

1xN Remote Protection Switch Pro-Cap Installation and Maintenance

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1. GENERAL

This practice provides installation and operational procedures for the ADTRAN, Remote 1xN Pro-Cap protection switch multi-mount housing (P/N 1190860L1). See **Figure 1**. Pro-Cap initiates remote switching of a DS1 or HDSL circuit to a standby line following detection of a fault. This eliminates the immediate need for a vehicle dispatch to investigate trouble or provide standby service. The shelf also accommodates DDS and ISDN technologies but without protection.

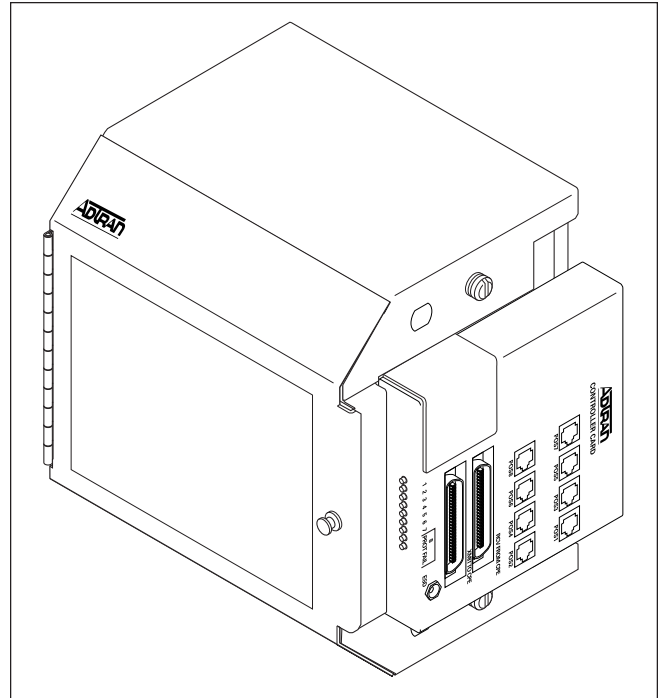


Figure 1. 1xN Pro-Cap

Pro-Cap can be used in conjunction with the ADTRAN Total Access[®] 3000 Carrier Class Broadband Multiservice Access Platform, or any standard Office Repeater Bay (ORB) with T1 or HDSL to provide a Protection Switching Network Interface (PSNI).

The Pro-Cap housing accepts eight T200 type circuit cards or four dual slot T400 DS-1, HDSL, or HDSL2 circuit cards. The unit is a wall mounted assembly that provides convenient access to CPE connections. The assembly incorporates a circuit board backplane that provides a choice of amphenol connector or wire-wrap pins for facility wiring hook-up.

The Pro-Cap accepts -48 VDC local power or a modular power supply that inserts into the POWER slot at the far right of the shelf. The power supply module includes an AC power cord that plugs into a standard 110 VAC grounded outlet.

The Switch Customer Interface Module (SCIM) can mount to either the left or right side of the Pro-Cap housing to facilitate access to all CPE connections.

The SCIM can be locally powered by -48 VDC, or span powered from the standby unit in slot 8 if equipped for span power. Slide switch S1 selects between local or span power. CPE receive and transmit connections are either amphenol or RJ-48C jacks.

Revision History

Issue 2 adds Auto-Protect information when the Pro-Cap is configured in a Total Access 3000 network.

Features

The 1xN Pro-Cap includes these features:

- Protection module.
- Compact and lightweight assembly that accommodates eight T200 mechanics or four T400 mechanics modules.
- Reversible SCIM for right side or left side assembly.
- Prewired backplane to minimize wiring errors and installation time.
- Protect module can function as standard channel module.
- Dedicated slot for modular power supply.
- LEC facility connections are made by 25-pair Amphenol XMT/RCV connectors or wire-wrap pins.
- CPE connections are made to RJ-48C modular jacks or 25-pair Amphenol XMT/RCV connectors.
- Auto-Protect Switching with Total Access 3000 applications.
- Swing open tinted Plexiglas front cover.
- Available with key-locking metal cover (List 4 Option).
- Includes standard 10-year warranty.

Physical Description

The 1xN Pro-Cap consists of four elements:

1. Mounting-Plate

The mounting-plate attaches to a customer premises backboard.

