



HPX-1600 USER GUIDE

**Chapter 1-8:
SDH-AU3
Linear 1+1 configuration example**

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1. INTRODUCTION

This chapter describes an example configuration for a linear multi-node network. The HPX-1600-SS can be configured in a linear mode for both SDH and SONET protocols with optional protected automatic protection on the trunk interfaces.

This example uses SDH-AU3 framing. The principle difference between SDH-AU3 and SDH-AU4 at STM-1 is in the types or supported virtual circuits.

AU4 supports E1, T1, E3 and T3 (DS3).

AU3 supports E1, T1 and T3 (DS3) but not E3

To illustrate example configuration details, the four node linear network depicted in Figure 1 will be used. This network has four nodes in a linear topology, connected by a SDH, STM-1 trunk. The end nodes, referred to as terminal nodes have a STM-1 trunk in one direction only while the mid-span nodes have STM-1 trunks to both East and West directions.

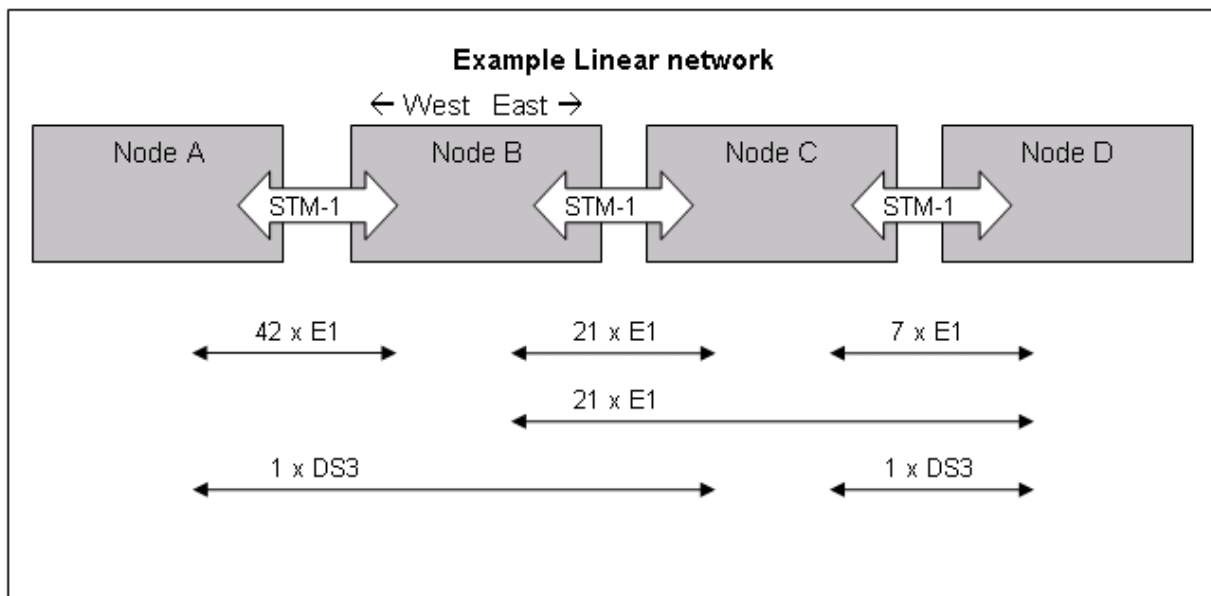


Figure 1 – Example four node linear network

Note that in the example network that the mid-span, Add-Drop Multiplexer nodes “B” and “C” terminate a total number of tributaries that exceeds the normal capability of STM-1 when configured in a point-to-point or ring topology. This is possible because of the re-use of trunk bandwidth in both East and West directions.

Node “A”

Terminates 42x E1 and 1x DS3.

Node “B”

Terminates 84x E1, 42x E1 to the West and 42x E1 to the East

Node “C”

Terminates 28x E1, 21x E1 to the West and 7x E1 to the East

Terminates 2x DS3, 1x DS3 to the West and 1x DS3 to the East

Node “D”

Terminates 28x E1 and 1x DS3.

1.1. TRUNK CIRCUIT CONNECTIONS

A Multi-Drop linear network is a linear series of connected network nodes that has a terminal node at each end and multiple mid-span nodes in between. There is a choice of STM-1/OC-3 trunk interface modules that can be used in this topology. The standard STM-1/OC-3 interface modules can be used except in the case of (1+1) protection configuration on a mid-span node. The Linear (1+1) trunk module incorporates the trunk switching support and both working and protection trunks. This module can be used in all terminal and mid-span nodes with or without trunk protection. For additional details refer to chapter 2-17.

Trunk definitions are as follows:

Terminal nodes using the standard trunk interface modules; slot 15 is defined as “working” trunk and slot 16 as “protection”. See notes in section 2.5.

Terminal nodes using the Linear 1+1 trunk interface modules; slot 15 is contains both “working” and “protection” trunks. Slot 16 is unused.

Mid-Span nodes; slot 15 is defined as “West” and slot 16 as “East”.

Mid-Span nodes; using the standard trunk interface modules do not support 1+1 protection.

Mid-Span nodes; using the Linear 1+1 trunk interface modules provide 1+1 protection.

