



## Configuration Guide

### High-Level Data Link Control

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This configuration and troubleshooting guide will aid in the setup of High-Level Data Link Control (HDLC) for ADTRAN Operating System (AOS) products. An overview of HDLC general concepts combined with detailed command descriptions provide step-by-step assistance for configuration. The troubleshooting section outlines proper use of **show** commands to verify that HDLC has been configured properly on the AOS product(s).

This guide consists of the following sections:

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## HDLC Overview

HDLC is one of the oldest Data Link Layer (Layer 2) protocols for a wide area network (WAN); predating even the personal computer (PC). Although it was developed for a mainframe environment containing primary and secondary devices, HDLC has been updated for use in the PC environment. The original HDLC protocol is significant to the world of internetworking because it is the basis of many modern Layer 2 protocols, including point-to-point protocol (PPP), Frame Relay, and Q.921 (LAP-D). Despite its historical significance, the original HDLC protocol is no longer in wide deployment. However, Cisco HDLC (cHDLC), an extension to the original HDLC protocol, is prevalent in today's industry.

The term HDLC in modern day conversation typically refers to the extended version of HDLC or cHDLC. cHDLC enhances the International Organization for Standardization (ISO) HDLC standard by adding multi protocol support and Serial Line Address Resolution Protocol (SLARP). SLARP enables dynamic address assignment and keep alive capability across a serial point-to-point connection.



*Following common industry verbiage, this document uses the acronym HDLC in place of cHDLC.*

HDLC allows for the efficient transport of IP traffic across various transmission mediums, including T1, E1, T3, digital data service (DDS), symmetric high-speed digital subscriber (SHDSL), and synchronous serial circuits. The protocol is simplistic and lacks the more advanced features found in PPP; such as authentication, automatic Layer 3 (IP) addressing, loop detection, and multilink applications. Although HDLC is a very basic protocol, efficient design and ease of configuration make it the preferred protocol of many Internet Service Providers (ISPs) across dedicated circuits to their customer's premises.

## Hardware and Software Requirements and Limitations

HDLC is supported in AOS products running version 9.1 or higher and support an appropriate WAN physical interface (T1, E1, T3, DDS, SHDSL, and synchronous serial).

The use of 31-bit IP prefixes on HDLC interfaces requires AOS version 14.1 or above.



*First generation NetVanta 3200/3205 routers do not support the appropriate software for HDLC implementation.*

## Advanced CLI Configuration

### T1, E1, DDS, SHDSL, Serial, T3, and HSSI Interfaces

The physical T1, E1, DDS, SHDSL, serial, T3, and high-speed serial interface (HSSI) interfaces must be set up and activated in addition to configuring the virtual HDLC interface. Table 1 shows the primary physical settings that must be configured for an interface that uses HDLC.

**Table 1. Primary Required Physical Settings**

Interface Configuration Mode Context	Command	Explanation
t1	<b>tdm-group</b> <number> <b>timeslots</b> <range of DS0s>	Defines the number of channels (DS0s) used for the T1 connection.
	<b>coding</b> [ami   b8zs]	Defines the line coding.
	<b>framing</b> [d4   esf]	Defines the frame format.
	<b>clock source</b> [internal   line   system]	Defines the clock source or timing for the T1.
	<b>lbo</b> [long   short]	Line build out (LBO) sets the strength level of the transmit signal.
	<b>no shutdown</b>	Activates the interface.
e1	<b>tdm-group</b> <number> <b>timeslots</b> <value>	Defines the number of channels used for the E1 connection.
	<b>coding</b> [ami   hdb3]	Defines the line coding.
	<b>framing</b> [crc4]	Defines the frame format.
	<b>clock source</b> [internal   line   system]	Defines the clock source or timing for the E1.
	<b>no shutdown</b>	Activates the interface.
dds	<b>clock source</b> [internal   line]	Defines the clock source for the DDS interface.
	<b>clock rate</b> [auto   bps56k   bps64k]	Defines the clock rate.
	<b>no shutdown</b>	Activates the interface.
shdsl	<b>equipment-type</b> cpe	Specifies this unit as a slave unit that is interfacing directly with a service provider.
	<b>no shutdown</b>	Activates the interface.
serial*	<b>serial-mode</b> [EIA530   v35   x21]	Configures the interface to support the appropriate cable.
	<b>et-clock-source</b> [rxclock   txclock]	Configures the serial interface to take the clock from the receive signal (rxclock) or from the transmit signal (txclock).
	<b>no shutdown</b>	Activates the interface.

Table 1. Primary Required Physical Settings (*Continued*)

Interface Configuration Mode Context	Command	Explanation
t3**	<b>clock source [local   loop]</b>	Defines the clock source or timing for the T3.
	<b>coding [b3zs]</b>	Defines the line coding.
	<b>framing [cbit   m13]</b>	Defines the frame format.
	<b>line-length [short   long]</b>	Sets the strength level of the transmit signal.
	<b>no shutdown</b>	Activates the interface.
hssi**	<b>no shutdown</b>	Activates the interface.
<p>* A serial connection on the WAN is typically used when the AOS device is placed behind an existing WAN access device.</p> <p>** T3 and HSSI are currently only supported in the NetVanta 5305.</p>		

## Basic HDLC Interface Setup

The first step to configuring HDLC for an E1, T1, DDS, SHDSL, serial, T3, or HSSI interface is to create a virtual interface. Start from the Global Configuration mode:

### Step 1: Create an HDLC Interface on the AOS Product

Create the virtual HDLC interface and assign it a number. Every HDLC interface must have a unique number.

```
(config)#interface hdlc <interface id>
```

<interface id> Specifies the HDLC interface number. Range is 1 to 1024. This value is only locally significant and does not need to match an identifier of the HDLC interface on the other end of the point-to-point circuit.

### Step 2: Configure an IP Address for the WAN Connection

The IP address for the E1, T1, or DDS WAN connection is configured on the HDLC interface rather than on the physical interface. There are two ways to assign an IP address to the HDLC interface:

- Assign a static IP address
- Configure the HDLC interface as an unnumbered interface

### Static IP Address

The static IP address is a fixed address assigned to the HDLC interface by a user.

```
(config-hdlc 1)#ip address <ip address> <subnet mask>
```

<ip address> Specifies a valid IP address. IP addresses should be expressed in dotted decimal notation.

<subnet mask> Specifies the subnet mask that corresponds to a range of IP addresses (network) or a specific host. Subnet masks can be expressed in dotted decimal notation or as a prefix length following a forward slash (/).

For example, the IP address 192.168.0.1, assuming a 24-bit subnet mask, could be entered in either of the following ways:

```
(config-hdlc 1)#ip address 192.168.0.1 255.255.255.0 (using dotted decimal notation) or (config-hdlc 1)#ip address 192.168.0.1 /24 (using prefix length).
```

### Unnumbered Interface

To conserve IP addresses on a network, users can create an HDLC interface as an unnumbered interface. When a logical interface on the router is assigned an IP address, the address cannot overlap with the IP addresses assigned to other logical interfaces on the network. As a result, each interface that has an IP address represents an entire subnet. Depending on the subnetting scheme used, this could use more IP addresses than a network can spare.

