 Adapter node, set the input clock rate to 10MHz. Then create a hardware definition for the custom node specifying these hardware properties. The SLTA-10 Adapter will not accept an incorrect clock rate or hardware properties. This may occur, for example, if you specify default_hw_props instead of the correct one. To install the SLTA-10 Adapter in a LonBuilder network using the service pin, you must either connect the SLTA-10 Adapter to a host, and open the network driver (for example, by running `HA`), or else set Switch3/CFG1 to the *Network Enable* state.

When installing the SLTA-10 Adapter node, the channel definition must match the transceiver on the SLTA-10 Adapter. If it does not, the SLTA-10 Adapter will not accept the new values. A '`No`' response is required to the prompt, `Do you want to install communications parameters?` *DO NOT use the Yes response to the prompt:* `Do you want to install communications parameters?` *unless the channel and hardware definitions are compatible with the transceiver and input clock on the SLTA-10 Adapter.*

When defining the application image, the `App Image Origin` field should be set to `Interface File`, and the `App Image Name` should be set to the name of an external interface file (XIF)created as described under *Binding to a Host Node* in Chapter 3 of the *LONWORKS Host Application Programmer's Guide.*

WARNING: This is NOT the default setting for the `App Image Origin`*. If you specify a Neuron C source file as the* `App Image Origin`*, the SLTA-10 Adapter may be rendered unusable.*

If the SLTA-10 Adapter is accidentally configured with the wrong communication parameters, it may be rebooted with the `NODEUTIL` application available on Echelon's web site. See the `README.TXT` file included with `NODEUTIL` for a description.

Installing an SLTA-10 Adapter with LonManager API, the DOS-based LonManager LonMaker for DOS Installation Tool, or the LonManager DDE Server

When an SLTA-10 Adapter is used as a network interface for a host application based on the LonManager API, these installation steps are automatically handled by the LonManager API `lxt_open()` function call.

When an SLTA-10 Adapter is used as a network interface for a network management PC running LonMaker for DOS installation tool or a LonManager API-based application, these installation steps are automatically handled by the LonMaker for DOS `Attach` command or the LonManager API `lxt_open()` function call.

When an SLTA-10 Adapter is used as a network interface for a control and monitoring PC running the LonManager DDE Server, these installation steps are automatically handled by the LonManager DDE Server.

11

Using the SLTA-10 Adapter with a Modem

This chapter describes the operation of the SLTA-10 Adapter when a remote host computer is connected via a pair of modems to the SLTA-10 Adapter. In this set-up, any node on the network may request the SLTA-10 Adapter to initiate a dial-out operation to connect to the host. In addition, if the SLTA-10 Adapter is functioning in NSI mode, the SLTA-10 Adapter itself may be configured to initiate a dial-out operation to connect to the host. The SLTA-10 Adapter can store a telephone directory of commonly called numbers, as well as accept commands to dial any other number.

The SLTA-10 Adapter may also be configured to accept incoming calls and connect the network to the host. Incoming callers may optionally be required to provide a password before the SLTA-10 Adapter will connect them to the network.

See Chapter 7, *Using the Windows 95/98 and NT Drivers and SLTALink Manager with SLTA-10 NSI Mode*, for configuring the SLTA-10 NSI mode EEPROM through the SLTALink Manager application.

Overview

The SLTA-10 Adapter network interface may be attached to the host processor using modems and the switched telephone network. Figure 11.1 illustrates this option.

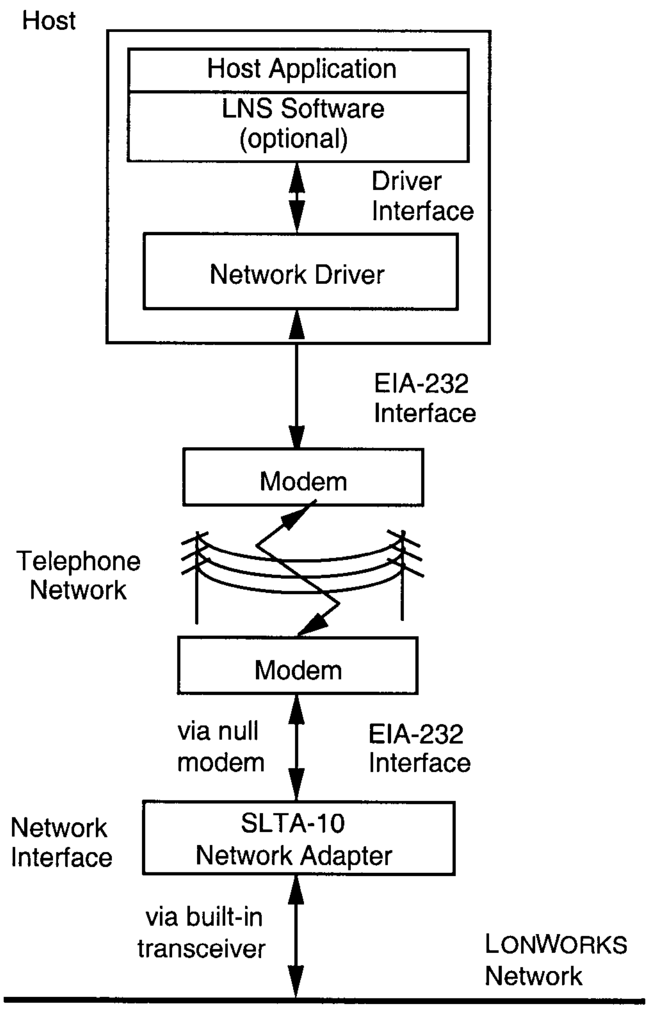


Figure 11.1 Using the SLTA-10 Adapter with Modems

When the SLTA-10 Adapter is configured for modem support, it will respond to special network management messages that cause it to communicate with the attached modem. The modem used must support the Hayes standard AT command set allowing it to dial-out, auto-answer incoming calls, and set various parameters.

Once a connection is established, the host computer communicates transparently with the network as though the SLTA-10 Adapter were attached locally.

In NSI mode, the SLTA-10 Adapter can be configured to initiate the connection with the host PC when LNS network management messages and/or network variable updates are addressed to the SLTA-10 Adapter. Alternatively, another node on the local network can command the SLTA-10 Adapter to initiate the connection.

In MIP mode, the SLTA-10 Adapter cannot itself initiate any connection; it must be commanded to do so by another node on the local network, or else by the modem's detection of an incoming call. This means, for example, another node on the local network must initiate the dialing procedure when an alarm is detected that needs to be reported to the host. Once a connection has been established, however, any node on the local network can communicate with the host by addressing messages to the SLTA-10 Adapter.

In order to support the modem functions, the SLTA-10 Adapter Switch2/CFG2 input must be set to the *Remote Host* state (UP position). Switch1/CFG3 should be set to the default ALERT/ACK link protocol (DOWN position). This automatically enables the reliable network interface transport protocol. See Chapter 4 for details of the configuration inputs. See Chapter 7 for using the SLTALink Manager with the SLTA-10 NSI mode or Chapter 8 for SLTA-10 MIP mode DOS network driver options.

Note that the packet throughput of the SLTA-10 Adapter is substantially reduced when using a modem because of the overhead associated with modem support.

SLTA-10 Adapter Connection States

When the SLTA-10 Adapter is operating in the remote host mode, several internal states (or *connection states*) will control its behavior:

- The `IDLE` state is entered after power-up reset. In this state any uplink bound messages are ignored since the SLTA-10 Adapter is not connected to a host. The `IDLE` state is also entered whenever the telephone connection is broken and the modem drops the DCD (Data Carrier Detect) line.
- The `CALL_IN_PROCESS` state is entered once a connection is initiated by a node on the network connected to the SLTA-10 Adapter. In this state uplink traffic is still discarded while the SLTA-10 Adapter monitors the modem for connection completion or connection failed events to occur.
- The `CONNECTED` state is entered once the connection is complete. The normal network interface protocol resumes between the SLTA-10 Adapter and the remote host. This state may be entered as a result of a node on the local network initiating a call, or as a result of a remote host calling up this SLTA-10 Adapter.
- The `FAILED` state is entered if the connection process failed. This state is operationally the same as `IDLE`.

The connection state of the SLTA-10 Adapter is preserved across software resets, allowing normal network management resets to occur without breaking the connection. The SLTA-10 Adapter will not preserve the connection state after it has been through a power reset.

Command Set Assumptions

The SLTA-10 Adapter uses the following strings received from the modem to interpret the connection state. These strings are consistent with all Hayes AT compatible modems operating in the word response mode (alphabetic responses). [CR] is the hex 0D character.

`CONNECT` [any text] [CR]

`BUSY` [CR]

`VOICE` [CR]

`NO` [any text][CR]

`ERROR` [CR]

The "`CONNECT`" string may be, and typically is, followed by other informative text, such as connection serial bit rate or error correction methods in use.

These other four states indicate a failure to make the connection.

Translated Characters

All strings that are sent specifically to the modem (as commands) by the SLTA-10 Adapter are scanned for certain characters by the SLTA-10 firmware. These characters are then translated into specific functions or characters unless they are preceded by a backslash ("\"). The characters are:

~ The tilde will cause the SLTA-10 Adapter to pause 500ms before sending the next character to the modem. The tilde itself is not sent.

! The exclamation point will cause the SLTA-10 Adapter to send a carriage return (0x0H) to the modem. The exclamation point itself is not sent.

The tilde is provided for users familiar with existing modem packages. It can be used, for example, in the command string which causes the modem to hang-up. When dialing out, Hayes AT-compatible modems use the comma character to insert delays between portions of a dial command; the comma character should continue to be used for dialing out.

DTE Connections

In addition to the basic three wire connections—Transmit Data (TXD), Receive Data (RXD), and Signal Ground— there are two additional signals that must be connected: Data Carrier Detect (DCD) and Data Terminal Ready (DTR). The modem must also be configured to use these signals. DCD is used by the SLTA-10 Adapter to determine that a connection has been made and DTR is used to terminate a connection by hanging up. Note that many modems default to ignore these two signals and must be configured to enable them. The following AT command enables these two signals on many modems.

```
AT&C1&D2[CR]
```

Network Management Messages

Network management messages are used to configure the operation of the network, as opposed to delivering application data during operation of the network. All LONWORKS nodes respond to the standard network management messages as described in Appendix B of the *Neuron Chip Data Book*. For nodes based on the SLTA-10 Adapter, additional network management messages are defined to configure and control the SLTA-10 Adapter. The message codes for network management messages are reserved, and therefore applications need not be concerned about possible conflicts in the choice of message codes. The additional SLTA-10 Adapter network management messages use the reserved message code 7D hex. The first data byte is used as a sub-code, and is 01 hex to indicate an SLTA-10 Adapter function. The second data byte is a specific application command code. Table 11.1 summarizes the network management messages specific to the SLTA-10 Adapter.