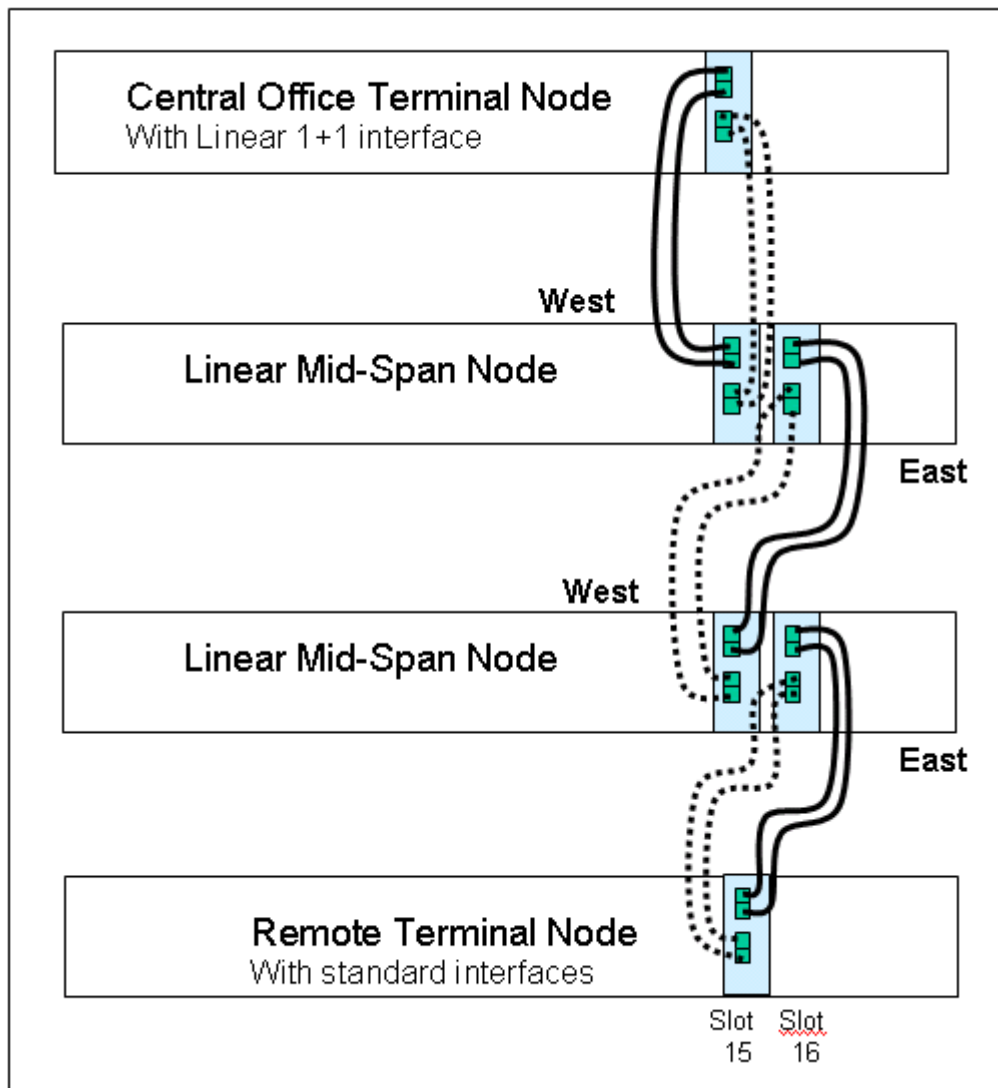


Figure 2 : Linear (1+1) topology

1.2. NETWORK PROTECTION

Protection of linear networks is supported for SDH multiplexer (ITU-T G.783 & G.841), Multiplexer Section Protection (MSP) 1+1 APS and SONET line, SWITCHED 1+1 APS (IEEE 105.1).

The automatic protection functionality is derived from the SDH/SONET Daughter Card (SDC) in association with the Linear 1+1 trunk interface module and supports protection of STM-1 trunks against trunk associated failures within a multiplexed trunk link.

By switching the bridged trunk within the interface module, the DCC bytes are always switched with the operational data trunk circuit. An interruption to the DCC circuit may occur during a switch over.

This function complies with ITU-T G.783 and G.841 can be configured to use either:

- Single ended local decision with K byte notification or
- Bi-directional k-byte switching synchronisation.

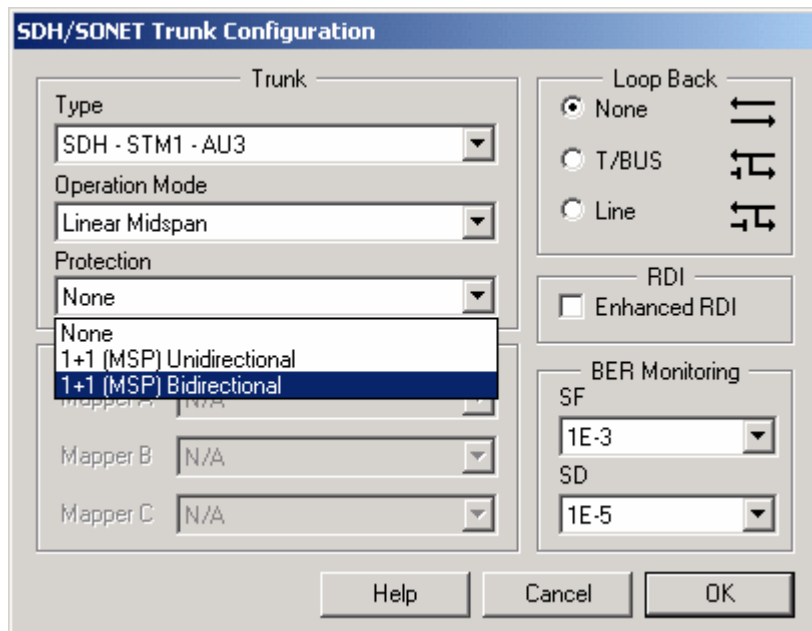


Figure 3 : uni or bi -directional protection

1.2.1.1. SINGLE ENDED SWITCHING

For 1 + 1 unidirectional switching, the signal selection is based on the local conditions and requests. Therefore each end operates independently of the other end, and bytes K1 and K2 are not needed to coordinate switch action. Therefore an APS switch event may result in East bound traffic using the “Working” trunk circuit and West bound traffic using “Protection” trunk circuit.