By configuring an HDLC interface as an unnumbered interface, the IP address of another interface (specified by the user) will also be used for the HDLC interface. AOS then uses the IP address of the specified interface when routing updates are sent over the HDLC interface.

```
(config-hdlc 1)#ip unnumbered <interface>
```

<interface> Specifies the interface that contains the IP address to use as the source address for all packets transmitted on this interface. For example, for an Ethernet interface, **eth 0/1** might be specified. Valid interface types include asynchronous transfer mode (ATM), bridged virtual interface (BVI), demand, Ethernet, Frame Relay, HDLC, loopback, and PPP. Virtual local area network (VLAN) interfaces are also an option on integrated switch-router products. Type **ip unnumbered ?** for a list of valid interfaces on a specific product.

Unnumbered interfaces allow better conservation of IP addresses, but there is a caveat associated with this IP addressing method. If the source interface is down for any reason (for example, an Ethernet interface is unplugged), the HDLC interface will also lose IP connectivity. Logical interfaces, such as Loopback or VLAN, are the best choice for an unnumbered interface because they do not go down unless they are administratively disabled.

### Step 3: (Optional) Configure Secondary IP Addresses

Depending on the network setup, secondary address configuration may or may not be needed. If secondary addresses are not needed for this HDLC connection, go to Step 4.

Additional IP addresses may be configured on HDLC interfaces, as needed. The most common reason for adding secondary addresses to WAN interfaces is for configuring port forwarding or one-to-one NAT. Port forwarding and one-to-one NAT allow users to make servers on a private network available to the Internet via public IP addresses. The configuration requires the publicly available IP addresses to be added to the router's WAN interface, usually as secondary addresses.

```
(config-hdlc 1)#ip address <ip address> <subnet mask> secondary
```

<ip address> Specifies a valid IP address. IP addresses should be expressed in dotted decimal notation (for example, 208.61.209.2).

<subnet mask> Specifies the subnet mask that corresponds to a range of IP addresses (network) or a specific host. Subnet masks can be expressed in dotted decimal notation or prefix length.

#### Step 4: Activating the HDLC Interface

Although this command activates the HDLC interface, the interface will not change until it is bound to the physical interface (refer to Step 5).

```
(config-hdlc 1)#no shutdown
```

#### Step 5: Cross Connect the Physical Interface to the Virtual Interface

Next, associate the appropriate physical interface to the HDLC interface, using the **cross-connect** command. The physical interface must be cross connected to the virtual interface so that the AOS device knows which data link layer protocol to use for that WAN connection. When a physical interface is cross connected to a virtual interface, the two are considered a single interface cross connect group. This guide assumes that the physical interface has already been configured.

```
(config-hdlc 1)#cross-connect <number> <from interface> <group number> <to interface>
```

<number> Identifies the cross connect using a number descriptor. Each cross connect within an AOS device must have a unique number. Range is 1 to 1024.

<from interface> Specifies the physical interface on one end of the cross connect. Specify an interface in the format <interface type [slot/port | interface id]>. To set up the HDLC cross connect as outlined in this guide, it is likely that a T1, E1, DDS, serial, or SHDSL WAN interface will be specified as the from interface. For example, for a T1 interface, use **t1 1/1**. Enter **cross-connect 1 ?** for a list of all valid interfaces.

<group number> Optional. Specifies which configured time division multiplex (TDM) group to use for this cross connect. This subcommand only applies to T1 or E1 physical interfaces. To set up the HDLC cross connect as outlined in this guide, use the same TDM group number previously assigned to the physical interface (see Table 2 for more details).

<to interface> Specifies the virtual interface on the other end of the cross connect. Specify an interface in the format <interface type [slot/port | slot/port.subinterface id | interface id | interface id.subinterface id]>. To set up the HDLC cross connect as outlined in this guide, the interface number placed here should match the number assigned to the HDLC interface in Step 1. For example, for **hdlc 1**, use the **?** to display a list of all valid interfaces.



*You do not include a TDM group number when cross-connecting a serial, HSSI, T3, SHDSL, or DDS interface to a virtual interface because they do not use TDM groups.*

The **cross-connect** command binds the virtual HDLC interface to the physical WAN interface in the AOS product. The HDLC interface can now attempt to negotiate an HDLC session with its peer, and if that negotiation is successful, the status of the HDLC interface will change to up. To view the status of or troubleshoot an HDLC interface, refer to *Troubleshooting* on page 29 of this guide.

### Step 6: Exit the HDLC Interface Configuration Menu and Save the Configuration

Issue the **exit** command once to leave the HDLC Interface Configuration mode and return to the Global Configuration mode. Issue the **exit** command a second time to return to Enable mode, which is where the **copy running-config startup-config** command is issued to save the configuration.

```
(config-hdlc 1)#exit
```

```
(config)#exit
```

```
#copy running-config startup-config
```



*The configuration may also be saved directly from the HDLC interface configuration mode or from the Global Configuration mode by typing the command **do copy running-config startup-config**.*

## Additional Settings

Depending on the user's WAN environment, other settings may need to be configured on the HDLC interface.

### Bridging

Generally, routing should always be used across WAN links. However, some legacy equipment, such as point-of-sale devices and older medical equipment, do not support IP networking. AOS offers bridging as an option available for legacy applications that do not support IP routing.

Use the **bridge-group** command to assign an interface to the specified bridge group. This command is supported on all Ethernet interfaces, HDLC and PPP virtual interfaces, and Frame Relay virtual subinterfaces. Use the **no** form of this command to remove an interface. Any two IP interfaces can be bridged (Ethernet to PPP virtual interface, VLAN to PPP virtual interface, etc.).

```
(config-hdlc 1)#bridge-group <number>
```

<number> Specifies the bridge group (by number) to which to assign this interface. Range is 1 to 255.



*Several additional steps are needed to complete bridging configurations. Refer to [Configuring Bridging in AOS](http://kb.adtran.com), article #2148 found at <http://kb.adtran.com> for more information on bridging.*

### Description

A description may be added to the HDLC interface to provide additional information about it. For example, if multiple HDLC interfaces at the corporate office have been configured toward different remote locations, a description can be used to identify the location of the connection at the far end of each HDLC link.

(config-hdlc 1)#**description** <text>

<text> Identifies the specified interface using up to 80 alphanumeric characters.

This description is displayed in the output when either the **show running-config** or the **show interface hdlc** commands are issued from Enable mode.

### Keepalive

Use the **keepalive** command to enable the transmission of keepalive packets on the HDLC interface and specify the time interval (in seconds) between transmitted packets. By default, the keepalive interval in AOS for HDLC interfaces is 10 seconds.

(config-hdlc 1)#**keepalive** <value>

<value> Defines the time interval (in seconds) between transmitted keepalive packets. Valid range is 0 to 32,767 seconds.

The keepalive interval must be set to the same value on devices at both ends of the HDLC link. The shorter the keepalive interval, the faster an interface failure will be detected. The keepalive signal may be disabled by issuing the command **keepalive 0** on the HDLC interface. However, this should only be done if the keepalive has been disabled on the device at the other side of the point-to-point connection.