2. Shelf

The shelf has slots for seven channel modules, one standby (protect) module, and one power module, plus two external edge connectors for the SCIM. The power terminal strip has connections for power, alarm, and ground. The shelf attaches to the mounting-plate.

3. Switch Customer Interface Module

This module inserts into one of the SCIM edge connectors located on either side of the shelf. It has both amphenol and RJ-48C interface connections to the customer loop. Behind an access panel is a power connection terminal strip, a slide switch for either span or local power, protect ON/OFF switch, and a pushbutton for selecting individual module protection or resetting the protect configuration. Selection and status is indicated with associated LEDs on the SCIM front panel.

4. Housing Cover

The Plexiglas swing door housing cover encloses the shelf allowing viewing and access to the shelf modules.

Functional Description

During normal customer and network transmission, data is transported through the active modules in slots 1 through 7. The module in slot 8 is the standby (protect) unit. If a fault is detected on an active line a series of facility initiated manual commands switch the standby module to an active mode in place of the faulted unit. When the faulted unit malfunction is resolved another series of manually initiated commands (or the reset switch) returns it to active service and the standby unit is returned to standby status. The LED bank shows module status during normal and standby conditions. When circuit protection mode is disabled the Pro-Cap unit can be used as a standard 8-slot T200 mounting.

Auto-Protect Switching

When the Pro-Cap is used in association with the ADTRAN Total Access 3000 platform, certain Total Access 3000 cards initiate an automatic protect function with the Pro-Cap. These cards send the same protect enable/disable, arming, and switching codes as sent in the manual switching mode. The Pro-Cap does not require configuration changes to support the auto-protect feature. The same configuration supporting manual switching also supports automatic switching. Additional information is in *Section 9* of this practice.

Listed here are Total Access 3000 cards that initiate the auto-protect codes:

- H2TUC 1181112L5
- H2TUR 1222026L7
- H2TUR 1221026L7

Documentation associated with the listed cards provides information on implementing the auto-protect function.

LED Indication

Table 1 describes LED indication.

- All LEDs OFF indicates no power to the SCIM.
- All LEDs flashing red indicates the protect card is disabled and SCIM power is local -48 VDC.

2. INSTALLATION



After unpacking the unit inspect it for damage. If damage is noted, file a claim with the carrier then notify ADTRAN. Refer to *Warranty and Customer Service*.

Mounting Procedure

The 1xN Pro-Cap installs at the remote location using the following procedure:

NOTE

All component fasteners are spring-loaded, captured thumb screws.

1. Remove the housing from the shelf by unscrewing the two thumb screws on the side of the housing. The housing pulls out and away from the shelf.
2. Remove the shelf from the mounting-plate by unscrewing the thumb screw at the top center of the shelf bay. It is not necessary to remove the SCIM assembly unless its position is to be reversed to the other side of the shelf.

3. The shelf assembly lifts away from the mounting-plate by disengaging the chassis tabs from the mounting-plate support hooks.
4. Using the mounting-plate as a template, position the mounting-plate at the desired location and mark four pilot holes. Ensure the unit is level and that cable plugs will reach their designated sockets.
5. Using an appropriate bit, drill the four pilot holes.
6. Align the mounting-plate to the pilot holes and attach to the wall with appropriate fasteners.
7. Reassemble the unit by reversing steps 1 through 3.

Cable Connections

Frame Ground

Both the shelf and SCIM have separate ground connections. Each must be connected to a known approved ground location. Verify metal to metal contact on all connections and ensure ground circuit continuity.

The shelf has various openings for wire route options along with tie-wrap anchor points and extrusions for securing cables and connectors.

Specific wiring arrangements are customer developed.

CAUTION

Transmit and receive loops to both facility and CPE have two connection schemes. Only one connection method is to be used, not both.

Facility Side

Amphenol Connection – The to-facility and from-facility amphenols can be either left-side or right-side oriented.

Table 1. LED Indication

Slot LED	OFF	Flash Green	Solid Green	Flash Red	Solid Red	Flash Red/Green
1 - 7	Protect Deselected	Request to Protect Enable	Protect Enabled	Protect Card Disabled**	In Protect Mode*	N/A
8 PROT	No Network Signal	Protect Activated	Protect In Standby	Protect Card Disabled**	N/A	Protect Card Armed
FAIL	Protect Operational	N/A	N/A	Protect Card Disabled**	Protect Failure	N/A

* Only one module at a time in slots 1 through 7 can be in Protect Mode.
 ** Protect switch S3 OFF.