1.2.1.2. BI-DIRECTIONAL SWITCHING

For 1+1 bi-directional switching, Bytes K1 and K2 are exchanged to complete a switch. Switching is completed when both ends select the signal from protection. This exchange of information ensures that both directions of transmission are using a common trunk path and equipment.

1.2.1.3. MSP 1+1 POINT-TO-POINT

Figure 4 shows a point-to-point configuration over four optic fibres. Fibres may be routed over diverse paths. The SDH signal is bridged over both paths. Protection is provided for failure of a single fibre only. A protection switch will switch the entire STM-1 payload.

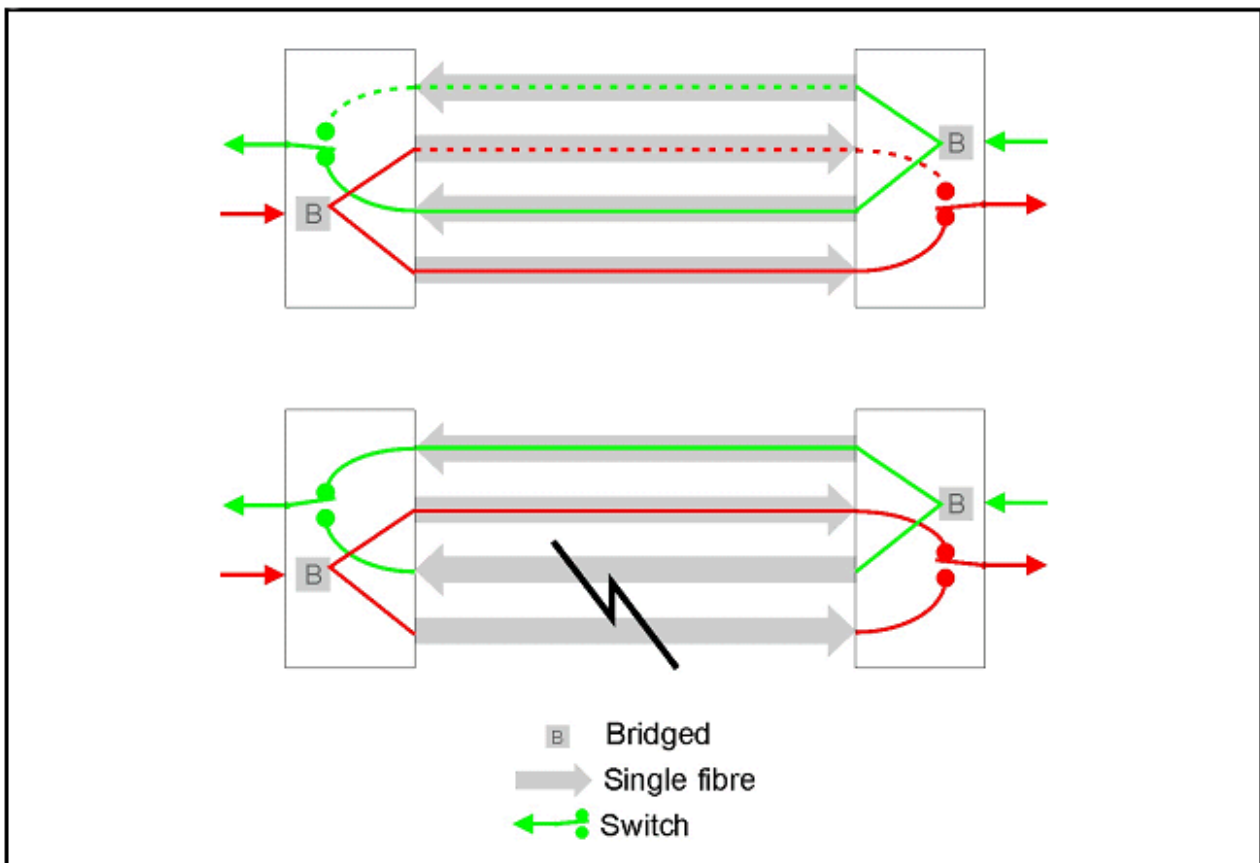


Figure 4 – Point to point MSP 1+1 protection

1.3. TRUNK AND DATA PATH CONFIGURATION

Once the SDH/SONET network TRUNK and APS have been selected and the physical fibre optic connected, the trunk and data paths must be configured.

The path alarm configuration dialogs are accessed from the SDH configuration windows. These are shown below in Figure 5.

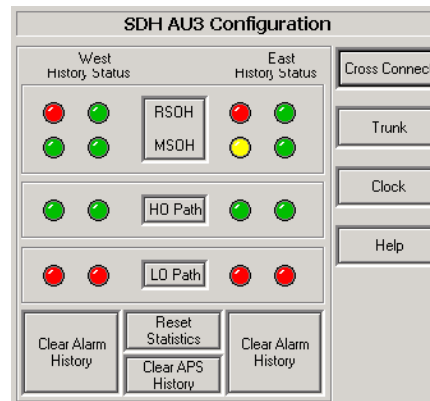


Figure 5 – SDH/SONET Configuration Windows

1.3.1. SDH TRUNK AND DATA PATH CONFIGURATION

Configure the overhead bytes in the following order;

- Regenerator,
- Multiplexer,
- High Order Path,
- Low Order Path.