*When an HDLC interface is enabled, it is normal for the interface line protocol to initially alternate between up and down status a few times. This will occur until the devices at both ends of the HDLC link have received each other's keep alive signal.*



### Maximum Transmission Unit (MTU)

The MTU defines the largest size that an HDLC frame can be. If a frame exceeds this size, it must be fragmented. By default, the MTU for HDLC interfaces is 1500 bytes.

```
(config-hdlc 1)#mtu <size>
```

<size> Specifies the window size (in bytes) for transmitted packets. The valid range for HDLC interfaces is 64 to 2100 except in the NetVanta 5305. The valid range for HDLC interfaces in the NetVanta 5305 is 64 to 4600.



*The valid MTU range for HDLC interfaces to all interfaces was 64 to 1520 prior to AOS 14.1.*

The MTU should be left at 1500 bytes for most network environments. However, in some cases the MTU size may need to be adjusted. If the peer router uses a different MTU size across the HDLC connection, transmissions and routing can be affected. For example, if the HDLC peer is set to an MTU less than 1500 and the host router sends a frame that is 1500 bytes, the HDLC peer will have to fragment the frame. Furthermore, if the frame is tagged with the *do not fragment* field, then the peer router cannot forward the frame at all.

If open shortest path first (OSPF) routing has been enabled on the AOS product, the MTU setting should be verified on all adjacent devices. OSPF routers cannot become adjacent if their MTU sizes do not match.

## GUI Configuration

The Web-based graphical user interface (GUI) is an especially useful tool for those who are less familiar with command line interface (CLI) configuration. AOS products ship standard with a user-friendly GUI that can be used to perform many basic management and configuration functions on the AOS product. Some advanced options are configurable via the GUI as well.


Open a GUI session. If you need assistance, refer to the quick start guide specific to your AOS product available on the *AOS Documentation* CD shipped with your unit or online at [www.adtran.com](http://www.adtran.com).

**Figure 1. System Summary Menu**

Once a successful connection to the GUI has been established, the main landing page appears.

A setup wizard option is available in the NetVanta 340, 3200, 3430, and 3448. Select **Setup Wizard** from the left-hand menu in the GUI. The same wizard is available in the Total Access 900(e) Series and NetVanta 6355, but it is called a **Configuration Wizard**. The wizard will guide a system administrator through setup of the most common HDLC configurations. However, if the system administrator prefers to configure HDLC without going through the wizard, the following step-by-step process mimics the configuration outlined in *Advanced CLI Configuration* on page 3 of this document.



While navigating the GUI you will notice question mark  symbols that indicate additional information is available. Simply place your cursor over the symbol to view the additional information.

## Step 1

Select **Physical Interfaces** from the left-hand **System** menu in the GUI. A list of all the physical interfaces on the AOS product will appear. Select the interface to be configured for HDLC by selecting its name (See Figure 2). As an example, this tutorial demonstrates the configuration of the interface **t1 1/1**.

**NOTE**

A virtual interface (i.e., HDLC 1) that has already been created will appear as a hyperlink listed under the **Logical Interface** heading. This hyperlink allows direct access to configuration menus for the virtual interface.

The screenshot shows the ADTRAN NetVanta 3200 GUI. On the left is a navigation menu with 'Physical Interfaces' selected. The main content area is titled 'Physical Interfaces' and contains a table of interfaces. An arrow points to the 't1 1/1' entry in the table, which is highlighted. Below the table, a text box says 'Select the interface to be configured for HDLC by selecting its name.'

Name	Logical Interface	Line Status	Type
<a href="#">eth 0/1</a>	none	Up	Ethernet
<a href="#">t1 1/1</a>	none	Up	WAN-T1
<a href="#">t1 1/2</a>	none	Interface Disabled	WAN-T1

Figure 2. Physical Interfaces Menu

Step 2

**NOTE** *The **Physical Interfaces Configuration** menu in the Total Access 900(e) Series, NetVanta 6355, and NetVanta 7000 Series is different than the NetVanta 3200 menu shown below. Refer to the Total Access 900(e) Series, NetVanta 6355, and NetVanta 7000 Series GUI on page 13 to find information applicable to the GUI in those products.*

The GUI now displays the **Physical Interfaces Configuration** options for **t1 1/1** (See Figure 3). Select the number of data DS0s on this T1 that are to be mapped to the router. All DS0s or a contiguous fraction of DS0s can be activated for data. Select the button next to **HDLC** to set the **Encapsulation** type. To enable the interface, ensure that a check mark appears in the box next to **Enable**.

**NOTE** *This page is a good place to double check all other physical parameters (e.g., **Clocking**, **Framing**, **Coding**, etc.) for the interface.*

Select **Apply** to proceed to the **HDLC Configuration Menu**.

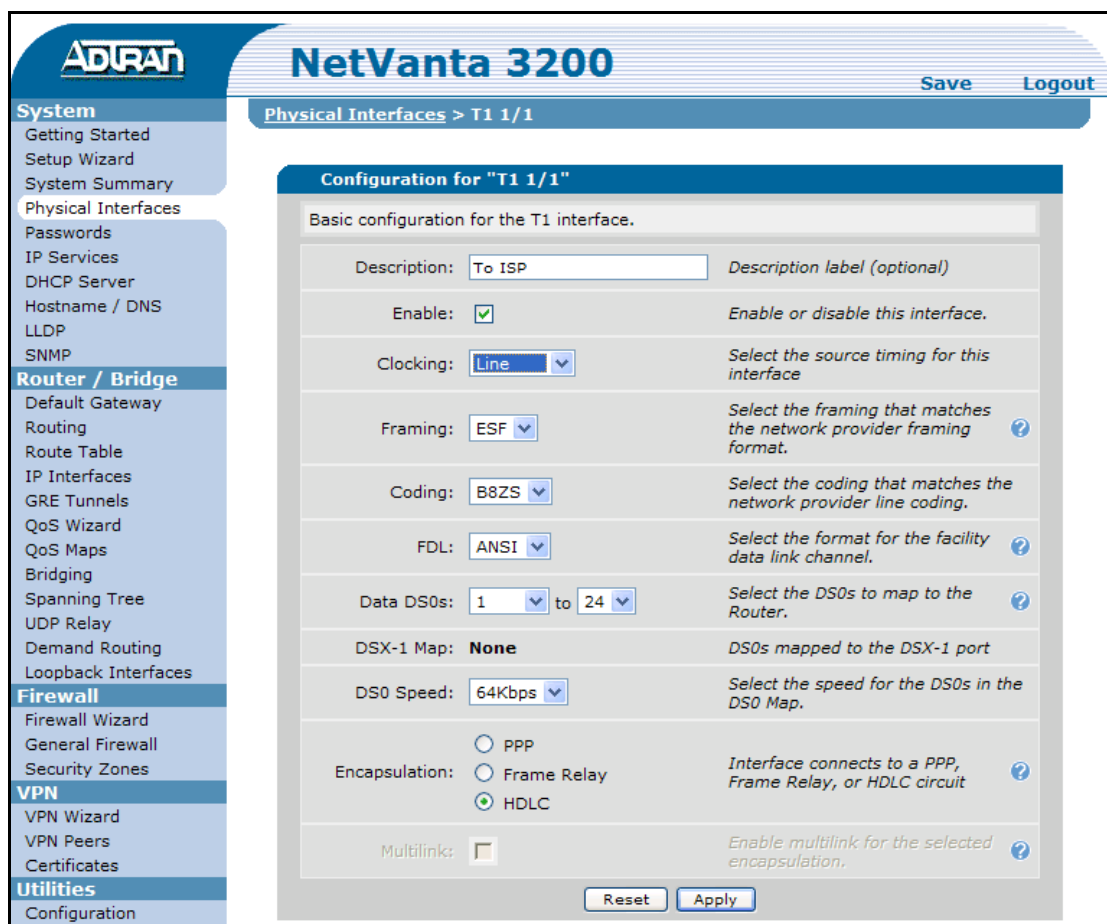


Figure 3. T1 Configuration Menu (NetVanta 3200)

## Total Access 900(e) Series, NetVanta 6355, and NetVanta 7000 Series GUI

The **Physical Interfaces Configuration** options are displayed for **t1 0/1** (see Figure 4). The top part of the page lists various physical parameters that already should have been configured for the T1 interface. However, it is always recommended to double check the settings.