Span Power Switch S1

This switch selects between span power or local power.

- SPAN – The SCIM receives power from the protect card in slot 8.
- LOCAL – The SCIM receives power from local -48 VDC to terminal strip TB1 on the SCIM card.

NOTE

Local -48 VDC can be jumpered from the shelf TB1 terminals.

Protection Select/Reset Switch S2

The first function of this pushbutton switch enables or disables standby protection for individual slots (1 through 7). Protection for selected slots can be disabled if cards of a different technology occupy those slots, or to meet SLA agreements. Protection is selected using the following procedure:

1. Depress S2 for 5 seconds. Slot 1 LED will start to flash green; all other LEDs will be OFF. Release S2.
2. To enable protection for slot 1, press and release S2. Slot 1 LED will turn solid green and the LED for slot 2 will begin to flash.
3. To pass over a slot that is not to be protect enabled, wait several seconds while that slot's LED is flashing. The LED turns OFF and the next LED begins to flash green.
4. Continue this process until the LEDs for all slots designated for protection are ON.

The protect configuration, once established, is maintained in memory.

The second function of this switch is to reset the protect configuration in the event the protect card was enabled to temporarily replace a malfunctioning shelf card. After the system is returned to normal, depressing S2 for a minimum 5 seconds resets the protect configuration stored in memory. Immediately release the pushbutton when the LEDs return to the protect configuration.

Protect Switch S3

This switch controls the protect feature.

- ON – All standby and protect functions are active.

OFF – The standby module in slot 8 is cut through and detection circuitry disabled. If the standby card was supplying span power to the SCIM, all the LEDs will be OFF. If the SCIM was receiving local -48 VDC power, all the LEDs will flash red.

NOTE

The protect card in slot 8 should have span power capability either permanent or as an enabled option.

Local Power

Terminal strip TB1 on the SCIM card accepts local -48 VDC power. Installation requires that wiring (14 to 26 AWG) be routed from the back of the SCIM housing. This arrangement is an alternative to span power the SCIM receives from the protect card. Slide switch S1 selects between span power or the -48 VDC supply. SCIM frame ground is attained through a separate ground terminal.

4. OPERATIONAL DESCRIPTION

The SCIM card is a component of the Pro-Cap assembly that provides T1 drops to the customer through an RJ-48C or Amphenol connector. The T1 1x7 Controller Card is an enhanced SCIM that also performs manual 1x7 protection switching on T1 (HDSL) services. The controller card is designed to function as a manual protection switch and does not have the capability to address an automatic protection switch function.

T1 protection switching is accomplished through two network elements:

- Central Office Element (COE)
- Remote Element (RE).

The COE functions as the master of the protection switching operation by initiating all commands. The RE will only respond to the COE commands. The controller card and a Network Interface Unit (NIU) represent the RE. A Digital Test Access Unit (DTAU), a Digital Cross-connect, or a T1 Test Set can represent the COE.

The controller card uses the card in slot 8 of the Pro-Cap mounting as the standby service. The NIU in slot 8 will provide the appropriate physical layer interface to the network (i.e. HDSL2, HDSL, or T1 AMI) and 4-Wire T1 AMI physical layer interface to

the controller card. The controller card will continuously monitor the network receive T1 transmission service in slot 8 (i.e. standby line) for commands. Upon the receipt of these commands, the controller card will initiate the T1 service switchover from the requested line (1 through 7) to the standby line. The controller card when optioned for protect will conduct the following:

1. Monitor the incoming network signal to determine if the protect line is operational. If the line is operational the FAIL LED will be OFF. If no signal is present, the slot 8 PROT LED will be OFF and the FAIL LED will be ON.
2. Provide a loopback to the network as long as a transmit signal is not present from the CPE. If a signal is placed on the slot 8 CPE transmit to the network, the loopback will be released and normal transmission to and from the network can occur. Upon removal of the transmit signal, loopback will be activated.

The SCIM controller card can be locally or remotely provisioned to either enable or disable slot-switching capability. If a slot is protect enabled, when a switch request for that slot is received on the protect channel, the slot will switch. If the slot is protect disabled, it cannot be switched.

5. NORMAL OPERATION

Data is transported from the network to the customer through an assigned slot (slot 1 through slot 7). The standby line is transported through slot 8 (see **Figure 3**).