For each of these configuration windows, there are alarms that can be enabled and a “J byte” field to enter a unique text string that is associated with the payload at that layer. This field has “received”, “transmitted”, and “expected” string fields.

The factory default configuration will match the existing “null string” J-bytes without any text configuration input. This practise is not recommended as it will not assist any future diagnosis, but may be adopted in for expediency of network setup.

The “expected” value is compared with the “received” J bytes, the “transmitted” value is forwarded to the next node for the same comparison. The J bytes are used to allow intuitive interconnection of multiple nodes. Unique textual labels are encapsulated with data as it is transmitted, at the destination a comparison is performed between the received and the “expected” text to confirm that the correct connection is made. Path labels are provided for the RSOH (Are we connected to the correct node?), at the HO-path (Are we connected to the correct HO payload?) and the LO-path (Are we connected to the correct tributary?)

Each alarm can be enabled as either a red or a yellow alarm. The history and current status of each alarm are also displayed. If any of the configured yellow alarms are active, the tributary unit box will be yellow. If any configured red alarms are active, the box will be red. If red and yellow alarms are active, the box will show red.

If the box is green, it indicates that all user configured alarm events are inactive.

Alarms can be disabled on a layer basis or individually at any given layer. This means that as a network is commissioned, the installer can disable all low order alarms until the higher order is established.

1.3.1.1. REGENERATOR & MULTIPLEXER CONFIGURATION

Alarms can be configured individually for both Regenerator and Multiplexer Sections. The “J0” bytes are used to trace between the adjacent nodes. Each node in the ring should transmit “J0” bytes to identify the adjacent unit.