Table 11.1 SLTA-10 Adapter Network Management Messages

Message Code	***Message Sub-code***	***Application Command***	***Function***
0x7D	1	1	Product Query
0x7D	1	2	Send Modem String
0x7D	1	3	Modem Status Readback
0x7D	1	4	Modem Response Query
0x7D	1	5	Connection Status Query
0x7D	1	6	Install Directory Entry
0x7D	1	7	Dial From Directory
0x7D	1	8	Hang-up
0x7D	1	9	Install Password
0x7D	1	10	Install Modem Configuration String
0x7D	1	11	Install Hangup String
0x7D	1	12	Install Dial Prefix
0x7D	1	13	Install Hangup Timer
0x7D	1	14	Configure Modem
0x7D	1	15	Request/Release Modem
0x7D	1	16	Clear EEPROM Pool
0x7D	1	17	Install NV Connect
0x7D	1	18	Install NSI Connect
0x7D	1	19	Install Callback Enable
0x7D	1	20	Report SLTA EEPROM contents

These network management messages may be sent from any node on the network to the SLTA-10 Adapter. If an application node wishes to send modem-control network management messages to the SLTA-10 Adapter, it does so using explicit messaging. See Chapter 4 of the *Neuron C Programmer's Guide* for details on explicit messaging. The message should be delivered using request/response service, and the message code for modem control messages is always 7D hex. The data portion of the message always begins with a sub-code value of 1, indicating that the message is addressed to an SLTA-10 Adapter, followed by an application command byte indicating which modem-control command this is. This is followed by parameters specific to the application command. These messages may be sent by a Neuron C-based node, a node based on the Microprocessor Interface Program (MIP), or a node based on another SLTA-10 Adapter.

See the supplied Neuron C program DIALOUT.NC for an example of an application that sends a message to an SLTA-10 Adapter to cause it to dial-out using an attached modem. The example GIZSETUP.NC sends messages to an SLTA-10 Adapter to configure its modem strings using a Gizmo I/O module as the user interface. A node can send these messages using either implicit or explicit addressing. When implicit addressing is used, a network management tool binds the output message tag in the node wishing to send the message to the SLTA-10 Adapter as the destination. When explicit addressing is used, the node wishing to send the message must explicitly insert the destination address in the outgoing message.

Note that the SLTA-10 Adapter will be unable to receive any messages, including these network management messages, if network communications is disabled, i.e., it is in the FLUSH state. This will normally be the case if it is not connected to a host. Therefore, in order to be able to dial-out and connect to a host, the SLTA-10 Adapter must be configured to initialize with network communications enabled, i.e., the NORMAL state, with the CFG1 input. See Chapter 4 for more details.

The messages should be sent with request/response service, and the response code should be checked to see if the message was executed correctly - it will be 0x3D if there was no error, and 0x1D if there was. Possible failure conditions are noted under each message. Some of these network management messages return data to the sender in the response structure as noted below.

Note that some of these messages cause one or more bytes of EEPROM in the SLTA-10 Adapter to be written. Each byte of EEPROM takes 20ms to write, and the response is not sent by the SLTA-10 Adapter until after the command is executed. This time should be taken into account when setting the transaction timer (tx_timer) in the message tag connection for implicit addressing, or in the destination address for explicit addressing. If the LonBuilder or LonManager API binder is used to create the connection, the transaction timer may be explicitly specified.

Example:

```
msg_tag SLTA_tag;
when ( ... ) {
   msg_out.code = 0x7D;              // network mgmt msg code
   msg_out.tag = SLTA_tag;
   msg_out.service = REQUEST;
   msg_out.data[0] = 1;              // sub-code for SLTA-10
   msg_out.data[1] = app_command;    // specific command
   msg_out.data[2] = .....           // additional parameters
   msg_send();
}
```

```
when (msg_fails(SLTA_tag)) {
   // SLTA-10 Adapter did not respond to the message
   ...
}

when (msg_succeeds) { ... }

when (resp_arrives(SLTA_tag) {
   // SLTA-10 Adapter did respond to the message
   if (resp_in.code == 0x3D)
      // command executed successfully
      ...
```

Certain SLTA-10 Adapter network management messages which are designed to send a command string directly to the modem will fail if the connection status is `CONNECTED`. This applies to the following messages: *Send Modem String*, *Dial From Directory*, and *Configure Modem*. The telephone connection must be broken and the SLTA-10 Adapter returned to the `IDLE` state for these messages to be issued.

Many of these network management messages, for example the "Install..." messages, may be sent to the SLTA-10 Adapter from the host computer via the telephone link if the SLTA-10 Adapter is in the `CONNECTED` state. In this case, they should be sent using the `niNETMGMT` network interface command so that they are addressed to the SLTA-10 Adapter itself.

Structures are defined in the file `SLTA_ANM.H` for each of the application commands, and include the `sub_code` and `app_command` fields, as well as any additional parameters for the specific application command. If the response contains data other than the response code, a structure for the returned data is also defined.

EEPROM String Pool Management

The SLTA-10 Adapter's EEPROM is used to store a number of varying-length configurable strings which are used to control the modem. These strings can be set by sending network management messages to the SLTA-10 Adapter, either from the modem side or the network side. Since the strings are varying in length and the EEPROM space is limited, a pool management system is used to optimize the usage of EEPROM. **The SLTA-10 MIP mode EEPROM string pool and the SLTA-10 NSI mode EEPROM pool are different! Changing the mode DIP switch and cycling power will destroy the EEPROM pool.**

For the SLTA-10 MIP mode, the EEPROM pool consists of the following strings:

- Up to eight dial-out directory entries. These may be used by index to initiate a dial-out connection, and may contain any combination of AT commands and numbers.
- One modem initialization string. This string is used to initialize the modem as required.

- One modem hang-up string. This string is used to hang-up the modem and break the connection when DTR control does not function.
- One dial-out prefix string. This string is sent as a prefix to any dial-out operation to specify the modem dial command and to indicate whether tone or pulse dialing should be used.
- An 8-byte dial-in password string.

EEPROM storage and allocation for these strings is managed by the MIP mode EEPROM pool. This allows flexible utilization of the SLTA-10 Adapter's MIP mode EEPROM space. The MIP mode pool consists of 21 blocks, each with 9 bytes of data storage space. A string occupies one or more blocks.

For the SLTA-10 NSI mode, the EEPROM pool consists of the following strings:

- Up to five dial-out directory entries. These may be used by index to initiate a dial-out connection, and may contain any combination of AT commands and numbers.
- One modem initialization string. This string is used to initialize the modem as required.
- One dial-out prefix string. This string is sent as a prefix to any dial-out operation to specify the modem dial command and to indicate whether tone or pulse dialing should be used.
- An 8-byte dial-in password string.
- A 1-byte code that enables an auto dial-out on a network variable message.
- A 1-byte code that enables an auto dial-out on a NSI message.
- A 1-byte code that enables callback.

EEPROM storage and allocation for these strings is managed by the NSI mode EEPROM pool. This allows flexible utilization of the SLTA-10 Adapter's NSI mode EEPROM space. The NSI mode pool consists of 8 blocks, each with 12 bytes of data storage space. A string occupies one or more blocks.

The NSI mode EEPROM pool does not require the exclamation point (translated to a carriage return) in the dial directories; whereas, it is required in the MIP mode EEPROM pool. In addition, the NSI mode EEPROM pool does not require a null terminator on exact sector size strings. In the MIP mode EEPROM pool, if a string winds up ending on the last byte of a sector, a subsequent sector is required to hold the null terminator.

The network management functions that install these strings allow incremental EEPROM writes, and include a `total_size` field. Incremental writes allow long strings to be installed without the requirement of large buffer sizes on the SLTA-10 Adapter. If the `total_size` field is greater than the amount of EEPROM storage space available then the network management message response will indicate a failed status. In all cases the strings should include a null terminator.

The `offset` field in the install messages indicates the starting point in the complete string of the current string piece to be installed. The first byte of the complete string is at offset zero. If the offset is such that the string piece would not fit in the allocated total size for the string, the total size for that string is automatically extended, if space is available.

All pieces of a string should specify the same value for `total_size`. Otherwise it means that you are starting over with a new string.

Once a particular string has been installed in the pool, it may be deleted by re-installing it with a total size of 0. Alternatively, the *Clear EEPROM Pool* message may be issued to clear the whole EEPROM string pool.

Product Query

This message may be used to check the type of interface product that the node is running. The value returned for the SLTA-10 Adapter is a '1'. Application nodes will respond with a failed code of 0x1D returned for this or any message where the request message code is 0x7D.

```
typedef struct  {
   byte sub_code;              // always #1
   byte app_command;           // value = 1
} ANM_product_query_request;

typedef struct {
   byte product;               // for SLTA-10 Adapter, = 1
} ANM_product_query_response;
```

Send Modem String

This message is typically used to send AT command character strings to the modem from another node on the local network. This provides full control of the modem and its internal control registers and settings. Normal use of this feature is to dial-out to a number that is not in the telephone directory of the SLTA-10 Adapter, or to change or set modem control registers and options. This puts complete control of the modem in the hands of any application node on the network. The message definition is:

```
typedef enum {
   NO_CHANGE           = 0,
   DIAL_OUT            = 1,
   HANGUP_DIAL_OUT     = 2
} STR_mode;


typedef struct {
   byte     sub_code;          // always #1
   byte     app_command;       // value = 2
   STR_mode mode;
   char     modem_string[];
} ANM_send_str_request;
```

The length of `modem_string` is limited to the application and network buffer sizes within the SLTA-10 Adapter node and the node which is communicating with it. The SLTA-10 Adapter as shipped has buffers sizes allowing for a maximum of 46 characters in the modem string sent with this message. The string must be null terminated.

If a large string needs to be sent to the SLTA-10 Adapter, use a series of these requests with a single carriage return in the last string. Note that many modems have a limited input buffer size, typically 32 to 80 bytes.

The `mode` parameter is used to control the connection state of the SLTA-10 Adapter. The values for this parameter are:

0 Make no change to the SLTA-10 Adapter's modem connection state. Send only if not CONNECTED. Otherwise, respond with a failed status.

1 Initiate a dial-out connection. If the SLTA-10 Adapter is already currently connected, preserve that connection, and ignore the message. The SLTA-10 Adapter's connection status changes from `IDLE` to `CALL_IN_PROCESS`, unless the connection is already made, in which case the state stays at CONNECTED. The dial-out prefix is sent first.

2 Same as '1', but disconnect (hang-up) if currently connected before initiating the new connection.

Modem Response Query

ASCII strings received from the modem when the SLTA-10 Adapter is not connected to a host will be buffered and may be read back by a node via this message. The storage for this string is limited, and so it will contain only the first 16 characters received from the modem in the disconnected state. Executing the *Send Modem String* message will always clear this buffered string. It will not be cleared when the modem disconnects, aiding in diagnosis of connection problems.

```
typedef struct {
   byte sub_code;       // always #1
   byte app_command;    // value = 4
   byte max_length;     // limits the size of the response.
} ANM_modem_response_query_request;

typedef struct {
   char response[];     // null terminated string
} ANM_modem_response_query_response;
```

Connection Status Query

The SLTA-10 Adapter's connection status may be polled with this message. Most modems may be configured with various time-outs for the different stages of establishing a connection. Consult your modem's documentation for details.

```
typedef struct {
   byte sub_code;       // always #1
   byte app_command;    // value = 5
} ANM_connect_state_request;

typedef enum {
   IDLE                 = 0,
   FAILED               = 1,
   CALL_IN_PROCESS      = 2,
   CONNECTED            = 3
} CONN_state;

typedef struct {
   CONN_state connection_state;
} ANM_connect_state_response;
```

Install Directory Entry

This message stores a dial-out directory entry in the SLTA-10 Adapter's EEPROM string pool. Up to 5 dial-out entries can be stored in the SLTA-10 NSI mode EEPROM pool; up to 8 can be stored in the SLTA-10 MIP mode EEPROM pool. The entries are numbered 0 to 4 (or 0 to 7) as specified by the `dir_num` field.

```
typedef struct {
   byte sub_code;       // always #1
   byte app_command;    // value = 6
   byte dir_num;        // value = 0-7 for MIP; 0-4 for NSI
   byte total_size;     // of the data string
   byte offset;         // for piecemeal writes
   char dir_string[];
} ANM_install_dir_request;
```

See the section on *EEPROM String Pool Management* above for details on the EEPROM string pool.