The next section contains options for configuring HDLC. Select **HDLC** from the **Connect To** drop-down menu. Next, select the number of data DS0s on this T1 that are to be mapped to the router. All DS0s or a contiguous fraction of DS0s can be activated for data.

Select **Add** to proceed to the **HDLC Configuration** menu.

The screenshot displays the ADTRAN Total Access 916 (2nd Gen) GUI. The top navigation bar includes the ADTRAN logo, the device name 'Total Access 916 (2nd Gen)', and 'Save' and 'Logout' buttons. A left-hand navigation menu lists categories: System, Voice, Data, Monitoring, and Utilities. The 'System' category is expanded, showing options like Config Wizard, System Summary, Physical Interfaces, Passwords, IP Services, DHCP Server, Hostname / DNS, LLDP, and SNMP. The main content area is titled 'Physical Interfaces > t1 0/1' and is divided into two sections:

- Configuration for "t1 0/1"**: This section provides basic configuration for the T1 interface. It includes:
  - Description: T1-RBS Trunk (with a note: Description label (optional))
  - Enable:  (with a note: Enable or disable this interface)
  - Clocking: System-Wide Clock Source (with a note: Please go to the 'Clock Source' page to set the system clock source.)
  - Framing: ESF (with a note: Select the framing that matches the network provider framing format)
  - Coding: B8ZS (with a note: Select the coding that matches the network provider line coding)
  - FDL: ANSI (with a note: Select the format for the facility data link channel)
- Configured DS0 Connections for "t1 0/1"**: This section provides instructions on connecting DS0s to the interface. It includes:
  - Add a Connection** section with:
    - Connect To: HDLC (with a note: Select an interface type to map to the DS0s)
    - Available DS0 Range: 13-24
    - DS0 Range: 13 to 24 (with a note: Set the range of DS0s to be mapped)
    - Speed: 64kbps (with a note: Select the speed for the DS0s being mapped)
  - An 'Add' button at the bottom.

Figure 4. T1 Configuration Menu (Total Access 916)

### Step 3

The **HDLC Configuration** menu (see Figure 5) contains basic HDLC control settings, such as whether or not the interface is enabled, choice of queuing method, MTU size, etc. An optional description of this HDLC link can be entered.

### IP Settings

The **IP Settings** configuration is located toward the bottom of the **HDLC Configuration** menu. Choose the type of IP address for the AOS device: **None**, **Static**, or **Unnumbered**. The **Address Type** should be set to **None** when connecting to a bridge with IP routing disabled. The **Address Type** should be set to **Static** when assigning a fixed IP address to the interface (see Figure 5). Secondary IP addresses may be entered after the static IP address has been assigned.



*The option to add secondary IP addresses does not appear until you have configured the initial IP Settings and selected Apply.*

**ADTRAN NetVanta 3448** Save Logout

Physical Interfaces > t1 1/1 > HDLC Config

**Configuration for "hdlc 1"**

Basic configuration for the HDLC interface.

Description:	<input type="text"/>	Description label (optional)
Enabled:	<input checked="" type="checkbox"/>	Enable data flow for this interface.
Weighted Fair Queuing:	<input checked="" type="checkbox"/>	If disabled, FIFO queuing method will be used.
MTU:	<input type="text" value="1500"/>	Maximum Transmit Unit
Physical Interface:	t1 1/1	Physical interface connection for this interface.
Qos-policy:	None	Outbound <a href="#">QoS-Policy</a> map.

**IP Settings**

Address Type: **Static**   
*Set to 'None' if connecting to a [Bridge](#) with [IP routing](#) disabled.*

IP Address:  .  .  .   
*IP address for this numbered interface*

Subnet Mask:  .  .  .   
*Subnet Mask for this numbered interface*

Dynamic DNS:    
*Used to register this interface's IP address with a DNS Name.*

**Media-Gateway**

IP Address Type: **None**   
*RTP traffic will flow over the selected IP address.*

**Monitoring**

RTP Monitoring:   
*Enables [RTP monitoring](#) on this interface.*

Figure 5. HDLC Configuration and Static IP Address Type

The **Address Type Unnumbered** allows the IP address of another interface on the AOS device to also be used as the IP address of the HDLC interface (see Figure 6). See *Unnumbered Interface* on page 5 for more information on the use of unnumbered interfaces.

**ADTRAN** NetVanta 3448 Save Logout

Physical Interfaces > t1 1/1 > HDLC Config

**Configuration for "hdlc 1"**

Basic configuration for the HDLC interface.

Description:	<input type="text"/>	Description label (optional)
Enabled:	<input checked="" type="checkbox"/>	Enable data flow for this interface.
Weighted Fair Queuing:	<input checked="" type="checkbox"/>	If disabled, FIFO queuing method will be used.
MTU:	<input type="text" value="1500"/>	Maximum Transmit Unit
Physical Interface:	<b>t1 1/1</b>	Physical interface connection for this interface.
Qos-policy:	<b>None</b>	Outbound <a href="#">QoS-Policy</a> map.

**IP Settings**

Address Type:	<input type="text" value="Unnumbered"/>	Set to 'None' if connecting to a <a href="#">Bridge with IP routing disabled</a> .
Interface:	<input type="text" value="eth 0/1"/>	Select the interface to associate with this unnumbered IP interface.
Dynamic DNS:	<input type="text" value="&lt;disabled&gt;"/>	Used to register this interface's IP address with a DNS Name.

**Media-Gateway**

IP Address Type:	<input type="text" value="None"/>	RTP traffic will flow over the selected IP address.
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**Monitoring**

RTP Monitoring:	<input type="checkbox"/>	Enables <a href="#">RTP monitoring</a> on this interface.
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Figure 6. HDLC Configuration, Unnumbered IP Address Type, and Media Gateway