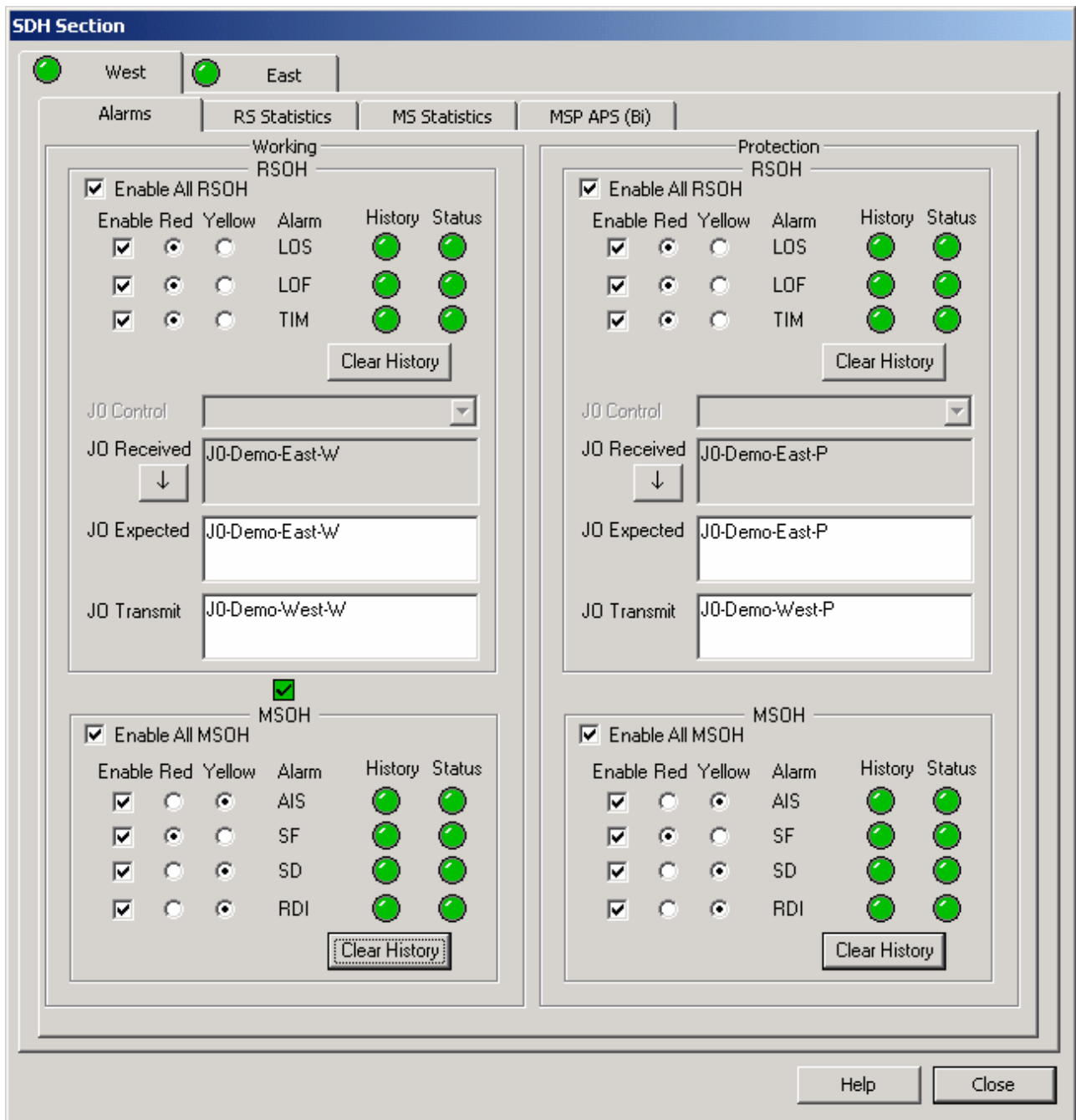


Figure 6 - RSOH & MSOH alarms and J0 bytes

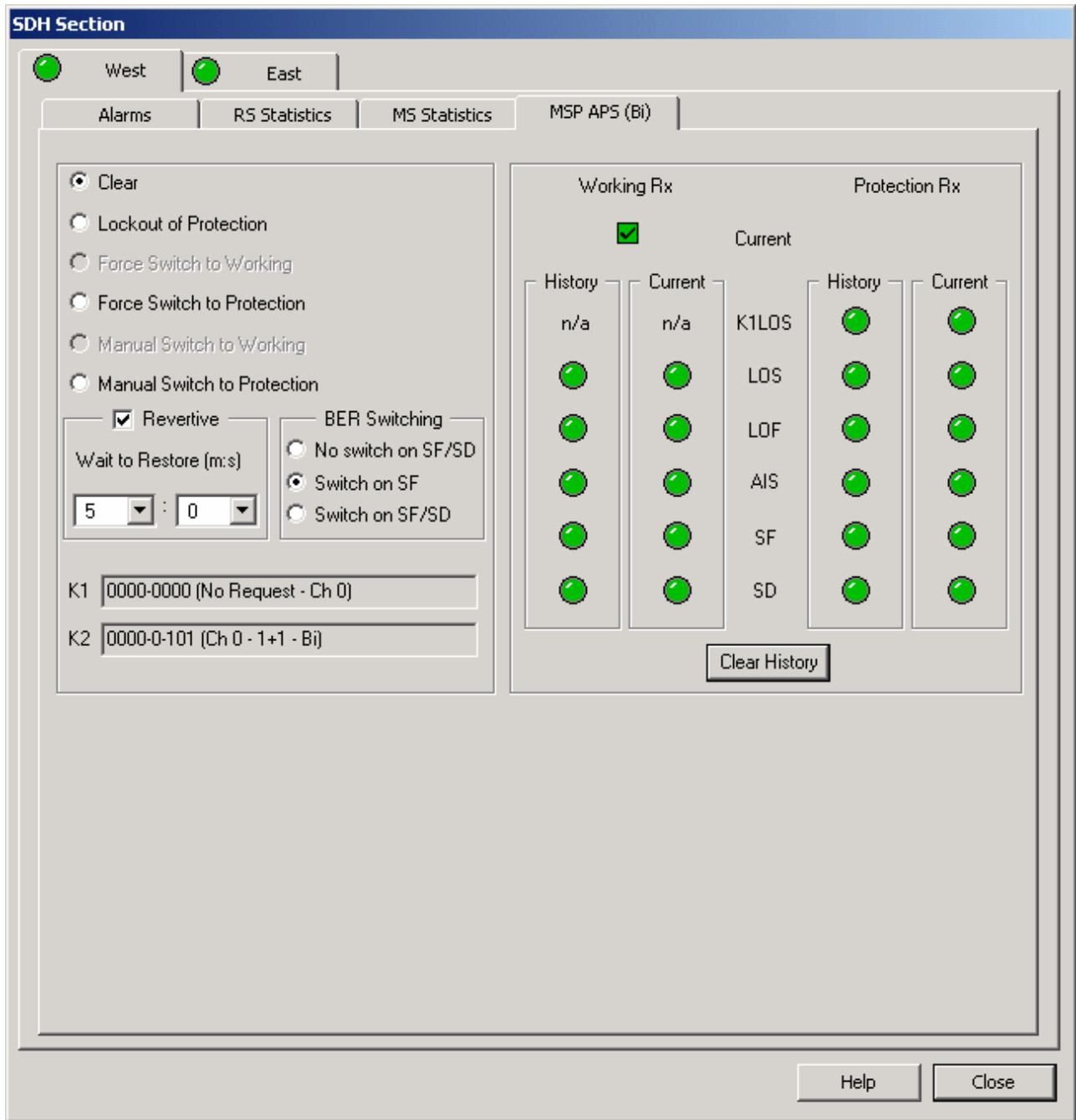


Figure 7 – MSP APS configuration and control

The MSP APS window displays current and historical status of the fibre optic interfaces. The green “tick” icon identifies the active fibre trunk. The Bit Error Rate is monitored and trunk protection can be configured to switch on signal Failure and/or Degradation. If the “Revertive” box is ticked, then the active trunk will switch from protection back to working after a switch over when the signal quality of the working trunk is within specification and the configured timer has expired.

At this point the SDH network is operational and now needs the tributary services to be configured.

1.3.2. SDH MAPPING

New and existing Interface Module types can be installed and multiplexed over the SDH/SONET trunk. E1/T1 and E3/DS3 circuits are mapped into SDH asynchronously.

Low speed (DS0) IMs, voice and data can be groomed into a composite E1 or T1 stream before transmission over the SDH/SONET trunk.

In this example the HPX-1600-SS is configured for SDH-AU3 framing and mapping, aligning and multiplexing of PDH signals. The PDH signals are mapped into virtual containers or virtual tributaries according to the following specifications.

SDH multiplexing and mapping is conducted in accordance with ITU-T G.707.

- 2.048Mbps Mapped to a VC-12 compliant to ITU-T G.707 section 10.1.4.1
- 1.544Mbps Mapped to a VC-11 compliant to ITU-T G.707 section 10.1.5.1
- 45Mbps Mapped to a VC-3 compliant to ITU-T G.707 section 10.1.2.1

Note that E3 (34Mbps) tributaries are not supported in AU3 mode.