Normal Receive Path

The receive path is non-protected and transformer coupled between the network and the customer. The receive path is monitored for in-band or ESF bit-patterned datalink messages. The receive path toward the network will be terminated with a 100 ohm resistor. This 100 ohm termination increases the reliability of T1 signal recovery and minimizes crosstalk. The receive path toward the customer will be an open termination.

Normal Transmit Path

The transmit path is non-protected and transformer coupled between the network and the customer.

Passive Mode

The controller card can be configured to establish a passive transmission path by detecting a T1 signal from the customer. The transition from normal to passive mode will require the loopback to the network removed and the receive path to the customer to be reconnected.

Passive Mode to Normal Operation

The controller card will return to normal operation by detection of a loss-of-signal from the customer.

6. PROTECT OPERATION

Protect operation is defined as the transport of data from the network to the customer using a standby line connected to Slot 8. Communication between the COE and RE will be based upon in-band or out-of-band (ESF datalink) commands. Upon detection of a fault on an active line, the controller card will not automatically switch the customer's data onto the standby line. A remote provisioning command must be used to switch the customer's data onto the standby line. Once the customer's data is on the standby line,

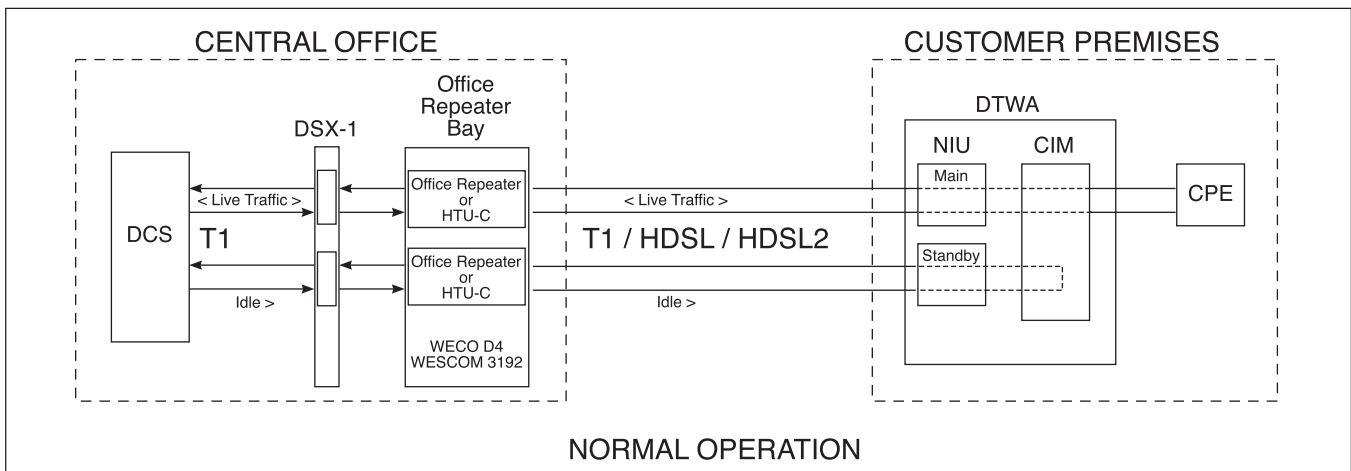


Figure 3. Normal Operation

this condition will be locked until a remote provisioning command orders the controller card to switch the customer data back onto the main line, or a signal failure of greater than 30 seconds occurs on the protect Slot 8.

Protect Receive Path

The receive path is non-protected and transformer coupled between the network and the customer. The receive path is monitored for in-band or ESF bit-patterned datalink messages. The receive path will be a passive transmission path.

Protect Transmit Path

The transmit path is non-protected and transformer coupled between the network and the customer. The transmit path will be a passive transmission path.

In-Band Commands

The in-band commands are based on a 16-bit repeating binary pattern. These patterns were selected to avoid random data replication and yellow alarm generation. In-band code qualifications involve receiving the codes for 5 contiguous seconds. The in-band codes can be transmitted using SF/ESF framing or unframed. See **Table 2** for in-band commands.

Out-of-Band Commands

The out-of-band commands are based on the ANSI T1.403-1995 standard on T1 protection switching. ANSI T1.403-1995, Table 4, specifies the command and response messages for T1 protection switching.