## Media Gateway

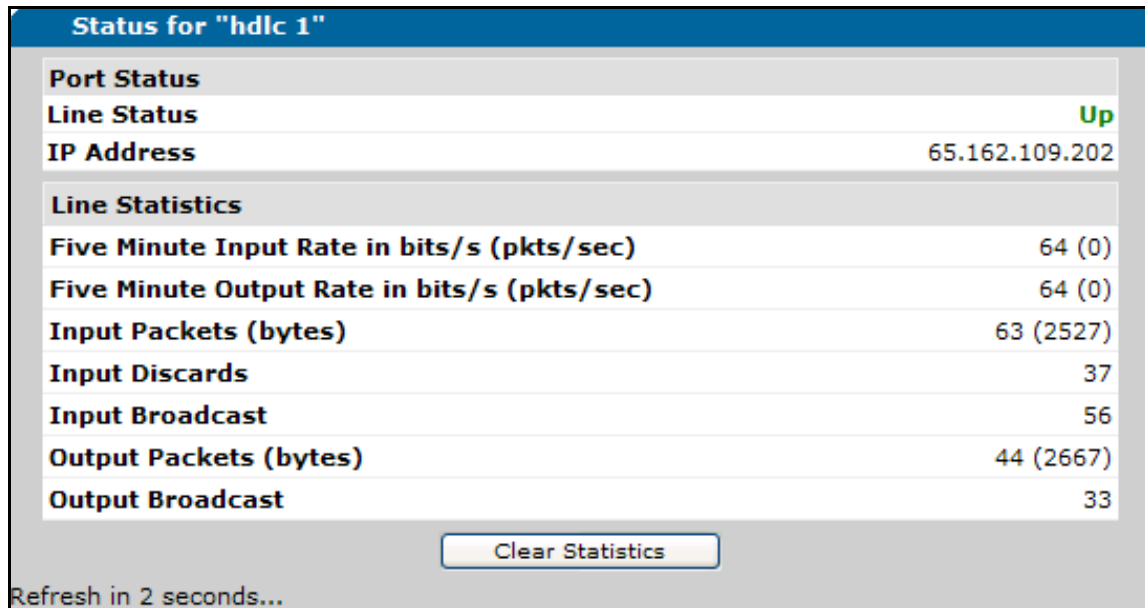
The option to designate the HDLC interface as a **Media Gateway** is available in the **IP Settings** menu for voice products as well as a number of data products (see Figure 6 on page 15). Refer to the AOS Feature Matrix, article #2272, found at <http://kb.adtran.com> for the most current listing of products that support this option.

The Media Gateway option is used in conjunction with the SIP Transparent Proxy feature. If the HDLC interface is the outbound interface used to connect to the Session Initiation Protocol (SIP) server, then the media gateway option should be set to **primary**. This setting should be enabled for all interfaces on the unit where voice traffic sourcing is desired. Refer to *Configuring SIP Transparent Proxy in AOS*, article #2183, found at <http://kb.adtran.com> for more information on SIP Transparent Proxy.



## Step 4

Upon completing all applicable fields for the HDLC Interface and **IP Settings**, select **Apply**. Basic HDLC interface configuration should now be complete. The GUI menu will refresh itself. Scroll to the bottom of the menu to view the status of the HDLC interface (See Figure 7 on page 17). If the peer end of the HDLC connection has been properly configured, the HDLC interface's **Line Status** should change to **Up**.



The screenshot displays a GUI window titled "Status for 'hdlc 1'". It is divided into three main sections: "Port Status", "Line Statistics", and a "Clear Statistics" button. The "Port Status" section shows "Line Status" as "Up" in green text and "IP Address" as "65.162.109.202". The "Line Statistics" section provides various performance metrics.

Port Status	
Line Status	Up
IP Address	65.162.109.202

Line Statistics	
Five Minute Input Rate in bits/s (pkts/sec)	64 (0)
Five Minute Output Rate in bits/s (pkts/sec)	64 (0)
Input Packets (bytes)	63 (2527)
Input Discards	37
Input Broadcast	56
Output Packets (bytes)	44 (2667)
Output Broadcast	33

Clear Statistics

Refresh in 2 seconds...

Figure 7. Status Menu

Upon completion of HDLC configuration in the GUI, be sure to save all changes to nonvolatile random access memory (NVRAM). This is accomplished by selecting the word **Save** in the upper right-hand corner of the menu.

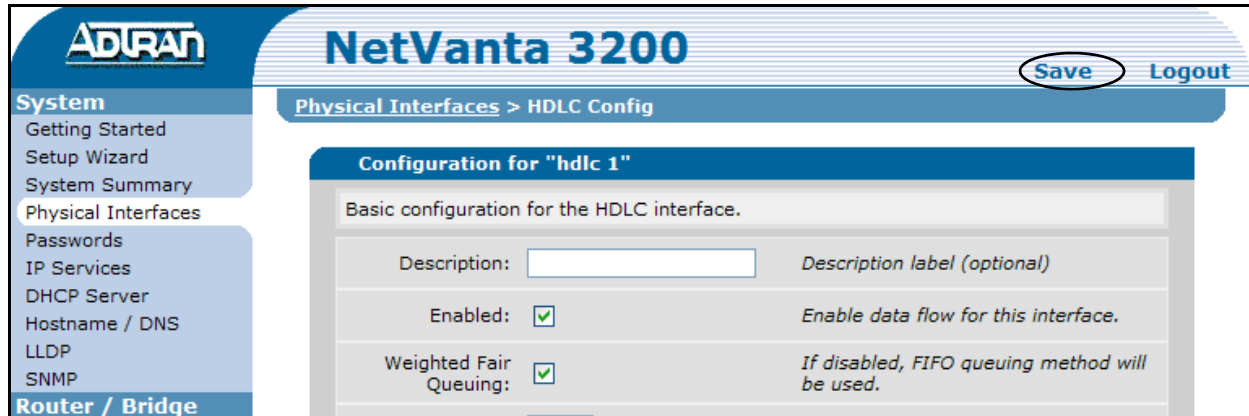


Figure 8. Save the Configuration

## Example Configurations

The example scenarios contained within this section are designed to enhance understanding of HDLC configurations on AOS products.

Some commands shown in the example configurations in this guide are already enabled as the default setting in the unit. These commands will not appear in the output when the **show running-config** command is issued. Keep this in mind when comparing the configuration in your unit to the configurations shown in this guide. Issue the **show run verbose** command to see all commands (including those that do not appear when the **show running-config** command is issued).

### Integrated Switch/Router Versus Nonintegrated Switch/Router Configuration

Configuration of the IP address and firewall access policies on the private Local Area Network (LAN) interface differs slightly depending on the type of AOS product. The IP address and firewall commands are placed on the private LAN Ethernet interface on nonintegrated switch/router products, such as the NetVanta 3200 and 3430. The *Advanced CLI Configuration* outlined in this guide on page 3, as well as the majority of the examples provided in this section, applies to nonintegrated switch/router products. Configuration of the IP address and firewall access policies on integrated switch/router products, such as the NetVanta 6355, varies in that the commands are issued on the appropriate VLAN interface(s) as opposed to the private Ethernet interface. An additional step is required to associate switch port interfaces to the appropriate VLAN that corresponds with the physical setup of the network. The example configuration below assigns the switch port 0/1 interface to VLAN 1.

```
!  
interface vlan 1  
    ip address 192.168.0.1 255.255.255.0  
    access-policy Private  
    no shutdown  
!  
interface switchport 0/1  
    switchport access vlan 1  
    no shutdown  
!
```