Dial From Directory

Using one of the directory entries specified by `dir_num`, dial-out to a remote host and establish a connection. Based on the `mode` argument, the directory string may be sent to the modem and the SLTA-10 Adapter enters the `CALL_IN_PROCESS` state.

Connection progress may then be checked periodically by interested nodes using the *Connection Status Query* message. The `mode` parameter is used to control the connection state of the SLTA-10 Adapter. The values for this parameter are:

1 Initiate a dial-out connection. If the SLTA-10 Adapter is already currently connected, preserve that connection, and ignore the message. The SLTA-10 Adapter's connection status changes from `IDLE` to `CALL_IN_PROCESS`, unless the connection is already made, in which case the state stays at `CONNECTED`. The dial-out prefix is sent first.

2 Same as '1', but disconnect (hang-up) if currently connected before initiating the new connection.

```
typedef enum {
   DIAL_OUT              = 1,
   HANGUP_DIAL_OUT       = 2
} STR_mode;


typedef struct {
   byte     sub_code;      // always #1
   byte     app_command;   // value = 7
   STR_mode mode;
   byte     dir_num;       // value = 0-7 for MIP; 0-4 for NSI
} ANM_dial_dir_request;
```

If the directory entry does not exist, the response to this message will indicate a failure. A successful response to this message indicates that the SLTA-10 Adapter has sent the dial-out command to the modem, not that the modem has successfully dialed. The *Connection Status Query* message should be sent to determine whether a successful connection has been established.

Hang-up

This message causes the SLTA-10 Adapter to pulse the EIA-232 DTR signal (Data Terminal Ready) low for 500ms. If the DCD signal is still ON following this step, then the SLTA-10 Adapter will send the hangup string (see below) if it is not a null string. This will terminate the connection, and the SLTA-10 Adapter enters the `IDLE` state. The response will not be sent until this process is complete. Therefore the transaction timer for this message should be set to at least 768ms if it is sent from a node on the network. If this message is sent from a remote host, no response should be expected, since the connection will have been broken before the response can be sent.

```
typedef struct {
   byte     sub_code;          // always #1
   byte     app_command;       // value = 8
   boolean  if_config;
} ANM_hangup_request;
```

If the SLTA-10 Adapter is forced to send the hangup string, and this string does not exist in the EEPROM configuration, the response to this message will indicate a failure. If the `if_config` byte of this message is non-zero, the SLTA-10 Adapter sends the configuration string to the modem following the hangup process. This provides a remote host with the ability to dial up a remote SLTA-10 Adapter, change the configuration string, hang-up, and reconfigure the modem.

Install Password

This message stores a dial-in password in EEPROM. The default setting for this string is a null string, which results in no password requirement by the SLTA-10 Adapter. Any node on the network may change the password, but an external host must have already connected and used the existing password in order to change it, unless it was blank. Any installed SLTA-10 Adapter should use a password, otherwise an intruder might change the password to another setting.

The password string is limited to 8 characters, and may be any sequence of non-zero eight bit values. The string must be null-terminated.

```
typedef struct {
   byte sub_code;              // always #1
   byte app_command;           // value = 9
   char passwd_string[8];
} ANM_install_passwd_request;
```

If a password is installed in the SLTA-10 Adapter, the host must issue the `niPASSWD` network interface command to the SLTA-10 Adapter after the connection is established. The code for this command is 0xE4, and it should be followed by up to eight password characters, null terminated. For details on sending network interface commands, see the *LONWORKS Host Application Programmer's Guide.*

If modem support is selected, a password is present in the SLTA-10 Adapter's configuration, and the connection state changes from `IDLE` to `CONNECTED`, the SLTA-10 Adapter will not process any other network interface commands until the correct password is sent downlink. If the password is correct the SLTA-10 Adapter will respond with the `niACK` code. Otherwise the SLTA-10 Adapter will respond with the `niNACK` code.

Install Modem Configuration String

Whenever the SLTA-10 Adapter is either powered or reset, the connection state is not `CONNECTED`, or is commanded to by the *Configure Modem* message, the SLTA-10 Adapter will send its modem configuration string to the modem. This string is stored in EEPROM, and may be changed by this message. The default setting for this string is "`ATE0&C1&D2S0=1!`". The commands specified in this string are:

- `E0` is the AT command to disable local echo of characters received by the modem.
- `&C1` is the AT command to enable the Data Carrier Detect (DCD) output of the modem, which is active when the modem detects the carrier signal of another modem on the line.

- `&D2` is the AT command to enable the Data Terminal Ready (DTR) input of the modem. The modem will hang-up, enter command state, and disable auto-answer when it detects an on-to-off transition of the DTR input.
- `S0=1` is the AT command to set register S0 to 1, meaning that the modem should auto-answer incoming calls on the first ring. This option should be used if remote hosts will be dialing in to the SLTA-10 Adapter. Use "`S0=0`" if the SLTA-10 Adapter will only be used for dialing out to remote hosts.

See *Modem Compatibility* later in this chapter for additional sample modem configuration strings.

```
typedef struct {
   byte sub_code;        // always #1
   byte app_command;     // value = 10
   byte total_size;      // of the data string
   byte offset;          // for incremental writes
   char cfg_string[];
} ANM_install_cfgs_request;
```

This message uses the EEPROM pool to store the modem configuration string. See the section on *EEPROM String Pool Management* above for details.

Install Hangup String (MIP mode only)

This message installs a hang-up string, which is used to terminate a connection if the DTR control fails to do so. The default setting for this string is "`~~~+++~~~ATH0!`". This particular sequence is useful for Hayes modems, or other modems that have licensed the use of the Guard Time feature from Hayes Corporation. Some so-called Hayes-compatible modems use other sequences. A 1.5 second pause, followed by the string '+++', followed by another 1.5 second pause will cause a Hayes-compatible modem to enter its command state if it is in the connected state. The command `ATH0` causes the modem to hang-up.

```
typedef struct {
   byte sub_code;        // always #1
   byte app_command;     // value = 11
   byte total_size;      // of the data string
   byte offset;          // for incremental writes
   char hups_string[];
} ANM_install_hups_request;
```

This message uses the EEPROM pool to store the hang-up string. See the section on *EEPROM String Pool Management* above for details.

Install Dial Prefix

The default setting for this string is "ATDT". This string is sent as a prefix for any dial-out operations. This particular sequence instructs the modem to dial using Touch-Tone (DTMF) signaling. If pulse dialing is required, the prefix should be set to "ATDP."

```
typedef struct {
   byte sub_code;       // always #1
   byte app_command;    // value = 12
   byte total_size;     // of the data string
   byte offset;         // for incremental writes
   char dpre_string[];
} ANM_install_dpre_request;
```

This message uses the EEPROM pool to store the dial prefix. See the section on *EEPROM String Pool Management* above for details.

Install Hangup Timer

The hangup timer is controlled by an eight bit value in EEPROM. The default setting for this value is zero, which results in no hangup timer action. If the hangup timer is a non-zero value, the SLTA-10 Adapter will hang-up and break a connection (if in the CONNECTED state) when the number of minutes specified by `timer_value` have elapsed and no uplink or downlink activity has occurred. The default value for this timeout is zero, meaning that the phone connection will remain active indefinitely, even if there is no activity on the link.

```
typedef struct {
   byte sub_code;       // always #1
   byte app_command;    // value = 13
   byte timer_value;
} ANM_install_hangt_request;
```

Configure Modem

This message will cause the SLTA-10 Adapter to send its Modem Configuration String to the modem provided it is not in the CONNECTED state. See the *Install Modem Configuration String* message for further details. If the modem is in the CONNECTED state, the failed status will be returned.

```
typedef struct {
   byte sub_code;       // always #1
   byte app_command;    // value = 14
} ANM_modem_config_request;
```

Request/Release SLTA

This message may be used to grant ownership access of the SLTA-10 Adapter to any node on the local network. In a design where there may be more than one network node that wishes to control the SLTA-10 Adapter's connection states, Request/Release provides a method of managing this control. In this case a node will request the SLTA-10 Adapter, and the response to this request will be successful (code 0x3D) if access was granted, or failure (code 0x1D) if it was denied. At the end of such a session the node which was granted ownership must release the SLTA-10 Adapter, allowing other nodes access to it. This process only works if all nodes employ this mechanism. The request state is not preserved across resets of the SLTA-10 Adapter.

```
typedef struct {
   byte sub_code;       // always #1
   byte app_command;    // value = 15
   boolean req_rel;     // TRUE if request, FALSE if release
} ANM_request_slta_request;
```

Clear EEPROM Pool

This message will clear the entire EEPROM pool usage, and will remove the following configurable strings. The strings will be set to null strings, not their default values.

- Modem configuration string
- Hangup string
- Dial prefix string
- All dial-out directory entries

```
typedef struct {
   byte sub_code;       // always #1
   byte app_command;    // value = 16
} ANM_clear_eepool_request;
```

Install NVConnect (NSI mode only)

This message writes the NVConnect byte. A value of 0xFF (the default) will disable this feature. When this feature is enabled, the SLTA-10 Adapter initiates a dial-out when it receives a network variable update.

```
typedef struct {
   byte sub_code;       // always #1
   byte app_command;    // value = 17
   byte NVConnect;      // two 4-bit fields
} ANM_install_nvconnect;
```

Install NSIConnect (NSI mode only)

This message writes the NSIConnect byte. A value of 0xFF (the default) will disable this feature. When this feature is enabled, the SLTA-10 Adapter initiates a dial-out when it receives an AddMyNSI message.

```
typedef struct {
   byte sub_code;        // always #1
   byte app_command;     // value = 18
   byte NSIConnect;      // two 4-bit fields
} ANM_install_nsiconnect;
```

Install CallbackEnable (NSI mode only)

The CallbackEnable configuration byte is written as a Boolean value using this command. A valus of zero (the default) will disable the callback configuration. When this feature is enabled and a remote host dials-in to the SLTA-10 Adapter, the SLTA-10 Adapter terminates the call and initiates a dial-out using the address entry requested by the initial dial-in.

```
typedef struct {
   byte sub_code;        // always #1
   byte app_command;     // value = 19
   byte NSIConnect;      // Non-zero enables callback
} ANM_install_callbackenable;
```

Report SLTAEE (NSI mode only)

This command will result in a response that includes the address of the SltaEE data, the revision of the data structure, and its length. This information can be used to read back any portion of the structure for analysis and deconstruction.

```
typedef struct {
   byte sub_code;        // always #1
   byte app_command;     // value = 20
} ANM_report_sltaee;

The response is:
typedef struct {
   word abs_address;     // 16-bit absolute address of
                         //  structure
   byte version;         // currently 1
   byte length;
} ANM_report_sltaee_resp;
```

Modem Compatibility

The SLTA-10 Adapter has been tested with the following modems:

Best Data	Smart One external modem 33,600 bps Data/Fax modem
Diamond	SupraExpress 336e external faxmodem
Hayes	Accura 336 external fax modem
US Robotics	Sportster Voice external 28.8 faxmodem

Synchronous communication should be disabled when synchronous modems are connected at lower serial bit rates (less than 4800 bps). Alternatively, data compression can be disabled at lower bit rates. For example, two V.42 or V.32bis modems connected at 2400 bps will have very low throughput due to the slow serial bit rate.

You should disable XON/XOFF flow control in the modem when using it with the SLTA-10 Adapter.

Note: When using the Hayes Accura external Fax Modem with Simultaneous Voice and Data 33.6 modem with the US Robotics 28.8 Faxmodem with Personal Voice Mail, an incompatibility in communication occurs. Testing the two modems via *Hyperterminal* reveals that the CD signal (Carrier Detect) is incorrect. Due to this communication incompatibility, do not use these two modems together with the SLTA-10 adapter.