Out-of-band code qualifications involve receiving the codes for greater than 4 consecutive messages. See **Table 3** for out-of-band commands.

Table 2. In-Band Commands

Command	Hex Pattern	Binary Pattern
Switch Arming	C440	1100 0100 0100 0000
Slot Enable	C540	1100 0101 0100 0000
Slot Disable	C640	1100 0110 0100 0000
Switch Release	C44F	1100 0100 0100 1111
Switch Activation Code		
Line 1	C441	1100 0100 0100 0001
Line 2	C442	1100 0100 0100 0010
Line 3	C443	1100 0100 0100 0011
Line 4	C444	1100 0100 0100 0100
Line 5	C445	1100 0100 0100 0101
Line 6	C446	1100 0100 0100 0110
Line 7	C447	1100 0100 0100 0111

Table 3. Out-Of-Band Commands

Command	Hex Pattern	Binary Pattern
Switch Arming	18FF	0001 1000 1111 1111
Slot Enable	78FF	0111 1000 1111 1111
Slot Disable	7AFF	0111 1010 1111 1111
Switch Release	26FF	0010 0110 1111 1111
Switch Activation Code		
Reset	24FF	0010 0100 1111 1111
Line 1	42FF	0100 0010 1111 1111
Line 2	44FF	0100 0100 1111 1111
Line 3	46FF	0100 0110 1111 1111
Line 4	48FF	0100 1000 1111 1111
Line 5	4AFF	0100 1010 1111 1111
Line 6	4CFF	0100 1100 1111 1111
Line 7	4EFF	0100 1110 1111 1111

7. PROTECTION SWITCH

Remote provisioning for a protection switch can be accomplished by sending a specific sequence of in-band or out-of-band messages. These remote provisioning commands are transmitted to the controller card from a remote test facility or a T1 test set at a DSX panel.

Arming

Arming the controller card prevents an inadvertent protection switch operation. The controller card can be armed with the presence of the appropriate in-band or out-of-band pattern on the network receive interface. Disarming the controller card can be accomplished with the presence of an in-band (11100) or out-of-band (ESF datalink) NIU loop down pattern on the network receive interface, a 1-hour time out, a protection switch, or a manual reset. See **Figure 4** for arming activation.

In-Band Slot Enable/Disable Protocol

See **Table 4** for in-band slot enable/disable protocol.