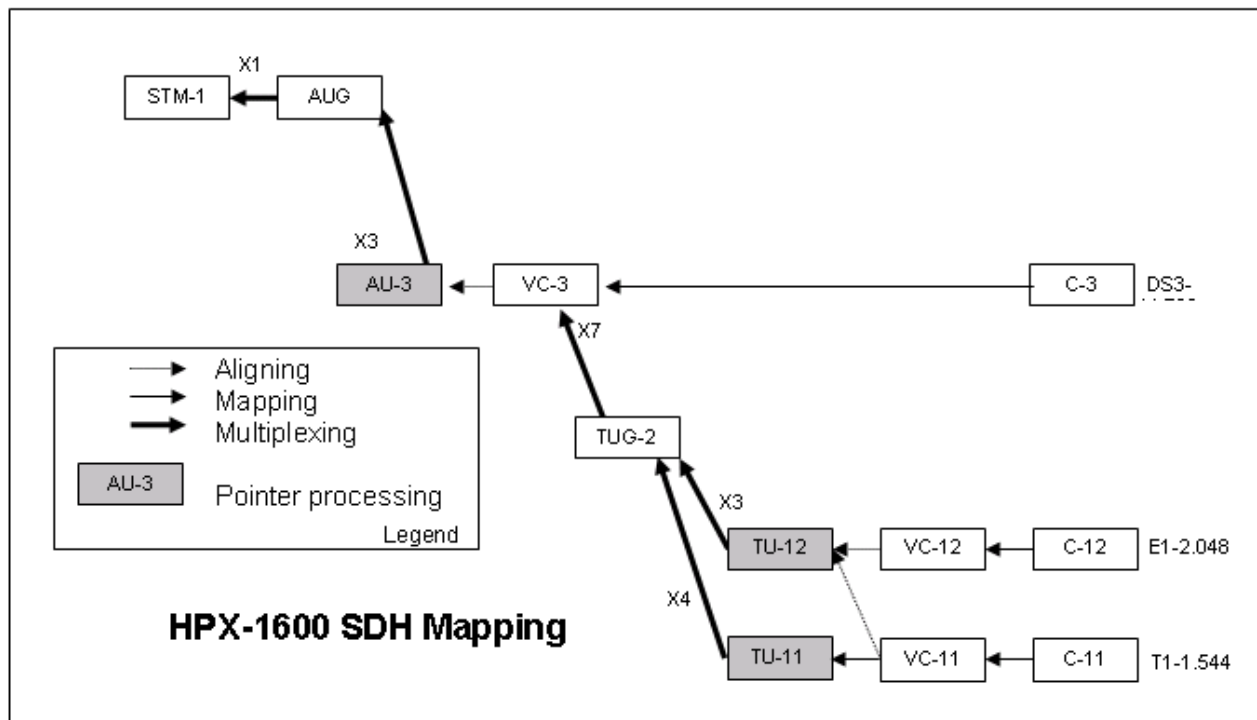


Figure 8 – SDH-AU3 mapping

The following page graphically describes the mapping of the physical interfaces of the four node example network into the SDH network virtual circuits. The allocation of the SDH VC's for the breadth of the network is described in Figure 9. The physical interface modules installed in each node is summarised in Figure 10. Thumbnails of the HPXView SDH tributary cross connects are illustrated in Figure 11.

TU#	VC type	Node "A"	Node "B"	Node "C"	Node "D"	Circuit
1-1-1 - 1-3-1	7x VC-12					7x E1
1-3-2 - 1-5-2	7x VC-12					7x E1
1-5-3 - 1-7-3	7x VC-12					7x E1
2-1-1 - 2-3-1	7x VC-12					7x E1
2-3-2 - 2-5-2	7x VC-12					7x E1
2-5-3 - 2-7-3	7x VC-12					7x E1
3-1-1	1x VC-3					1x DS3

Figure 9 : Four node example - VC usage

Node name	Node "A"	Node "B"	Node "C"	Node "D"
Trunk config	Terminal	Mid-span	Mid-span	Terminal
Hardware summary	2x E1 Map 1x DS3 Map 5x 8E1 + 1x 2E1 1x DS3	3xE1 Map 11x 8xE1	1x E1 Map 1x DS3 Map 1x 8E1 1x ET3M 2x DS3	1x E1 Map 1x DS3 Map 4x 2E1 1x ET3M 1x DS3
Direction		West East	West East	
E1 circuits	42x E1	42x E1 42x E1	7x E1 7x E1	7x E1
E1 in G.747			14x E1 7x E1	21x E1
DS3 circuits	1x DS3		1x DS3 1x DS3	1x DS3

Figure 10 : Four node example - equipment & interface summary

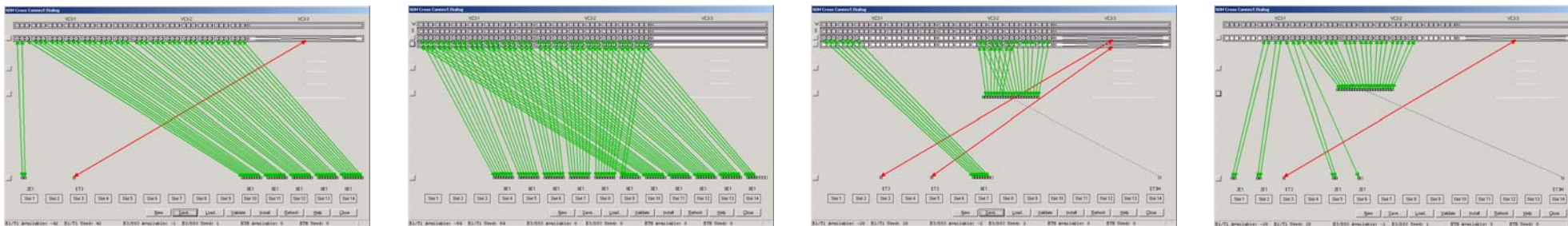


Figure 11 : Four node example - Cross Connect summary

1.3.2.1. HIGH ORDER BYTES CONFIGURATION

1.3.2.1.1. SDH CROSS CONNECT

At this point of the configuration, the SDH network trunks are configured and the tributary interfaces configured and cross connects installed to the SDH virtual circuits.