V.90 Modems Tested with the SLTA-10

The SLTA-10 Adapter has been tested with the following V.90 modems:

Best Data	Smart One 56SX V.90
Zoom Telephonics	Faxmodem 56KX Dualmode
US Robotics	External Faxmodem V.90 56K

The V.90 modems were tested using default Windows settings on the host side:

Windows Setting	*Default*
Use error control	On
Compress Data	On
Hardware (RTS/CTS) Flow Control	On
Standard Modulation Type	On

In all cases both the host side and the SLTA-10 side were set to 115200 baud.

Since 56K V.90 or V.FAST modulation is asymmetrical and requires a digital modem and special phone line connections at one end, do not expect a modulation rate of greater than 33.3K when connecting with two of these modems. This is normal.

When using the USRobotics modem on the SLTA-10 side, set the DIP switch SW4 on the modem to the DOWN position. This configures the modem for "No echo offline commands".

Remote Site Monitoring

This section describes the steps necessary to configure an SLTA-10 located at a remote site to dial-in to a Windows 95/98 or Windows NT 4.0 host PC running an LNS application using the equipment shown in figure 11.1.

Hardware Setup

Assuming the use of a modem with speeds less than or equal 28.8K band, set the switches as shown in figure 11.2.

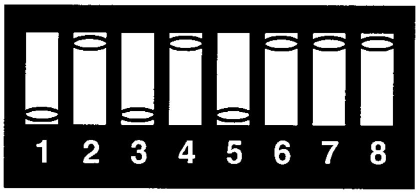


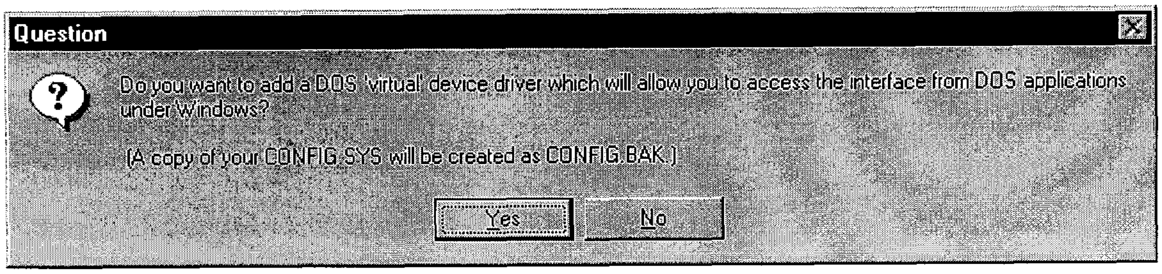
Figure 11.2 DIP Switch Settings for Use with a Diamond SupraExpress 336e Modem

Use an Echelon Model 73380 Null Modem Cable between the SLTA-10 and the modem. A 3-conductor cable, complete with connectors wired as shown in table 3.1, also will be required.

Software Setup

The host PC must be operating under Windows 95, 98, or NT. For the purposes of this example, the PC uses Windows 95.

Run the `setup.exe` supplied for the SLTA-10 Driver and the SLTALink Manager software. After common installation queries are addressed, the setup program will display the dialog box shown in figure 11.3. Answer "`Yes`" if using 16-bit LonManager API for Windows-based applications. Answer "`No`" if suing 32-bit LNS-based applications, i.e., LonMaker for Windows Integration Tool.


Question

Do you want to add a DOS 'virtual' device driver which will allow you to access the interface from DOS applications under Windows?

(A copy of your CONFIG.SYS will be created as CONFIG.BAK.)

Figure 11.3 DOS Virtual Device Driver Configuration Screen

Reboot the PC after installing the SLTA-10 driver software.

SLTALink Manager

The SLTALink Manager software provides the interface to setup the SLTA-10 for different modes of operation. The remote PC is assumed to have the network database required for the connection application. The LonMaker for Windows tool is assumed for this example.

The SLTALink Manager (`sltalink.exe`) launches automatically from the Start.Programs.Startup folder when Windows boots up. The SLTALink Manager must be running prior to accessing the SLTA-10 from LonMaker for Windows tool, The SLTALink Manager application does not appear as a button on the taskbar, but it does present an icon in the notification section of the taskbar as shown in figure 11.4.

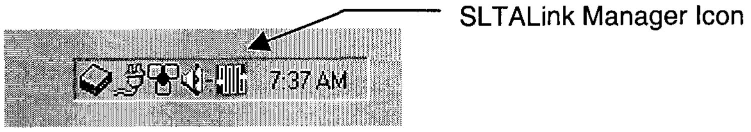


Figure 11.4 Taskbar with SLTALink Manager Running

To configure the SLTA-10 and modem for remote dial-in access, follow these steps:

1. Temporarily connect the serial port of the host PC directly to the SLTA-10.
2. Click on the SLTALink Manager icon found in the notification section of the taskbar (figure 11-5).

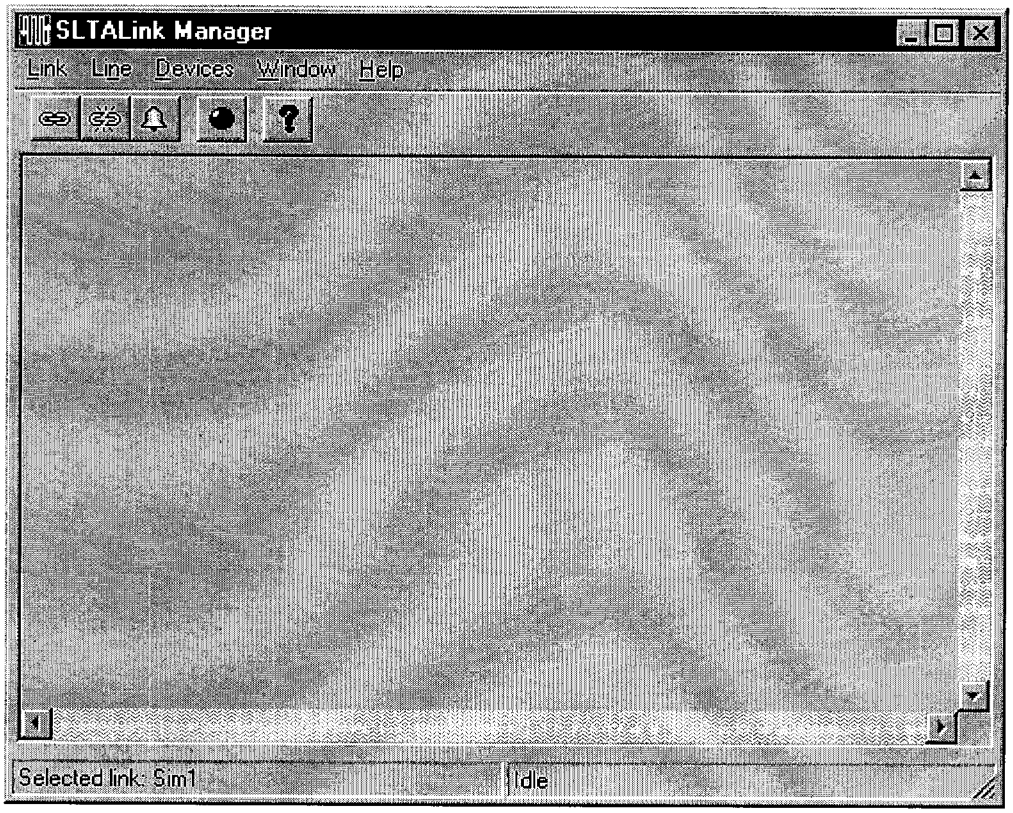
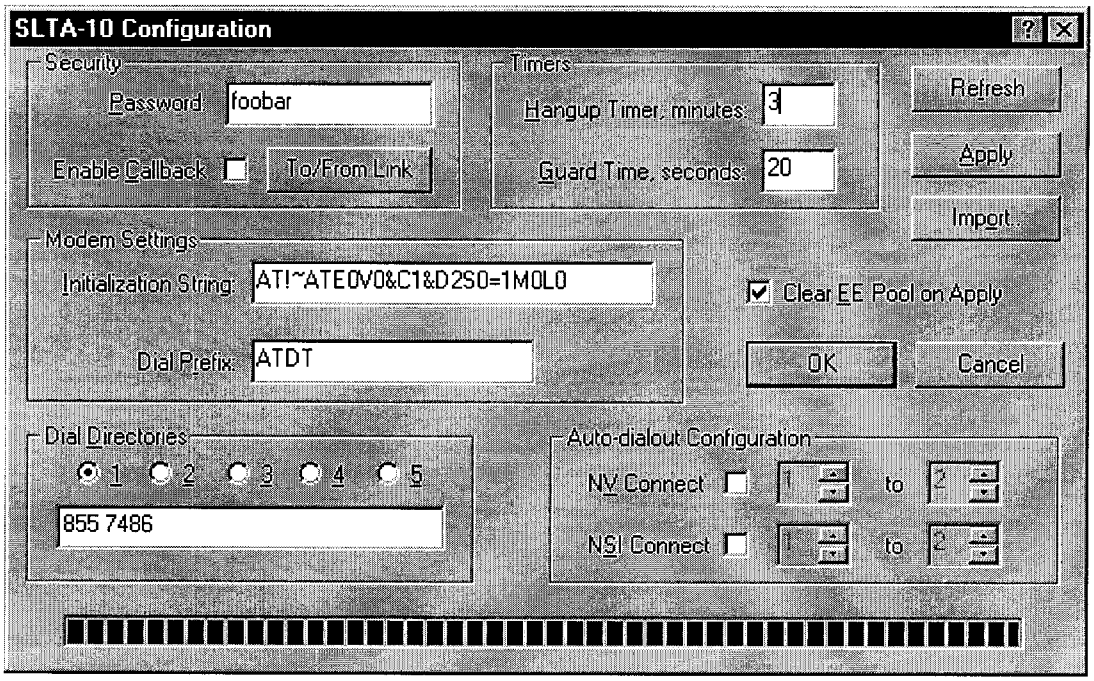


Figure 11.5 SLTALink Manager Application Screen

3. Confirm that the left panel of the SLTALink status bar shows the 'Local SLTA-10'. If not, then click on the `Link.Select>` menu to select the Local SLTA-10.

4. Click on the `Manual Connect Link` speed button (left-most button on the toolbar) to establish a connection to the local SLTA-10. A successful connection will immediately be reported in trace frame of the SLTALink Manager. If the application requires only a dial-in from a remote SLTA-10 to a host PC, then the main configuration concern is the password used to gain access to the SLTA-10 remotely. Use the `Device.Configure SLTA...` dialog to set the password used to control access to the SLTA-10 (figure 6). Figure 11.6 shows a `Password`, with `Clear EE Pool on Apply` selected, and `Auto-dialout` options not selected. When `Apply` button is clicked, the SLTA-10 connected to the PC updates with the new configuration information.