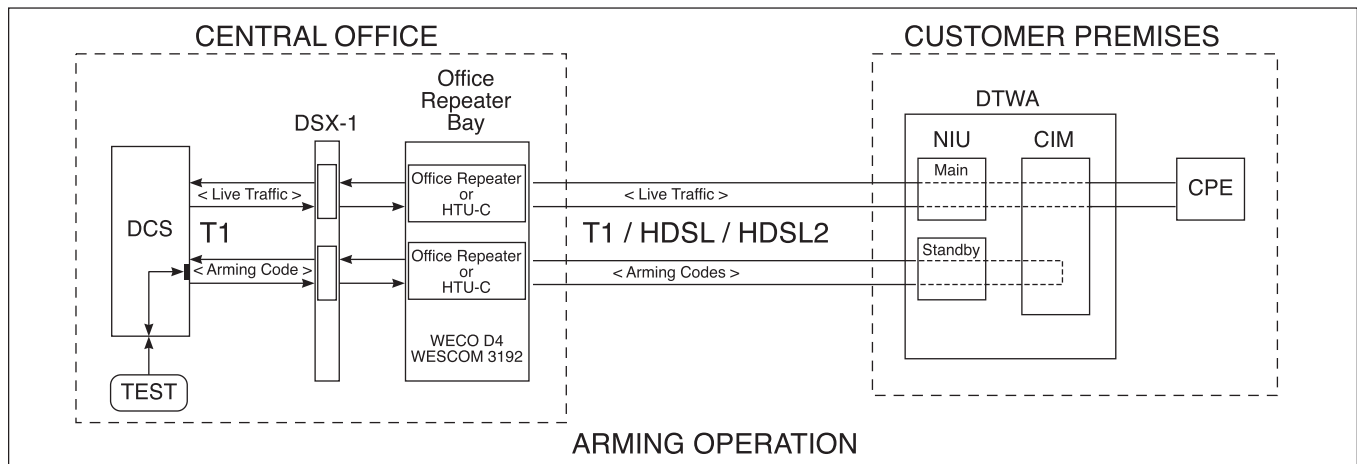


Figure 4. Arming Operation

Table 4. In-Band Enable/Disable Protocol

Step	COE In-Band Command Patterns	In-Band Pattern	Controller Card
1	Send Arming Code	C440 Hex	Loopback the Arming Code.
2	Send Slot Enable or Disable Code	C540 Hex Enable C640 Hex Disable	Loopback the Enable/Disable code for 5 Sec, then No Sync for 5 Sec. Repeat until pattern is removed.
3	Send Protection Line Switch C44X where X = line number	C44X Hex X = Line Number	Loopback the C44X code where X = line number for 5 Sec., then No Sync for 5 Sec. Repeat until pattern is removed.
4	Remove Pattern		Slot is now Enabled or Disabled for protection switching.

In-band Protection Switch ProtocolSee **Table 5** for in-band protection switch protocol.**Out-of-Band Protection Switch Protocol**See **Table 7** for out-of-band protection switch protocol.**Out-of-Band Enable/Disable Protocol**See **Table 6** for out-of-band slot enable/disable protocol.**Table 5. In-Band Protection Switch Protocol**

Step	COE In-Band Command Patterns	In-Band Pattern	Controller Card
1	Send Arming Code	C440 Hex	Loopback the Arming Code.
2	Send Protection Line Switch Code Slot Enabled Slot Disabled	C44X Hex X = Line Number	Loopback the C44X code where X = line number. Perform switchover 5 seconds later. Loss of sync. Continuous Loopback of the C44X code where X = line number. No switchover and no loss of sync.

Table 6. Out-Of-Band Enable/Disable Protocol

Step	COE In-Band Command Patterns	Bit-Oriented Datalink Pattern	Controller Card
1	Send Arming Code	0001 1000 1111 1111	Loopback Arming Code for 400 ms followed by AIS.
2	Send Slot Enable or Disable Code	Enable 0111 1000 1111 1111 Disable 0111 1010 1111 1111	Loopback the Enable/Disable code for 400 ms followed by AIS.
3	Send Protection Line Switch	0100 XXX0 1111 1111 XXX = Line Number (see Table 3)	Loopback line # code for 400 ms followed by AIS.
4	Remove Pattern		Slot is now Enabled or Disabled for protection switching.

Table 7. Out-Of-Band Protection Switch Protocol

Step	COE In-Band Command Patterns	Bit-Oriented Datalink Pattern	Controller Card
1	Send Arming Code	0001 1000 1111 1111	Loopback Arming Code for 400 ms followed by AIS.
2	Send Protection Line Switch Code Slot Enabled Slot Disabled	0100 XXX0 1111 1111 XXX = Line Number (see Table 3)	Loopback line # code: Perform switchover after 4 consecutive messages received. Loopback line # code followed by AIS. No switchover.

See **Figure 5** and **Figure 6** for switchover codes and traffic results.

8. SWITCHBACK

Switchback operation is defined as the re-establishment of the T1 transmission path between the network and the customer using the regularly assigned line. Communication between the COE and RE will be based upon in-band or out-of-band (ESF datalink) commands.

Switchback Receive Path

Remote

Switchback operation is accomplished by sending a specific sequence of SF in-band patterns or ESF datalink messages over the standby line.

NOTE

Communication using in-band codes will override the customer's data during the switchover operation. The customer's data will be overridden for 10 seconds. These remote provisioning commands are transmitted to the controller card from a remote test facility or a T1 test set at a DSX panel.

Local

Depressing S2 on the SCIM card for a minimum 5 seconds resets the protect configuration in memory.