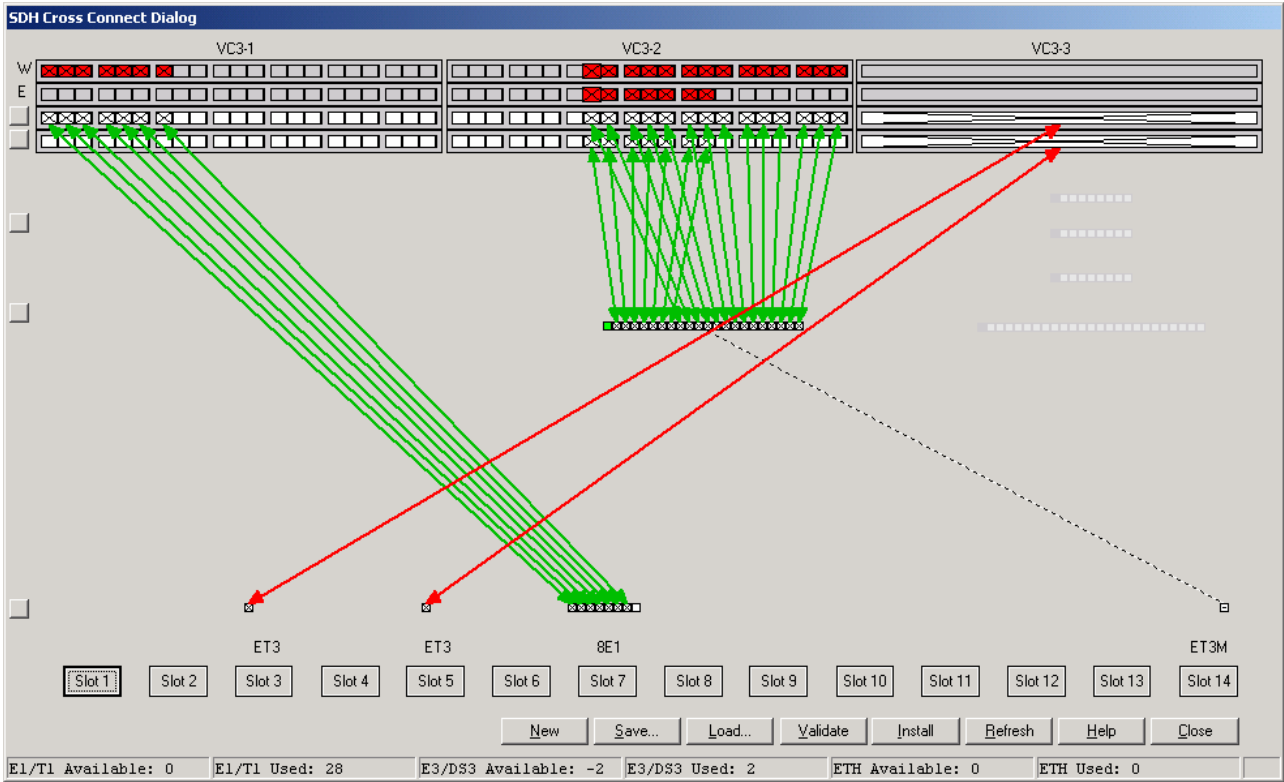


Figure 12 : Node "C" - SDH cross connect

A cross connect example is shown in *Figure 12 : Node "C" - SDH cross connect*. West or East tributary circuits can be dimmed or removed from view for clarity, by clicking on the associated view button on the left of screen. This results in a view similar to that in *Figure 13*.

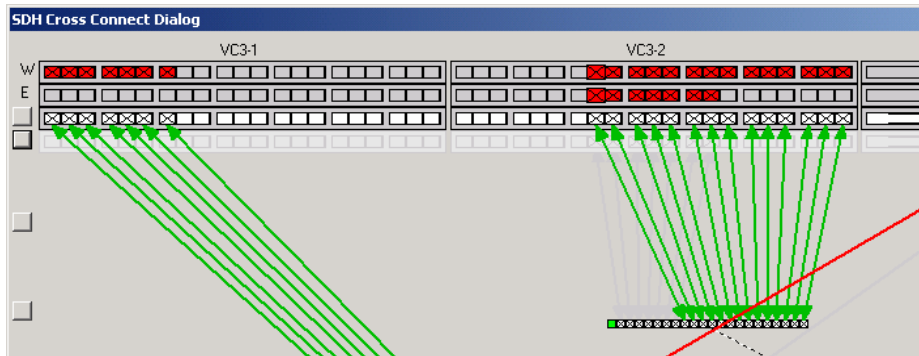


Figure 13 : Dimmed cross connect view

1.3.2.1.2. E3 AND DS3 TRIBUTARIES

The High Order (J1) bytes are used to define and trace the actual path end to end between nodes on the SDH ring. The Path Signal Label values should be selected as “bit synchronous”.

1.3.2.1.3. E1 AND T1 TRIBUTARIES

The High Order (J1) bytes are used to define and trace the path between adjacent nodes on the SDH ring. The Path Signal Label values should be selected as “TUG structure” or Tributary unit Group.