SLTA-10 Configuration

Security
Password: foobar
Enable Callback [ ]

Timers
Hangup Timer, minutes: 3
Guard Time, seconds: 20

Modem Settings
Initialization String: AT!~ATE0V0&C1&D2S0=1M0L0
Dial Prefix: ATDT

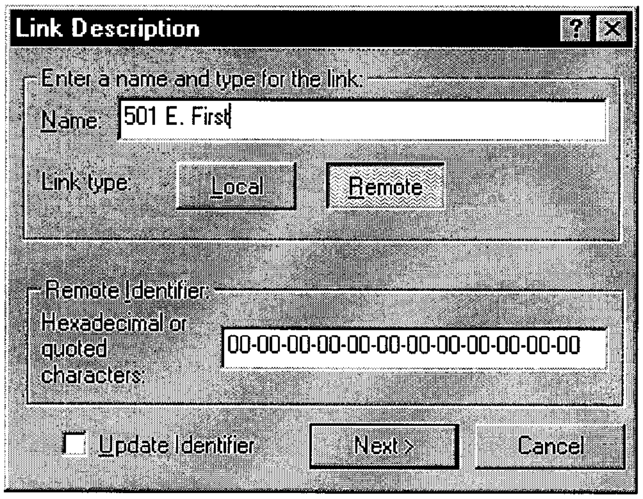
[✓] Clear EE Pool on Apply

Dial Directories
(●) 1 ( ) 2 ( ) 3 ( ) 4 ( ) 5
855 7486

Auto-dialout Configuration
NV Connect [ ] 1 to 2
NSI Connect [ ] 1 to 2

Figure 11.1 SLTA-10 Configuration Dialog Setup for Remote Dial-ins

5. The SLTA-10 can now be tested by running the LonMaker for Windows tool and selecting SLTALON1 to make the current active local SLTA-10 be the network interface. In the LonMaker for Windows tool, the `LonMaker.Status Sumary...` command will provide a quick confirmation that the SLTA-10 functions properly and can reach all devices in the target network. Once the operation of the SLTA-10 has been established, shut down the LonMaker for Windows tool and manually disconnect the local SLTA-10 using the SLTALink Manager.
6. Connect the proper null modem cable between the SLTA-10 and the modem and verify that both devices are powered.
7. From SLTALink Manager, use the `Link.New...` command to define the remote connection description. See figures 11.7 through 11.9.


Link Description

Enter a name and type for the link:

Name: 501 E. First

Link type: Local [✓ Remote]

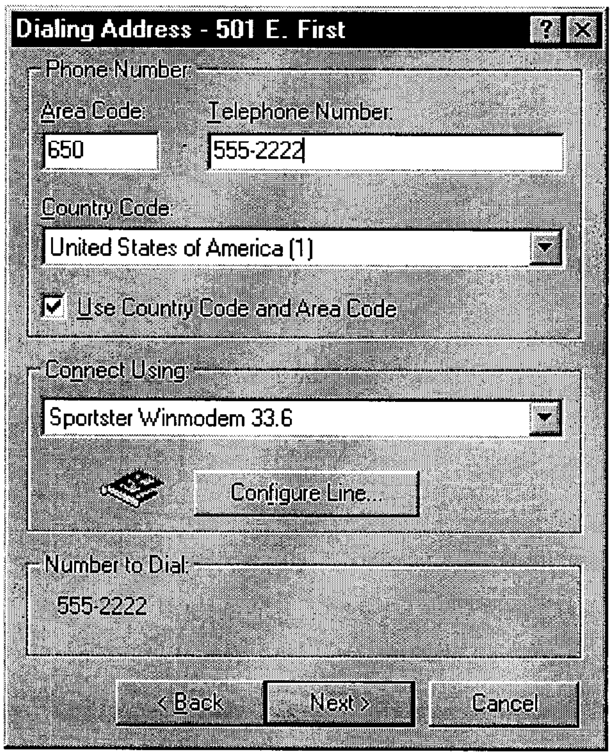
Remote Identifier:

Hexadecimal or quoted characters: 00-00-00-00-00-00-00-00-00-00-00-00

☐ Update Identifier

Figure 11.7 Link Description Wizard

8. Provide the dialing information as shown in figure 11-8.


Dialing Address - 501 E. First

Phone Number:

Area Code: 650

Telephone Number: 555-2222

Country Code: United States of America (1)

☑ Use Country Code and Area Code

Connect Using: Sportster Winmodem 33.6

Number to Dial: 555-2222

Figure 11.8 Dialing Information for the Remote Link

9. Provide the password that was configured during the local connection, as shown in Step 5.

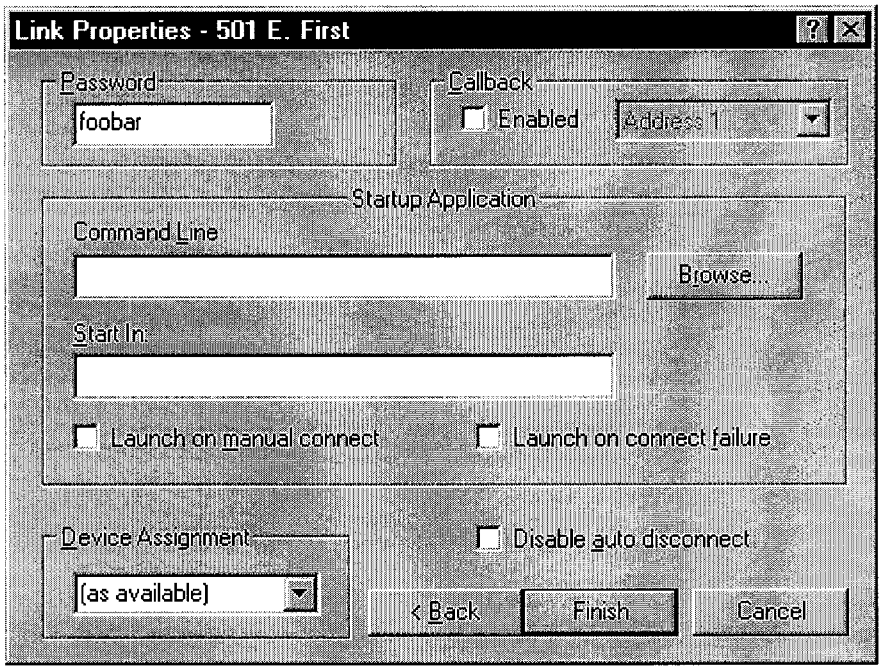
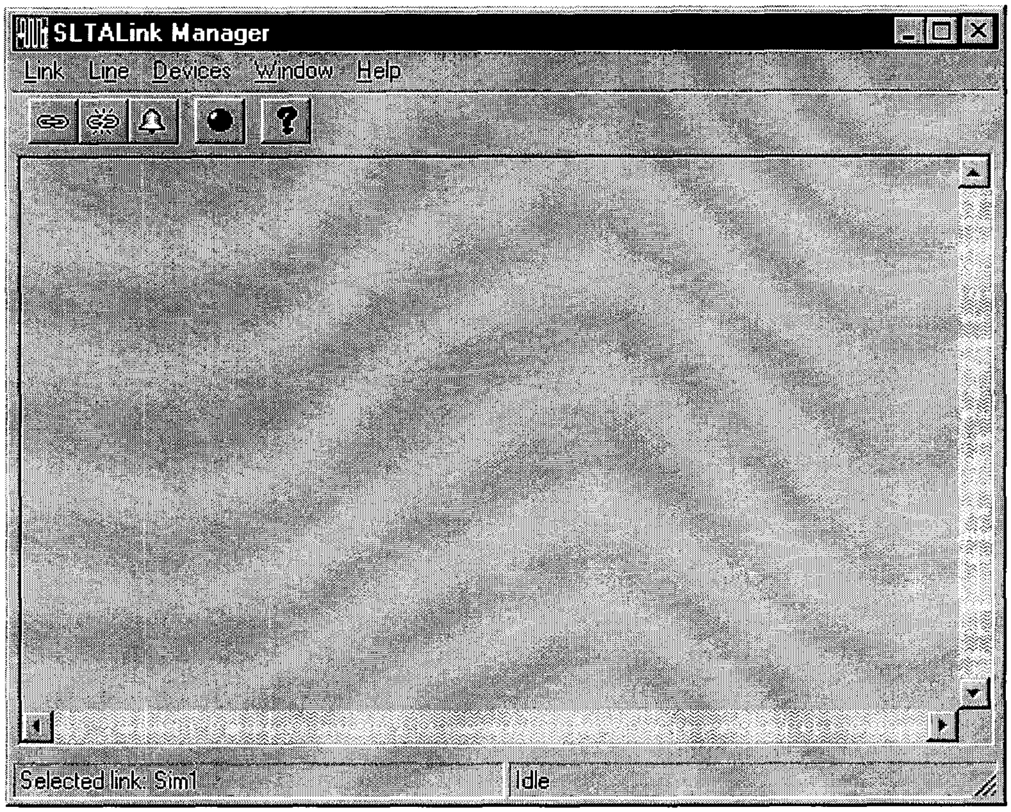


Figure 11.9 Setting the Password for the Remote Link Description

12. Attach the remote SLTA-10 modem to the telephone network. The SLTA-10 is now configured to dial-in and perform the network management functions required to diagnose and maintain the network just as if there was a local connection between the host PC and the remote site. To establish the remote connection, connect the modem of the PC operating the network management tool (i.e., LonMaker for Windows tool) to the telephone network, select the remote link just defined using the `Link.Select>` menu function, and click on the `Connect` speed button. A successful remote connection is shown in figure 11.10. The network management application can now connect to the `SLTALON1` device.



Selected link: Sim1

Idle

Figure 11.10 Results of a Proper Connection to a Remote SLTA-10

12

Using the Host Connect Utility with the SLTA-10 MIP Mode

The Host Connect Utility, or HCU, is a standalone DOS utility designed to dial out and make a connection to a remote SLTA-10 Adapter in MIP mode. This utility may be used prior to executing an application based on a LonManager product, or may be called directly from such a product. The source code for HCU is supplied with the Connectivity Starter Kit so that it may be used as a model for host applications that need to establish connections directly with a remote SLTA-10 Adapter, as well as host applications on platforms other than PCs running DOS.

The features provided by this program are:

- *Dial Out or Hangup Operations*
- *User Defined Modem Strings, Used for Initialization or Dialing*
- *Modem Control via the LDVSLTA Network Driver*

Skip this Chapter if you are using the SLTA-10 NSI mode.

HCU Usage

The command line arguments for HCU are:

```
HCU [options] [string1 .. string(n)] | [@filename]
```

The optional [options] arguments may include:

-C *or* **-H**	To indicate to HCU that this is a **C**onnection operation (the default), or a **H**angup operation. For example, a host application that needs to communicate with a remote SLTA-10 Adapter can be invoked from a DOS batch file, with preceding and subsequent calls to HCU. Prior to invoking the application, HCU is called to connect to the remote SLTA-10 Adapter. Following execution of the host application, HCU is called to disconnect from the remote SLTA-10 Adapter.
-D*devname*	To select a non-default device name, where *devname* is the device name, default `LON1`.
-P*password*	To indicate a password, where *password* is a string of up to 8 characters, which will be sent downlink to the remote SLTA-10 Adapter once the connection is made. Each character in the password string may be any eight bit value. Non printable characters may be represented by hex or octal values in the same format as for C strings, such as "\x10", or "\020".
-T*nnn*	To select a non-default connection wait time of *nnn* seconds; the default is 60 seconds. This value limits the period for which HCU will wait for a connection to be completed.
-B*bps*	To change the LDVSLTA network driver serial bit rate. The default is the current setting of the network driver. This controls the link rate between the host computer and the modem. The acceptable values for the *bps* value are the same as those available on the SLTA-10 Adapter: `1200`, `2400`, `9600`, `14400`, `19200`, `38400`, `57600`, and `115200`.
-N	To enable the buffered link protocol and disable the ALERT/ACK link protocol. This option is not recommended for connection operations.
-X	To exit HCU with the network driver's modem support mode **disabled**. Use with the `-H` option to disconnect from a remote SLTA-10 Adapter for subsequent connection to a local SLTA-10 Adapter.

All options must precede string arguments on the command line when evaluated from left to right.