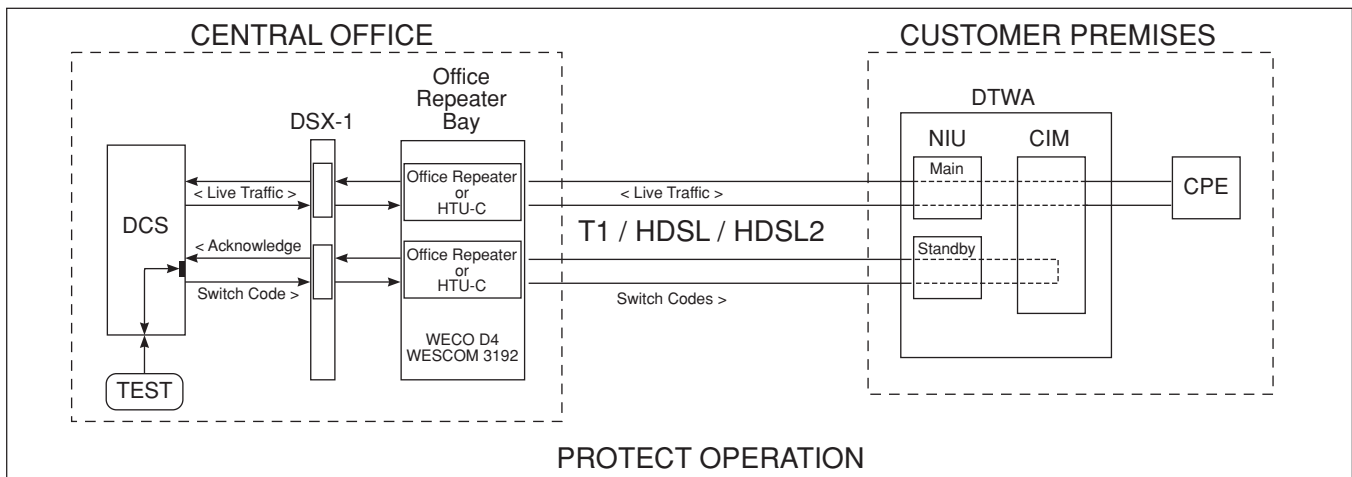


Figure 5. Protect Operation

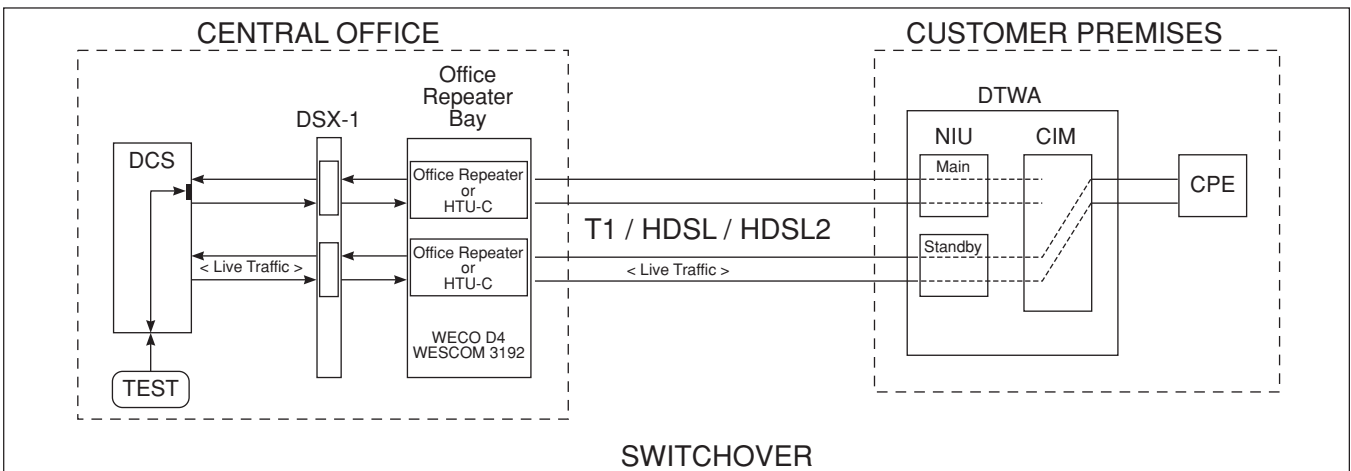


Figure 6. Switchover

In-band Release Protocol

See **Table 8** for return to normal operation.

Out-of-Band Release Protocol

See **Table 9** for return to normal operation.

Signal Transmit

The controller card will transmit a 0 dB signal.

Line Build Out (LBO)

The controller card will not provide LBO functions.
The controller card will rely upon the NIU to provide LBO.

9. AUTO-PROTECT OPERATION

When the Pro-Cap is configured in a Total Access 3000 network optioned for the auto-protect feature, the TA 3000 will re-map a failed loop's data to the TA 3000 protect unit which in turn sends the protect initiate codes to the Pro-Cap. The Pro-Cap will put its protect unit online to complete the standby transmission loop to the customer. Loss of data transmission on a particular loop for any reason initiates the protect function. See **Figure 7**. Normal transmission is automatically restored when the failure is corrected.