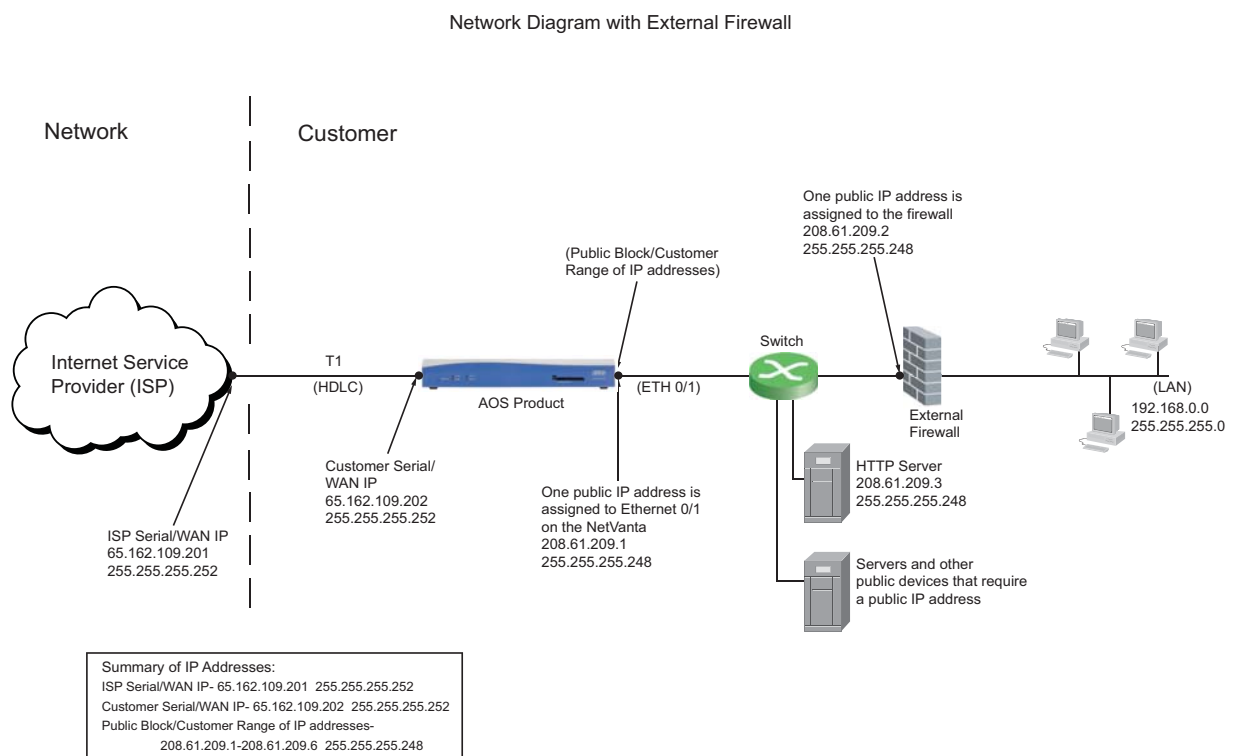
*Some switch/router AOS products, such as the NetVanta 1224R Series, label the switch port interfaces **interface ethernet 0/x** instead of **interface switchport 0/x**, where *x* is a variable from 1 to 24 depending on the product.*



*Refer to Example 2 on page 22 to see an integrated switch/router product example configuration for the NetVanta 3448.*

### Example 1: HDLC to an ISP with AOS Device and External Firewall

HDLC is sometimes used across a T1 connection between an ISP and its customer. The following configuration example has an external firewall that is connected to Ethernet 0/1 on the AOS product. The external firewall will perform all security functions, including network address port translation (NAPT) and port forwarding. A virtual interface, HDLC 1, defines the IP address assignment for the HDLC connection. The customer's WAN IP address (65.162.109.202 /30) is statically assigned and 24 DS0s on the WAN interface will be used for this HDLC connection. One public IP address (208.61.209.1 /29) will be assigned to Ethernet 0/1 on the AOS product. Another public IP address from the public block (208.61.209.2 /29) will be assigned to the external firewall. A default route that points to interface HDLC 1 is added to the route table in the AOS product. The external firewall needs to have its default route pointing to the public IP address assigned to the AOS product's Ethernet 0/1 interface (208.61.209.1 /29).



**Figure 9. An HDLC Connection to an ISP with an External Firewall on the Customer's LAN**

The following configuration applies to Example 1:

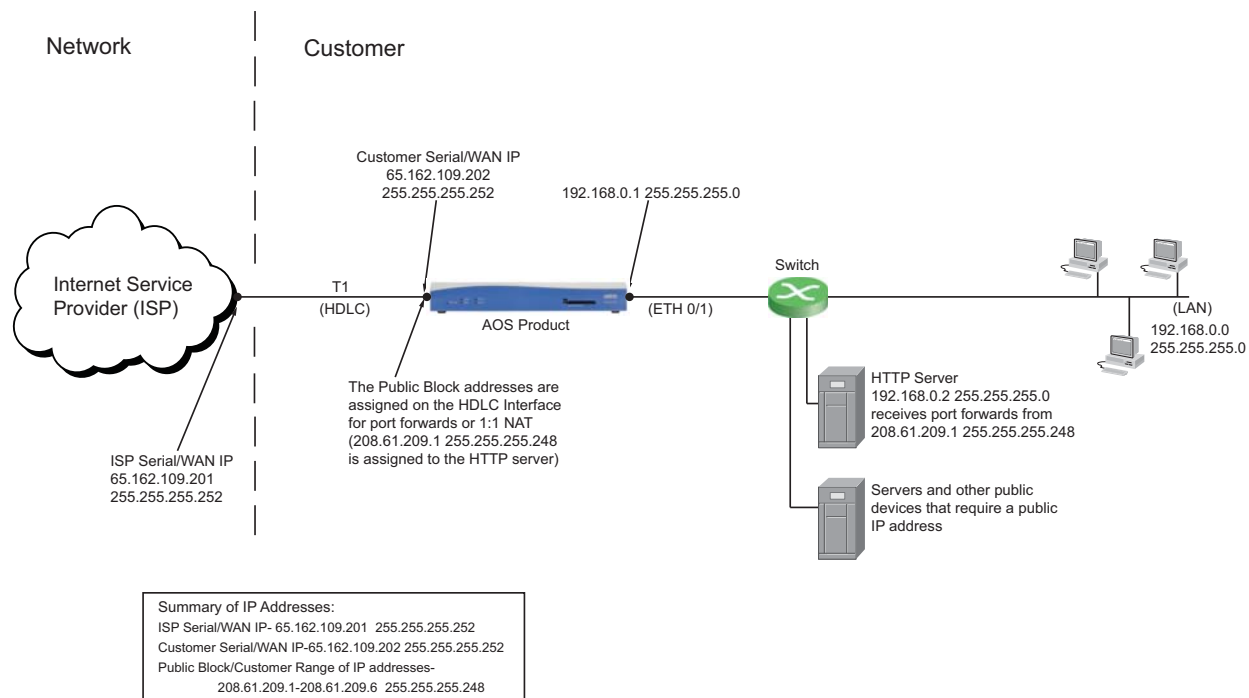
```
!  
interface eth 0/1  
    ip address 208.61.209.1 255.255.255.248  
    no shutdown  
!  
interface t1 1/1  
    clock source line  
    tdm-group 1 timeslots 1-24 speed 64  
    no shutdown  
!  
interface hdlc 1  
    ip address 65.162.109.202 255.255.255.252  
    no shutdown  
    cross-connect 1 t1 1/1 1 hdlc 1  
!  
ip route 0.0.0.0 0.0.0.0 hdlc 1  
!
```

### Example 2: HDLC to an ISP with AOS Device (Using the Internal Firewall Capabilities)

HDLC is sometimes used across a T1 connection between an ISP and its customer. The following configuration example uses the built-in firewall capabilities of the AOS product to perform security functions, including NAPT, 1:1 (NAT), and port forwarding. The customer's WAN IP address (65.162.109.202 /30) is statically assigned and all 24 DS0s on the WAN interface will be used for the HDLC connection. Through the internal firewall, 1:1 NAT or port forwarding is used for any public IP addresses that are assigned to servers and public devices that sit on the private side of the AOS product. This example shows a Hypertext Transfer Protocol (HTTP) server with a private IP address (192.168.0.2 /24) receiving port forwards from public IP address 208.61.209.1 /29. The public IP address is entered as a secondary IP address on the WAN HDLC interface. NAPT is also used to provide Internet access to devices on the LAN.