The string arguments are modem command strings, typically Hayes-compatible AT commands. These strings are sent directly to the modem. For details of the allowable commands, see the documentation supplied by your modem manufacturer. If more than one string is included, HCU will wait for the `OK` response from the modem before sending the next string. This requires that word (alphabetic) modem responses are enabled in the modem. If the OK response does not appear within 4 seconds, HCU will stop waiting and proceed to the next string.

In most cases the command string arguments need to be terminated with a carriage return. The carriage return is represented by the "!" character. HCU will interpret the "!" character by sending a carriage return (0x0D) to the modem. HCU will also interpret the "~" character by pausing 500ms. If either of these characters themselves need to be sent to the modem they can be escaped with a leading backslash, "\!" or "\~". HCU does not send implied carriage returns at the end of each string.

Spaces may be included in the string arguments. If you are including space in an argument you must enclose the string in double quotes or else the DOS command line interpreter will view the spaces as argument delimiters.

A filename may be used as a source of the string arguments. The filename should be preceded by the "@" character, and may be any full pathname. The structure of the file should be a series of text lines, where each line is a separate string argument. Command line strings and filename arguments may be intermixed.

Theory of Operation

Upon execution, HCU will open the network driver, set the driver's operational mode to modem support on, force direct mode on (disables any SLTA-10 Adapter network interface protocols, enabling communications with the modem itself), modem responses on (enables modem responses to be passed to the host), and reliable transport protocol on. If a serial bit rate has been indicated, this also is set within the driver.

Next, if the HCU hangup operation is selected, HCU will drop DTR for 500ms. See *Using the SLTA-10 Adapter with a Modem*, Chapter 11.

Next, all string arguments are sent to the modem. Acceptable modem responses to these strings are OK or ERROR.

Next, if the HCU connection operation is selected, HCU will wait for the connection to be established. This wait will be terminated by one of the following conditions:

- A response from the modem indicating either success or failure. These responses may be one of the following. [CR] is the carriage return (0x0D) character.

  CONNECT [any text] [CR]   This indicates a successful connection.

  These indicate a failed connection:

  NO [any text] [CR],   BUSY [CR],   VOICE [CR]

- Any keyboard action. This will abort the HCU process.

Once the connection is considered made, HCU will process any additional modem responses for a few seconds. It will then change the operational mode of the network driver to force direct mode off and modem responses off. If this is a connection operation, the selected network interface protocol is enabled. If the `-X` option is specified, modem support is disabled.

Finally, if the user has indicated that a password is to be used, HCU will send the password command plus the password to the remote SLTA-10 Adapter, and wait for a response. If the response does not appear within five seconds, or if the response is not an acknowledgment, the process is repeated up to two additional times.

HCU will exit with a status of zero if the connection or hangup was successful. Otherwise the exit status will be '1'. Upon successful exit the network driver state will be set to modem responses off. This implies that if the connection is broken during the course of a host application execution the network driver will not start sending modem responses back to the host application, since it may not know how to handle them.

If operating under Microsoft Windows 3.1x, dialing out to a remote SLTA-10 Adapter requires running the DOS program `HCU.EXE` in a session prior to running the Windows API application. The HCU source code is available from Echelon for integration into a DOS application.

When using HCU with the Windows 95/98 operating system, use the following procedure:

- Start Windows 95/98.
- Start a DOS box. Make the DOS box a small window.
- Run HCU in the DOS box.
- After the message "successfully connected" and the DOS prompt appears, EXIT (type c:\>exit) DOS box.
- Then run the application.

Usage Examples

To connect at 9600 bps with a modem initialization string included in the process:

```
HCU -b9600 -pSLTA_2.0 "ATM1E1S8=1!" "ATDT9,555-1234!"
```

It is important to remember to include the carriage return ('!') at the end of each command string argument.

To hangup:

```
HCU -h "~~~+++~~~ATH0!"
```

which includes the Hayes AT command mode escape sequence.

The following is a DOS batch file which will make the connection using a script '`dial.cmd`', execute a host program '`hostapp.exe`', and then hangup:

```
@echo off
```

```
hcu -b9600 -pSLTA_2.0 @dial.cmd
if not errorlevel 1 hostapp.exe
hcu -h "~~~+++~~~ath0!"
```

If using a Windows-based network management application, a connection can be created by using HCU and then closing the DOS box before initializing the connection with `lxt_open()`.

Suggested Modem Configurations

Following is a list of configuration settings that are suggested for optimal operation of both HCU and for SLTA-10 Adapter to host phone links. These should be included in the string arguments to HCU if they are not the modem defaults. When possible, the corresponding AT command is included.

- Command echo: enabled ("`E1`"). This is a personal preference, and will result in modem commands being included in the HCU display.
- Send modem responses: enabled ("`Q0`"). This causes the modem to respond to commands sent to it with a result code.
- Word responses ("`V1`"). The modem result codes will be expressed as full word codes (alphabetical) rather than as numerical codes.
- Full response set ("`X4`" or "`X2`"). This will include the `BUSY` and `NO DIALTONE` responses, which will expedite the process when these cases occur.
- Data Carrier Detect signal (DCD): reflects carrier state ("`&C1`").
- DTE flow control: disable ("`S58=0`" for Telebit modems, "`&K0`" for Hayes modems). **If your modem uses software (XON/XOFF) flow control, you must disable it since the SLTA-10 Adapter link layer is a binary one.**
- Auto-answer: enabled ("`S0=1`"). If you need your Host modem to answer to an incoming call from a remote SLTA-10 Adapter and modem, you will need to enable this feature.

Status and Error Reporting

HCU will print its progress to the standard output device, which defaults to the CRT screen. The format of this display is:

```
** HCU mm/dd/yy hh/mm/ss progress string
```

where `mm/dd/yy` is the current month/day/year, and `hh/mm/ss` is the current time. All modem responses are also displayed.

Table 12.1 HCU Progress Strings

devname: No such file or directory **or** Not ready reading device *devname*	Indicates that HCU could not open the device *devname*.
Dialing **or** Hanging up	Indicates the HCU operation.
Device initialization error, *devname*	Indicates a problem with initializing the network driver.
Could not open file *filename*	Indicates a problem with opening the string argument file.
Password Format error, abort	Indicates there was a problem interpreting the password argument.
Modem Response Timeout	Indicates that the modem did not respond to a command string.
DCD state test error, *devname*	Indicates a problem communicating with the network driver.
Connect timeout, *devname*	Indicates that the connection was not established within the connection timeout period.
User Abort	Indicates that the connect wait process was aborted by the user.
Connected **or** Connection Failed	Indicates the status of the connection. If the message `Connection Failed` appears following what appears to be a successful modem connection there may be a problem with the DCD signal from the modem.
Downlink Password Failure	Indicates a problem sending the password command downlink to the SLTA-10 Adapter. The connection may have been broken unexpectedly.
Password Validation Fail	Indicates that the remote SLTA-10 Adapter has responded to the password command with a negative acknowledgment. You are probably using the wrong password.
Password Validation Complete	Indicates a successful password command transfer with the remote SLTA-10 Adapter, and that HCU has successfully communicated with the remote SLTA-10 Adapter.
Downlink Password Timeout	Indicates no password acknowledgment or negative acknowledgment was received. Either the remote SLTA-10 Adapter is not operational, or the SLTA-10 Adapter link layer protocol does not match, or there is a problem with transferring binary data across the modem connection.
Hangup Failed, Still Connected	Indicates HCU still thinks that the connection is made following a hangup. This could be the result of a persistent DCD ON level.

13

Using a Programmable Serial Gateway

This chapter describes how to develop a gateway for a user-defined EIA-232 serial protocol. The SLTA-10 is shipped with SLTA firmware that allows it to be used as a LonTalk network interface for network management, monitoring, and control. When the SLTA firmware is installed, the data passed between the firmware and the host application via the EIA-232 port is in the format of LonTalk protocol application buffers. Serial gateways are developed using the models 73381, 73382, 73383, or 73384 PSG/3 (Programmable Serial Gateway). These products allow you to replace the SLTA firmware with your own firmware, enabling custom protocols to be translated into LonTalk.

Creating a Serial Gateway

For applications of the SLTA hardware platform, which cannot use the LonTalk network interface protocol on the EIA-232 link, the SLTA hardware may be programmed for other data formats using Neuron C. For example, the SLTA hardware may be used to connect ASCII devices such as printers, modems, and terminals to a LONWORKS network. The SLTA hardware may also be programmed to build a gateway between a foreign EIA-232-based protocol, such as the serial port on a Programmable Logic Controller (PLC), and the LonTalk protocol. The SLTA hardware without the firmware (e.g., without the PROM) is called a *programmable serial gateway*.

The programmable serial gateway is used to create a LONWORKS application node, so all the standard Neuron Chip firmware features described in the *Neuron C Programmer's Guide* are available to the application programmer. The firmware images for NSI and MIP mode, as well as capabilities described in the *LONWORKS Host Application Programmer's Guide* are not available. For example, there is no support for modem control or for more than 62 bound network variables on such a node. The serial gateway will also not be usable as a network interface for LonMaker, LonManager DDE Server, or LNS-based applications, although it can still be installed and managed by such an application.

SLTA / PSG History

Echelon manufactures (or has manufactured) the following LONWORKS serial devices. Each device ships with firmware:

Product	**Description**	**Firmware**	**Status**
SLTA	Original Serial LonTalk Adapter	Firmware implemented MIP level functionality	Replaced by SLTA/2
SLTA/2	Second generation SLTA	Firmware implemented MIP level functionality	Replaced by SLTA-10
SLTA-10	Third generation SLTA	Firmware implements MIP or NSI level functionality	Current product

Each of the serial adapters listed above may also be ordered *without* firmware. The hardware is identical, but no firmware is shipped with the device. The user must provide firmware using the functions described below.

Product	**Description**	**Firmware**	**Status**
PSG	Original Programmable Serial Gateway; Hardware is identical to SLTA	None	Replaced by PSG/2
PSG/2	Second generation PSG; Hardware identical to SLTA/2	None	Replaced by PSG/3
PSG/3	Third generation PSG; Hardware identical to SLTA-10	None	Current Product

Depending on the hardware you intend to use, one of the following `#defines` must be defined in your source (`.NC`) just before the `PSG.H` file is included.

`#define SLTASIP`	When targeting PSG-10
`#define SLTA2`	When targeting PSG/2
`#define PSG20`	When targeting PSG/3 or PSG-20

Programmable Serial Gateway Hardware Resources

The SLTA-10 hardware includes a UART attached to the I/O pins of a Neuron Chip, memory, oscillator, reset circuitry, and a twisted pair transceiver, as shown in figure 13.1.

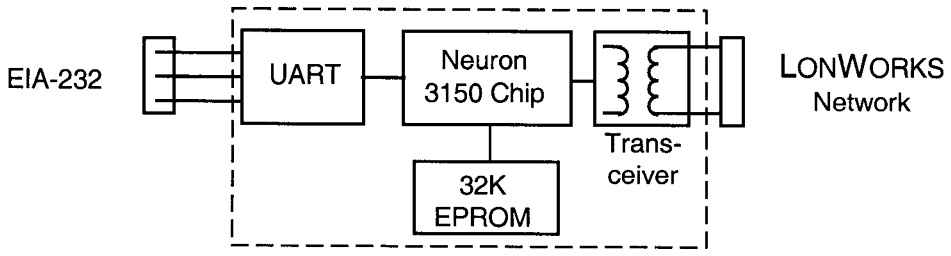


Figure 13.1 SLTA-10 Block Diagram

Developing a PSG Application with the NodeBuilder Development Tool

Developing an application for the PSG/3 serial gateway is similar to developing an application for any other custom device. Follow the device creation procedure outlined in Chapter 5 of the *NodeBuilder User's Guide*.