Table 8. In-Band Protection Release Protocol

Step	COE In-Band Command Patterns	In-Band Pattern	Controller Card
1	Send switch release code	C44F Hex	Loopback Release Code. Perform switchback 5 seconds later.
2	Remove pattern		Slot is returned to normal operation.

Table 9. Out-Of-Band Protection Release Protocol

Step	COE In-Band Command Patterns	Bit oriented Datalink Pattern	Controller Card
1	Send switch release code	0010 0110 1111 1111	Perform switchback after 4 consecutive messages received.
2	Remove pattern		Slot is returned to normal operation.

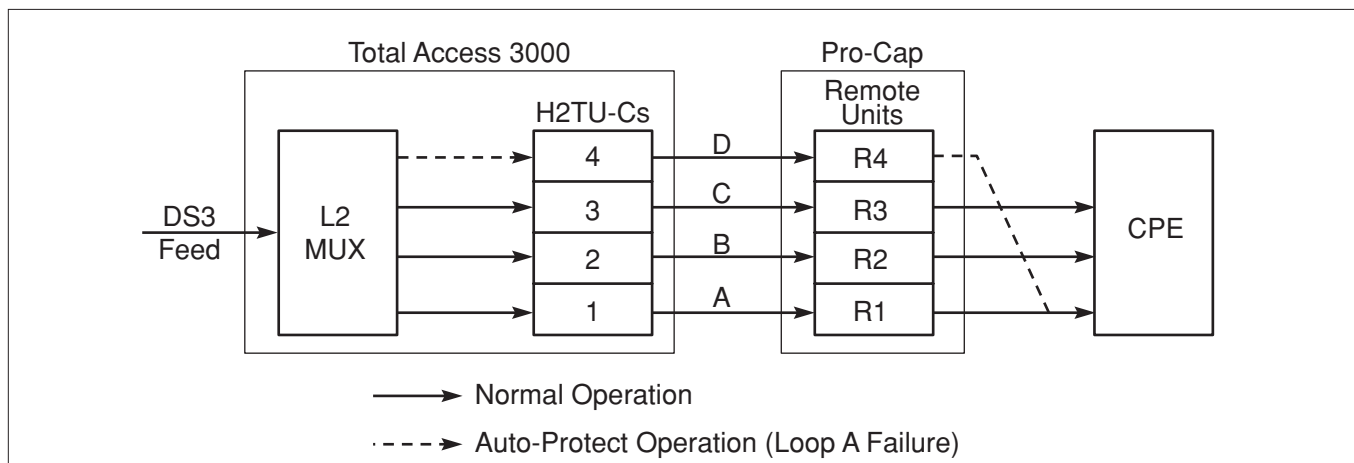


Figure 7. Total Access 3000 Auto-protect Switching

10. SPECIFICATIONS

See **Table 10** for Specifications.

Table 10. Specifications

Specification	
Physical Interface:	4-Wire
Signal:	T1 Bipolar
Coding:	AMI or B8ZS compatible
Framing:	SF, ESF, or Unframed
Line Rate:	1.544 Mb/s @ 50 ppm
Transmit Signal:	0 dB
Insertion Loss:	1.5 dB max at 772 kHz
Line Impedance:	100 ohms ($\pm 20\%$) at 772 kHz
Maximum Detect Error Rate:	$< 10^{-3}$
Power:	Span Power at 57 to 63 mA Local Power at ± 24 VDC to 56 VDC
DC Voltage Drop (Span Powered):	24 VDC at 60 mA
Operating Temperature: Humidity:	-40° C to +65° C Up to 95% noncondensing
UL Compliance: FCC Compliance:	UL 1950 3 rd Edition FCC Part 15, Subpart B, Class A Requirements

11. MAINTENANCE

The Pro-Cap does not require maintenance for normal operation.

12. WARRANTY AND CUSTOMER SERVICE

ADTRAN will replace or repair this product within ten (10) years from the date of shipment if it does not meet its published specifications or fails while in service. Refer to ADTRAN *U.S. and Canada Carrier Networks Equipment Warranty*, document 60000087-10.

Contact Customer And Product Service (CAPS) prior to returning equipment to ADTRAN.

For service, CAPS requests, or further information, contact one of the following numbers:

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