**NOTE** *Sample configurations for this example are provided for both the NetVanta 3430, a nonintegrated switch/router product and NetVanta 3448, an integrated switch/router product. Refer to the beginning of this section for more information on the configuration differences between these two types of products.*

**NOTE** *Refer to the Port Forwarding Quick Configuration Guide, article #2154 found at <http://kb.adtran.com>, for information on port forwarding, 1:1 NAT, and other firewall features.*



**Figure 10. A HDLC Connection to an ISP with the Built-in Firewall of the AOS Device**

The following configuration applies to Example 2:

### NetVanta 3430

```
!  
ip firewall  
ip firewall nat-preserve-source-port  
!  
interface eth 0/1  
    ip address 192.168.0.1 255.255.255.0  
    access-policy Private  
    no shutdown  
!  
interface t1 1/1  
    clock source line  
    tdm-group 1 timeslots 1-24 speed 64  
    no shutdown  
!  
interface hdlc 1  
    ip address 65.162.109.202 255.255.255.252  
    ip address 208.61.209.1 255.255.255.248 secondary  
    access-policy Public  
    no shutdown  
    cross-connect 1 t1 1/1 1 hdlc 1  
!  
ip access-list standard MATCHALL  
    permit any  
!  
ip access-list extended WEB-IN  
    permit tcp any host 208.61.209.1 eq www  
!  
ip access-list extended WEB-OUT  
    permit ip host 192.168.0.2 any  
!  
ip policy-class Private  
    allow list MATCHALL self  
    nat source list WEB-OUT address 208.61.209.1 overload  
    nat source list MATCHALL interface hdlc 1 overload  
!  
ip policy-class Public  
    nat destination list WEB-IN address 192.168.0.2  
!  
ip route 0.0.0.0 0.0.0.0 hdlc 1  
!
```



The commands **ip firewall nat-preserve-source-port** and **clock source line** are enabled by default. Therefore, these commands will not appear in the output when the **show running-config** command is issued.



*A default route directing all traffic from the LAN to the HDLC 1 interface is needed.*

### NetVanta 3448

```
!  
ip firewall  
ip firewall nat-preserve-source-port  
!  
interface switchport 0/1  
    switchport access vlan 1  
    no shutdown  
!  
interface t1 1/1  
    clock source line  
    tdm-group 1 timeslots 1-24 speed 64  
    no shutdown  
!  
interface vlan 1  
    ip address 192.168.0.1 255.255.255.0  
    access-policy Private  
    no shutdown  
!  
interface hdlc 1  
    ip address 65.162.109.202 255.255.255.252  
    ip address 208.61.209.1 255.255.255.248 secondary  
    access-policy Public  
    no shutdown  
    cross-connect 1 t1 1/1 1 hdlc 1  
!  
ip access-list standard MATCHALL  
    permit any  
!  
ip access-list extended WEB-IN  
    permit tcp any host 208.61.209.1 eq www  
!  
ip access-list extended WEB-OUT  
    permit ip host 192.168.0.2 any  
!  
ip policy-class Private  
    allow list MATCHALL self  
    nat source list WEB-OUT address 208.61.209.1 overload  
    nat source list MATCHALL interface hdlc 1 overload  
!  
ip policy-class Public
```



```
    nat destination list WEB-IN address 192.168.0.2
!
ip route 0.0.0.0 0.0.0.0 hdlc 1
!
```

**NOTE**

*The commands **switchport access vlan 1**, **ip firewall nat-preserve-source-port**, and **clock source line** are enabled by default. Therefore, these commands will not appear in the output when the **show running-config** command is issued.*

**NOTE**

*A default route directing all traffic from the LAN to the HDLC 1 interface is needed.*

### Example 3: HDLC from Central Corporate to a Branch Office

HDLC can be used across the connection between a central corporate office and a remote branch office. The distance between the two locations is transparent, with clients on the remote LAN operating seamlessly with clients and resources on the corporate LAN. Internet access for the remote office is also funneled through the corporate office and across the HDLC connection. The following configuration example uses private static IP addresses at each end of the HDLC link (10.0.0.1 /30 at corporate and 10.0.0.2 /30 at the branch office). Clocking on the T1 interface is provided by the AOS product at the corporate location. Each LAN is assigned a different subnet (192.168.1.0 /24 at corporate and 192.168.2.0 /24 at the branch office). The remote office is programmed with a default route that points to the HDLC interface. This route ensures that Internet and other traffic destined for the corporate LAN is directed to the proper place. The default route programmed into the corporate AOS product points toward the corporate Internet router connected to the ISP (192.168.1.254 /24). A static route programmed into the corporate router ensures that traffic destined for the remote LAN (192.168.2.0 /24) is directed towards the HDLC interface on the remote router (10.0.0.2 /30).

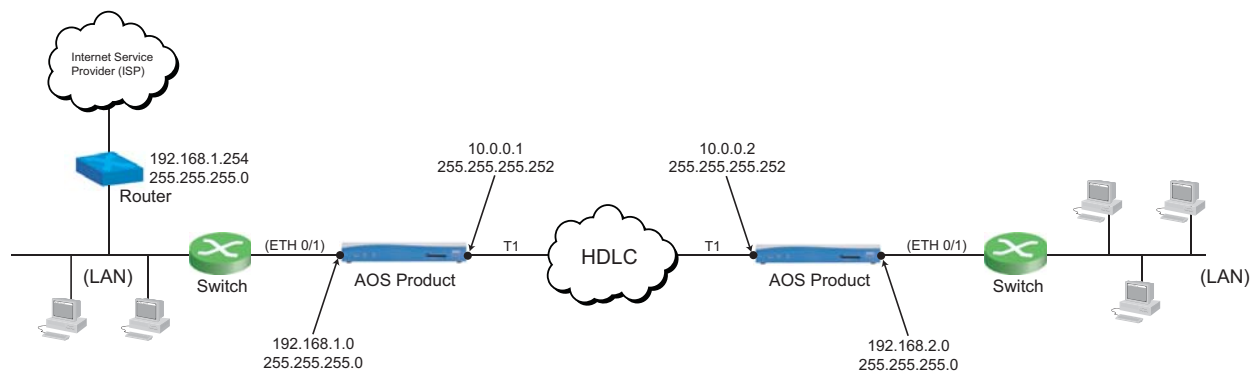


Figure 11. An HDLC Connection from Central Corporate to a Branch Office

The following configuration applies to Example 3:

**Central Office:**

```
!  
interface eth 0/1  
    ip address 192.168.1.1 255.255.255.0  
    no shutdown  
!  
interface t1 1/1  
    clock source internal  
    tdm-group 1 timeslots 1-24 speed 64  
    no shutdown  
!  
interface hdlc 1  
    ip address 10.0.0.1 255.255.255.252  
    no shutdown  
    cross-connect 1 t1 1/1 1 hdlc 1  
!  
ip route 0.0.0.0 0.0.0.0 192.168.1.254  
ip route 192.168.2.0 255.255.255.0 hdlc 1  
!
```

**Remote Office:**

```
!  
interface eth 0/1  
    ip address 192.168.2.1 255.255.255.0  
    no shutdown  
!  
interface t1 1/1  
    clock source line  
    tdm-group 1 timeslots 1-24 speed 64  
    no shutdown  
!  
interface hdlc 1  
    ip address 10.0.0.2 255.255.255.252  
    no shutdown  
    cross-connect 1 t1 1/1 1 hdlc 1  
!  
ip route 0.0.0.0 0.0.0.0 hdlc 1  
!
```

The corporate Internet router (192.168.1.254) must be configured with the following routes:

```
ip route 192.168.2.0 255.255.255.0 192.168.1.1  
ip route 10.0.0.0 255.255.255.252 192.168.1.1
```



*The command **clock source line** is enabled by default. Therefore, this command will not appear in the output when the **show running-config** command is issued.*

## Quick Configuration Guide

Table 2. HDLC Configuration Command Summary

	Command	Description
<b>Step 1</b>	(config)# <b>interface hdlc</b> <interface id>	Create a virtual HDLC interface.
<b>Step 2</b> (or)	(config-hdlc 1)# <b>ip address</b> <ip address> <subnet mask>	Configure the HDLC interface with a static IP address.
	(config-hdlc 1)# <b>ip unnumbered</b> <interface>	Configure the HDLC interface as an unnumbered interface.
<b>Step 3</b> (Optional)	(config-hdlc 1)# <b>ip address</b> <ip address> <subnet mask> <b>secondary</b>	Configure secondary IP addresses on the HDLC interface.
<b>Step 4</b>	(config-hdlc 1)# <b>no shutdown</b>	Activate the HDLC interface.
<b>Step 5</b>	(config-hdlc 1)# <b>cross-connect</b> <number> <from interface> <group number> <to interface>	Cross connect the physical WAN interface to the virtual HDLC interface.
<b>Step 6</b>	(config-hdlc 1)# <b>exit</b>	Exit the HDLC Interface Configuration mode.
	(config)# <b>exit</b>	Exit the Configuration mode.
	# <b>copy running-config startup-config</b>	Save the configuration.

Table 3. Additional Settings

Command	Description
<b>bridge-group</b> <number>	Assign an interface to a specified bridge group. Any two interfaces may be bridged together.
<b>description</b> <text>	Add a text description that describes this HDLC interface.
<b>keepalive</b> <value>	Enable the transmission of keepalive packets on the interface and specify the time interval between transmitted packets.
<b>mtu</b> <size>	Specify the MTU for this HDLC connection.

## Troubleshooting

Network issues observed across an HDLC connection are commonly caused by problems on the physical transmission medium. Therefore, troubleshooting should begin by examining the status of the Layer 1 interface to which the HDLC interface is bound. T1 is the physical layer used for the troubleshooting examples that follow. The output below shows that the physical layer is up and there are no alarms:

### #show interfaces t1 1/1

#### t1 1/1 is UP

```
Receiver has no alarms
T1 coding is B8ZS, framing is ESF
Clock source is line, FDL type is ANSI
Line build-out is 0dB
No remote loopbacks, No network loopbacks
Acceptance of remote loopback requests enabled
Tx Alarm Enable: rai
Last clearing of counters 00:01:08
  loss of frame      : 0
  loss of signal     : 0
  AIS alarm          : 0
  Remote alarm       : 0
```

```
DS0 Status: 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4
             N N N N N N N N N N N N N N N N N N N N N N N N N N N N N N
```

```
Status Legend: '-' = DS0 is unallocated
               'N' = DS0 is dedicated (nailed)
```

```
Line Status: -- No Alarms --
```

```
5 minute input rate 56 bits/sec, 0 packets/sec
5 minute output rate 72 bits/sec, 0 packets/sec
```

#### Current Performance Statistics:

```
0 Errored Seconds, 0 Bursty Errored Seconds
0 Severely Errored Seconds, 0 Severely Errored Frame Seconds
0 Unavailable Seconds, 0 Path Code Violations
0 Line Code Violations, 0 Controlled Slip Seconds
0 Line Errored Seconds, 0 Degraded Minutes
```

```
TDM group 1, line protocol is UP
```

```
Encapsulation HDLC (hdlc 1)
```

```
9 packets input, 522 bytes, 0 no buffer
0 runs, 0 giants, 0 throttles
0 input errors, 0 CRC, 0 frame
0 abort, 0 discards, 0 overruns
10 packets output, 715 bytes, 0 underruns
```

The statistics listed under the TDM group 1 section all pertain to the HDLC interface. Ideally, all error indicators (runs, giants, throttles, input errors, CRC, frame, abort, discards, overruns, and underruns) should be 0. It is normal to have a few errors if the interface has been active for an extended period of time. A rapidly increasing error value is a good indicator that there are Layer 1 problems on the transmission medium.



The command **show interfaces t1 1/1** displays all cumulative errors for the TDM group since the last time the **clear counters** command was issued. The errors displayed under **Current Performance Statistics** only reflect what has occurred during the last 15 minutes. To view all performance statistics errors that have occurred over the last 24 hours, enter the following command: **show interfaces t1 1/1 performance-statistics total-24-hour** or **show interfaces t1 1/1 p t**.

If Layer 1 is up and transmitting properly, the next step is to check the status of the HDLC link using the **show interface hdlc <interface id>** command. The AOS CLI output shows the interface status as UP or DOWN, the local HDLC interface configuration, and the traffic and queuing statistics. This information is vital in identifying the HDLC problem.

Below is sample output of the **show interface hdlc** command. The output shows that interface HDLC 1 is up and transmitting and receiving data with no errors.

#### #show interface hdlc 1

##### hdlc 1 is UP

###### Configuration:

Keep-alive is set (10 sec.)  
IP is configured  
65.162.109.202 255.255.255.252

###### Link information:

Receive: bytes=3658, pkts=73, **errors=0**, broadcast=54  
Transmit: bytes=4763, pkts=74, **errors=0**, broadcast=55  
5 minute input rate 56 bits/sec, 0 packets/sec  
5 minute output rate 72 bits/sec, 0 packets/sec  
Port BW 1536 Kbps

###### Queueing method: weighted fair

Output queue: 0/1/460/64/0 (size/highest/max total/threshold/drops)

Conversations 0/1/256 (active/max active/max total)

Available Bandwidth 1152 kilobits/sec

IP is UP Address=65.162.109.202 Mask=255.255.255.252

IP MTU=1500, Bandwidth=1536 Kbps

If there are no Layer 1 errors and the HDLC interface is DOWN, several settings should be checked:

- Verify the data DSOs on each end of the connection to ensure that they match (for T1 and E1)
- Verify the cross-connect statement to ensure it is present and accurate in the configuration
- Verify that each end of the connection has been setup for HDLC encapsulation