Warning: The PSG Software relies on the software update provided in NodeBuilder Patch 5. Use the following steps to make certain this patch has been applied to your NodeBuilder development tool before building your PSG images.

1. Select `About NodeBuilder`... in the NodeBuilder HELP menu.
2. Check to be sure the version listed in the "About" dialog box is Version1.5 **Build 05**.

PSG Software Installation

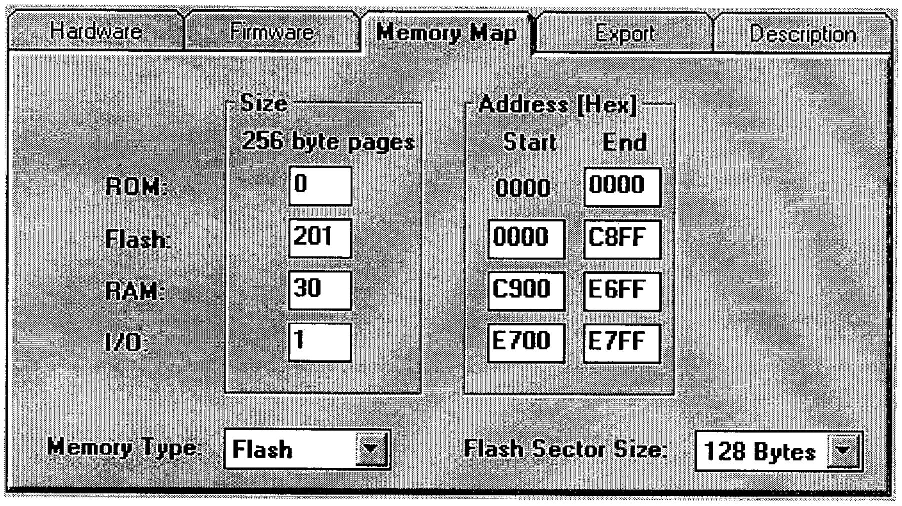
The PSG/3 software diskette contains the following files:

`PSG20R.DTM`	//Device Template
`Readme.txt`	//Must read notes
`PSG.LIB`	//Neuron C library containing PSG functions
`PSG.H`	//Function prototypes
`PSGREGS.H`	//UART register and address definitions

To install the PSG software on your development tool:

1. Copy the device template (`PSG20R.DTM`) to your device template directory. By default, this directory is `c:\lonworks\template`.
2. The two header files (`PSG.H` and `PSGREG.H`) should be copied to your development tool include directory. By default, this directory is `c:\lonworks\neuronc\include`.
3. The final step is to copy the `PSG.LIB` file to your development tool's library directory. By default, this directory is `c:\lonworks\images`.

PSG20R.DTM



Size
256 byte pages

Address [Hex]

	Size (256 byte pages)	Start	End
ROM:	0	0000	0000
Flash:	201	0000	C8FF
RAM:	30	C900	E6FF
I/O:	1	E700	E7FF

Memory Type: Flash

Flash Sector Size: 128 Bytes

PSG/3's are modified to ignore DIP switch #4. The NSI memory map is the only available memory map.

Firmware Library Support

To aid in programming the custom serial gateway application, a firmware library (`PSG.LIB`) provides hardware access functions callable from Neuron C. (`PSG.LIB` replaces and supercedes the `SLTA.LIB` library that shipped with the SLTA/2 and PSG-10 products.) The include files also have been renamed to `PSG.H` and `PSGREG.H`. The new include files contain functions that are backward compatible with the functions declared in `SLTA.H` and `SLTAREG.H`.

In most cases, this library provides all the functions necessary to control the UART hardware and to read and write data from the serial port. Your application program will normally make use of some or all of the firmware functions included in the library `PSG.LIB`. Prototypes for the following functions, and the enumeration literals used in the following descriptions, are in the include file `PSG.H`.

This library is available for free download from the licensed software section of the Developer's Toolbox at www.echelon.com. The library also is provided with the NodeBuilder Development tool.

Usage

A single programmable serial gateway library (`PSG.LIB`) is included with the PSG software. Depending on the hardware you intend to use, one of the following #defines must be defined in your source (`.NC`).

`#define SLTASIP`	When targeting PSG-10
`#define SLTA2`	When targeting PSG/2
`#define PSG20`	When targeting PSG/3 or PSG-20

This will control which low-level I/O access functions are used. Include the `#define` before the `#include <PSG.H>` statement. For example:

```
#include <netdbg.h>

#define PSG20

#include <psg.h>

...

when (reset)

{

    ...

}
```

Code Development and Debugging

The PSG applications can be debugged only with the NodeBuilder Development Tool. The LonBuilder Development Tool may be used to develop/load/export applications, however no debugging facilities are available.

1. Use the Nodebuilder tool with the PSG20R device templates described above to create the following default [dummy] program:

   ```
   #include <netdbg.h>

   #define PSG20

   #include <psg.h>

   when (reset)

   {

   }
   ```

2. Export the program to Motorola S Records or Intel HEX format. See Chapter 5 of the *NodeBuilder User's Guide* for details.
3. Load an AT29C512 or AT29C010 FLASH part with your PROM programmer.
4. Insert the FLASH. into the PSG and power the PSG. Be sure that your NodeBuilder tool is connected to the PSG using the LONWORKS network. (The same way you would connect to any other custom node.)
5. It is now possible to create a real application and download it over the LONWORKS network to the PSG. The NodeBuilder debugging features are available if you included `<netdbg.h>` in your source.

   Note: You should remove the reference to `<netdbg.h` when creating your final distribution build.

```
void slta_init(slta_format, slta_baud, slta_intfc);
```

This function initializes the UART. It sets up the frame format, the serial interface bit rate, and the modem handshake lines. The frame format parameters are listed in `PSG.H` and may be set to:

Format Parameter	*Data Bits*	*Parity*	*Stop Bits*
`format_8N1`	8	no	one
`format_7E1`	7	even	one
`format_7O1`	7	no	one
`format_7N1`	7	no	one
`format_8E1`	8	even	one
`format_8O1`	8	odd	one
`format_6N1`	6	no	one
`format_6O1`	6	even	one
`format_5N1`	5	no	one
`format_5E1`	5	even	one
`format_5O1`	5	odd	one

The `slta_baud` parameter may be set to `baud_300`, `baud_600`, `baud_1200`, `baud_2400`, `baud_4800`, `baud_9600`, `baud_14400`, `baud_19200`, `baud_38400`, `baud_57600`, or `baud_115200`. The EIA-232 interface parameter may be set to `intfc_3wire`, or `intfc_8wire`. Configuration switch inputs are ignored–all configuration information is taken from the parameters supplied to `slta_init()`. This function should be called once in the `reset` clause of the application program.

Example:

```
      when (reset) {
            slta_init(format_8N1, baud_38400, intfc_3wire);
      }
```

```
unsigned slta_config(void);
```

This function reads the configuration inputs. Each input corresponds to a bit in the value returned by `slta_config()`. All of the configuration inputs are available for application use. The model PSG/3 DIP switches, described in Chapter 11, are only valid for the standard SLTA firmware. An application which uses the software in `PSG.LIB` may allocate these inputs for any purpose. To set the serial bit rate and other parameters, see the function `slta_init()`. The DIP switches on the PSG/3 return a logic 1 when set to up position, and a logic 0 when set to the down position. The `BAUD0` input corresponds to the least significant bit, followed by the `BAUD1`, `BAUD2`, `AUTOBAUD`, and the `CFG0` through `CFG3` inputs. The `CFG3` input corresponds to the most significant bit.

MSB							LSB
CFG3	CFG2	CFG1	CFG0	AUTOBAUD	BAUD2	BAUD1	BAUD0

```
boolean slta_txrdy(void);
```

This function returns TRUE if the UART is ready to accept a character to be transmitted and `FALSE` otherwise.

```
void slta_putchar(unsigned data);
```

This function waits until the UART is ready, and then transmits the data character. If the UART is busy, this can take up to one character time. Since the UART is buffered, this function can return before the character is actually transmitted.

```
void slta_puts(const char *s)
```

This function waits until the UART is ready and then outputs a null-terminated string to the UART. Since the UART is buffered, this function can return before the string is completely transmitted. The terminating NUL is not transmitted. For other useful string-manipulation functions, see the *Neuron C Reference Guide.*

Example:
```
      network input SNVT_str_asc text_message;
      when(nv_update_occurs(text_message)) {
            slta_puts(text_message.ascii);
            slta_puts("\r\n");
      }
```

```
boolean slta_rxrdy(void);
```

This function returns TRUE if the UART has one or more characters in its input FIFO buffer and FALSE otherwise. The UART used in the programmable serial gateways has a 16-character input FIFO buffer.

```
long slta_getchar(void);
```

This function tests to see if a character is waiting in the UART's input FIFO buffer. If there is no character waiting, the function returns -1. If there is a character waiting, it is returned in the least significant byte, and zero is returned in the most significant byte.

Example:

```
      when (slta_rxrdy()) {                 // keep polling UART
            char c;
            c = (char) slta_getchar();      // get the character
      }
```

Advanced Applications

For most applications, the functions in PSG.LIB are all that are necessary to create custom programs for a programmable serial gateway using Neuron C. However, for specialized applications, the registers of the UART and the programmable serial gateway may be accessed directly by the application software. This section describes these registers and how they are accessed. For complete documentation, obtain a data sheet for the UART. The UART is an Exar Model 16C550I (http://www.exar.com/products/st16c550.html).

The registers are accessed using the slta_write_uart() and slta_read_uart() functions, which can be used to access any of the locations in the PSG/3 or PSG-20 I/O space. When using these functions, include the file PSGREG.H, which contains definitions for many of these locations.

```
   void slta_write_uart (unsigned addr, unsigned data);
```

This function writes the data byte to the memory mapped I/O location defined by addr.

```
      extern unsigned slta_read_uart (unsigned addr);
```

This function reads the data byte from the memory mapped I/O location defined by addr, and returns that value.

The map for the extended address space is shown in the following sub-sections. Neuron C declarations for these addresses and bit assignments are provided in the include file SLTAREG.H on the PSG software diskette.

UART Registers

The UART registers are located at address 0xE780 – 0xE787. See the UART datasheet for register usage information.

PROM / FLASH Specifications

The following specifications apply to PROM and FLASH.

PROM (90ns)

FLASH 29C512 or 29C010

Differences Between PSG/2 and PSG/3

The following differences exist between PSG/2 and PSG/3.

- PSG/3 supplies DIP switches instead of the PSG/2's internal jumpers.
- PSG/3 no longer supports a 9V battery.
- PSG/3 does not require a control module. The Neuron Chip and the transceiver are on the motherboard.
- PSG/3 uses a 29C512, or 29C010 FLASH. You can also use 27C512.
- PSG/3 no longer supports `STL_BYTE` Board Control Register.
- PSG/3 no longer supports `STAT_BYTE` Board Status Byte.
- PSG/3 supports larger memory map with expanded RAM and ROM/FLASH options.
- `SLTA.H` has been replaced by `PSG.H`.
- `SLTAREG.H` has been replaced by `PSGREG.H`.
- `SLTA.LIB` has been replaced by `PSG.LIB`.
- PSG/3 can be powered by 9 – 30 Volts AC or DC.

Porting PSG/2 Code to the PSG/3

Use the following steps to port an existing application from a PSG/2 to a PSG/3.

1. Use the device template supplied in the PSG/3 software distribution.
2. Change all references to `<slta.h>` to reference `<psg.h>`.
3. Change all references to `<sltareg.h>` to `<psgreg.h>`.
4. Change #define `SLTASIP` or #define `SLTA2` to #define `PSG`.
5. Recompile your application and link with the `PSG.LIB` library.

14

Modem Troubleshooting

This chapter provides solutions to problems that may arise with a modem attached to an SLTA-10 Adapter.

Troubleshooting

A Host/Modem - Modem/SLTA-10 Adapter configuration has many user-selected options including the choice of modems, configuration of the modems, the operating system of the host, the network interface link protocol, and the serial bit rates of both the host/modem link layer and the SLTA-10 Adapter modem link layer.

The most common problem is a failure to use the correct SLTA-10 Null Modem Cable specified in Chapter 3.

SLTA-10 Adapter and Modem Do Not Answer or Pick Up

The modem attached to the SLTA-10 Adapter must be configured to auto-answer if you want it to pick up and connect when dialed up. Set the modem's S0 register to a non-zero value.

Modems Will Not Connect

This is an unusual case with current modems which utilize modulation scheme fallbacks and error control negotiation fallbacks. One rule for modem modulation speed configuration is that if your modem can be configured to connect at the speed of the last 'AT' command, do so. Also, be sure that the modem's connect/carrier (Register S7) wait time is sufficient. Start with 60 seconds.

SLTA-10 Adapter to Host Link Fails Completely

This can be observed as repeated retries at the link layer when the first actual downlink or uplink transfer is attempted. This can be due to any of the following conditions (in order of likelihood):

- Mismatched network interface link protocols. One end is using the ALERT/ACK link protocol and another is using the buffered link protocol. These settings are determined on the SLTA-10 Adapter by Switch1/CFG3 and in the host by network driver switches. The ALERT/ACK link protocol should be used (OFF/down position for Switch1/CFG3 on the SLTA-10 Adapter).
- Using the Host Connect Utility in the wrong network interface link protocol. HCU can and may modify the current configuration of the DOS network driver. Ensure that the command line switches for the HCU maintain the desired network interface link protocol and serial bit rate settings. For example, you may have used the `/N` option with the DOS device driver, but did not use the `-N` switch with HCU.
- Using XON/XOFF flow control in your modem. Since the SLTA-10 Adapter network interface protocol is a binary one, this configuration will interfere with, or lock up, your modem. Be sure that this feature is disabled in your modems.

SLTA-10 Adapter to Host Link Fails Partially

This can be observed as retries at the link layer when certain downlink or uplink transfers are attempted. This can be due to any of the following conditions (in order of likelihood):

- Extreme-case delays in either the modem or the connection. In this case the DOS network driver's calculated timeout values are too short. Increase the basic timeout value for the driver using the `/Rnn` option. Start with 10 for *nn* and go up.
- Use with Microsoft Windows 3.1x, particularly at higher serial bit rates (9600 or greater). This is always a problematic case. The priority of the serial I/O interrupts for PC/ATs is always lower than the DOS tick interrupt, which is used by Windows to perform many multi-tasking services. During these services, the serial I/O interrupts may not be serviced in time, resulting in lost uplink data. One solution is to lower the serial bit rate. Another solution may be to replace the PC/AT's UART with the 16550 UART, which has a 16 byte FIFO buffer built into it. This only works for external modem configurations, and will add about 16ms of interrupt headroom at 9600 bps, because of the hardware FIFO buffer. Another suspect in this area can be a disk caching program. These programs also perform services under the DOS tick interrupt, such as flushing data onto the disk drive, which can postpone serial I/O interrupts for lengthy periods.
- Modem serial bit rate overrun. For example, if the SLTA-10 Adapter serial bit rate is set to 38,400 bps and the modem telephone line speed is set to 2,400 bps, the modem will likely be overrun by sending it data faster than it can transmit it. This can occur since no flow control schemes can be used to restrict the rate that data is sent to the modem. In general, set the modem link rate equal to the telephone line speed. In certain cases it will be acceptable to exceed the telephone line speed - for instance, with a 14,400 bps V.32bis modem with data compression enabled, it may be possible to run the modem link at 19,200 bps.
- Full duplex FIFO overrun. This is caused by excessive full duplex traffic when using the buffered link protocol. The ALERT/ACK link protocol should be used instead.

SLTA-10 Adapter Sends Modem Configuration String, But It Has No Effect

Most modems will determine the serial bit rate based on the assumption that the first two characters sent to them while in the command mode are the characters "AT". This means that a type of bit rate detection is being performed when these characters are sent to the modem. If the modem has been power cycled it will need to repeat this process. Some modems cannot handle being sent an entire configuration string following these first two characters during this link rate sensing phase. One way to accommodate these modems is to add an extra AT command, followed by a delay, to the front of the configuration string. For example:

```
"AT!~ATE0&C1&D2S0=1!"
```

This will allow the modem time to become fully synchronized with the new link bit rate before sending any actual command strings to the modem.

Appendix A

LONWORKS DLL Interface Software

This appendix describes the function and use of the LONWORKS DLL interface software provided with Echelon's Connectivity Starter Kit.

Introduction

Microsoft Windows 3.1x supports access to DOS drivers through an interface layer called DOS Protected Mode Interface (DPMI). This interface standard defines the requirements to switch the processor between protected (Windows) and Real (DOS) mode operation, and also the mechanisms for proper data transfer between code running in these operating environments. Using DPMI, the same driver may be used in DOS, Windows 3.1x, and Windows 95/98 without modification.

The DPMI layer that allows access to the LDVSLTA.SYS and other DOS drivers provided by Echelon is contained in the Windows 3.1x DLL, WLDV.DLL. This DLL is part of the LonManager® API for Windows, and the LonManager DDE Server. It is also supplied on the Windows 3.1x DLL diskette. The LonManager API provides high level functions for network installation, maintanence, monitoring, and control. The LonManager DDE Server provides a simple Dynamic Data Exchange (DDE) interface for other client Windows applications to access to a LONWORKS based network for monitoring and control.

Programs specify a logical network driver name when first requesting access to the network. The WLDV.DLL supports simultaneous access to a maximum of eight (8) DOS drivers. The functions provided by WLDV.DLL are described in the following section.

ldv_close

Purpose

Terminates access to the network interface hardware.

Syntax

```
#include <ldv.h>
short ldv_close(short handle);
```

See Also

`ldv_open()`

Returns

`LDV_OK (0)`	Device closed successfully.
`LDV_NOT_OPEN (3)`	Invalid handle or device not open.

Parameters

`handle`	`short` Device identifier returned by `ldv_open()`.

ldv_get_version

Purpose

Returns the current version of the driver DLL as a text string. Format of the version string is "M.mm[.sss]" where M is the major release number, mm is the minor release number, and [.sss] is an option sub-release number. All numbers are decimal. Using this function allows your application to verify that a compatible version of the driver `WLDV.DLL` is loaded.

Syntax

```
#include <ldv.h>
const char far *ldv_get_version(void);
```

See Also

None.

Returns

`char far *`	Character pointer to text string containing the `WLDV.DLL` version number.

Parameters

None.

ldv_ioctl

Purpose

Ldv_octl error codes are the same as for ioctl(); the number of bytes actually transferred. –1 implies invalid handle, func, or device type. Only DOS device drivers are allowed.

Syntax

```
int ldv_ioctl (int handle, unsigned char func, pVoid argdx, int argcx);
```

See Also

```
ldv.h
```

Returns

Parameters

The only valid values for 'func' are:

2	Read from device
3	Write to device

ldv_open

Purpose

Initializes the network interface hardware for access by a Windows application. A Windows application can open multiple network interfaces. In the case of DOS drivers, this is done by loading multiple drivers in `CONFIG.SYS`. Initialization required to prepare the SLTA-10 Adapter is performed by this function. Different drivers and hardware interfaces could require different initialization and configuration requirements. Each driver must provide its own mechanism for providing these services. In the case of DOS device drivers, this is assumed to be command line options specified at the time the driver is loaded.

Note: A driver should only allow itself to be opened once. If the driver is already open, it should return the error value 2.

Syntax

```
#include <ldv.h>
short ldv_open(char far *device_id_p, short far *handle)
```

See Also

`ldv_close()`

Returns

`LDV_OK (0)`	Device successfully opened.
`LDV_NOT_FOUND (1)`	Hardware does not exist or is not accessible.
`LDV_ALREADY_OPEN (2)`	Device already open.
`LDV_DEVICE_ERR (4)`	Error occurred accessing device.
`LDV_INVALID_DEVICE_ID (5)`	Invalid device ID.
`LDV_NO_RESOURCES (8)`	No device handles available.

Parameters

`device_id_p`	`char far *` Pointer to a character string identifying the network interface hardware device to be accessed. The following naming conventions are used to identify the type of device driver being used: `LON`*n* — DOS Device Driver named *LONn*, where *n* is a number from 1 to 9.
`handle`	`short far *` Pointer to an integer in which the open function will return a handle to be used to identify this device in other driver functions.

ldv_read

Purpose

Retrieves an available message from the network interface hardware. The function returns immediately when no messages are available. An error is returned when the next available message is longer than the specified buffer length.

Syntax

```
#include <ldv.h>
short ldv_read(short handle, void far *msg_p, short len);
```

See Also

`ldv_write()`

Returns

`LDV_OK (0)`	Message read and placed in the buffer pointed to by `msg_p`.
`LDV_NOT_OPEN (3)`	Invalid handle or device not open.
`LDV_DEVICE_ERR (4)`	Error occurred accessing device.
`LDV_NO_MSG_AVAIL (6)`	No message available.
`LDV_INVALID_BUF_LEN (9)`	Invalid buffer length.

Parameters

`handle`	`short` Device identifier returned by `ldv_open()`.
`msg_p`	`void far *` Pointer to the buffer into which the message will be placed.
`len`	`short` Length of buffer, in bytes.

ldv_write

Purpose

Delivers a message to the network interface hardware.

Syntax

```
#include <ldv.h>
short ldv_write(short handle, void far *msg_p,
            short len);
```

See Also

`ldv_read()`

Returns

`LDV_OK (0)`	Message written successfully.
`LDV_NOT_OPEN (3)`	Invalid handle or device not open.
`LDV_DEVICE_ERR (4)`	Error occurred accessing device.
LDV_NO_BUFF_AVAIL (7)	No message buffers available.

Paramters

`handle`	`short` Device identifier returned by `ldv_open()`.
`msg_p`	`void far *` Pointer to buffer containing the message to be delivered to the network.
`len`	`short` Length of outgoing message, in bytes.

ECHELON®

DECLARATION OF CONFORMITY

LonTalk Adapters (SLTA-10, PSG/3, PSG/20)

Application of Council Directive:	89/336/EEC; 73/23/EEC
Manufacturer's Name:	Echelon Corporation
Manufacturer's Address:	415 Oakmead Parkway Sunnyvale, CA 94086 USA
Manufacturer's Address: in Europe	Echelon BV Printerweg 3 3821 AP Amersfoort The Netherlands
Product Model Number:	73301, 73302, 73303, 73304 73351, 73352, 73353, 73354, 73381, 73382, 73383, 73384
Type of Equipment:	Information Technology Equipment
Standards to which: Conformity is Declared	EN 60950:1992+A1+A2+A3+A4:97 EN 55022:1995 EN 50082-1:1997 ENV 50204 EN 61000-4-2 EN 61000-4-3 EN 61000-4-4 EN 61000-4-5 EN 61000-4-6 EN 61000-4-8 EN 61000-4-11

I, Paul Smith, hereby declare that the equipment specified above conforms to the above Directives and Standards.

[illegible]

Place: Amersfoort, The Netherlands Date: October 2000 Position: Controller, Echelon Europe