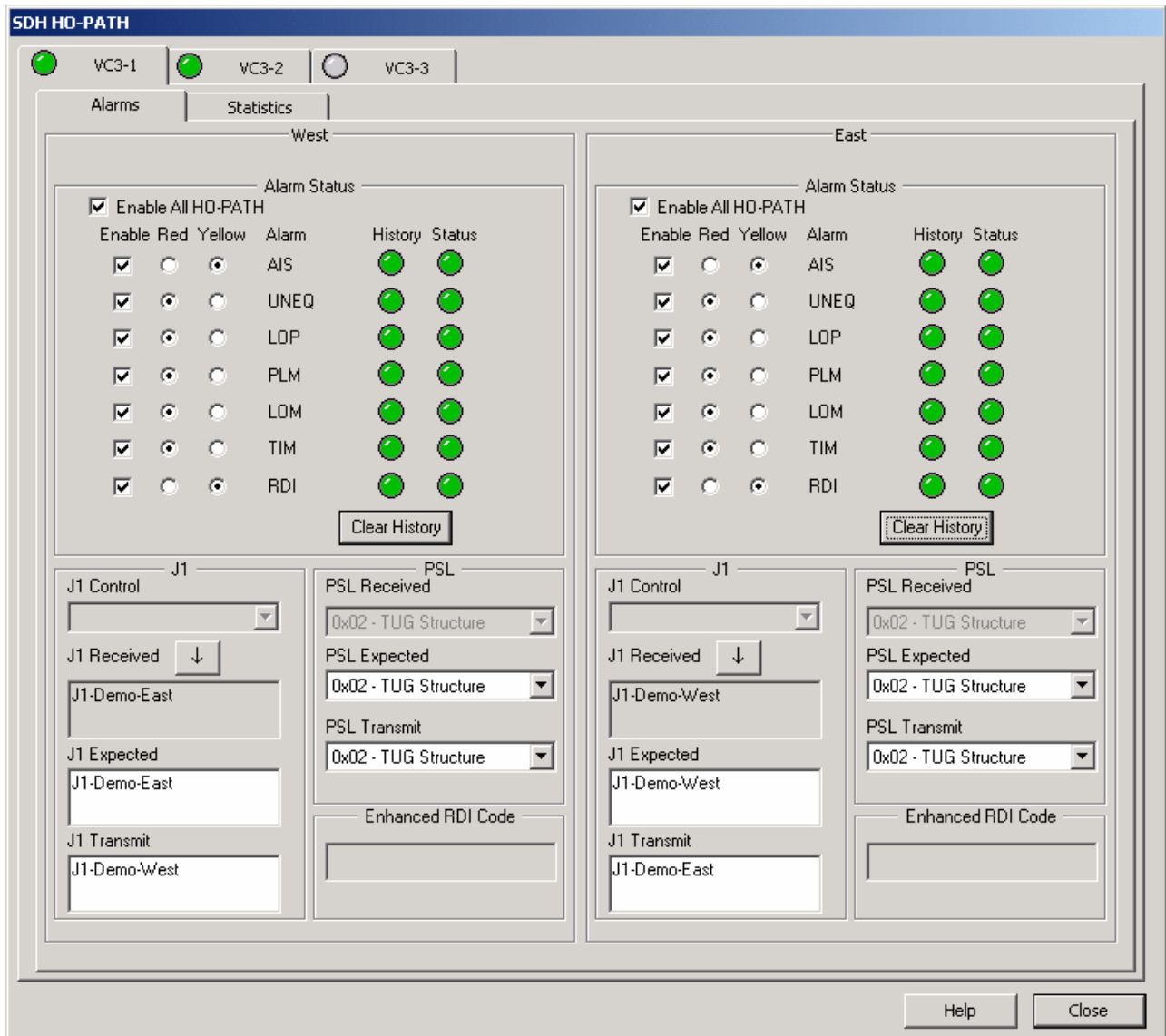


Figure 14 - High Order Path alarms and J1 bytes

At each node the received J1 bytes can be copied to the “Expected” field by clicking on the down arrow button.

The Path Signal Label (PSL) section is used to compare the received and expected payload types, to protect against mis-configuration. The payload type used must match at both ends of the link such that they are set to the same type. The PSL setting of “Equipped” is a wild card match for any service.

1.3.2.2. LOW ORDER TRIBUTARY CIRCUIT CONFIGURATION

The Low Order path is used to transport T1 and E1 data streams. The “J2” bytes are used to trace this path. The tributary circuits **must** be selected and mapped to the selected Tributary Unit Group (TUG) and installed **before** the Low Order path can be configured. Tributary circuits can be T1 or E1 IM interfaces or framed E1 stream outputs from the Digital Access Cross Connect. Refer to Chapter 3 for details on cross connect of tributaries and DACS.

The TUG-3 groups are displayed as the three possible addressable TUG-3 payloads, which is the maximum capacity of the SDH STM-1 network. Each TUG3 group contains the possible payload of seven TUG2 groups. Tributaries may be mapped to VC12 or VC11 containers within each TUG2 group. The user is free to use any TUG3 groups.

The HPX-1600-SS will dynamically distribute the payloads across the installed mapper daughter boards. There is no direct relationship between the TUG3 group addressing and the installed mapper hardware. The user can define VC12 tributary circuits for 1-1-1, 2-1-1 and 3-1-1 with only a single E1/T1 mapper installed.

The Low Order Path configuration can be accessed from the main configuration window, giving a display similar to that in Figure 15.

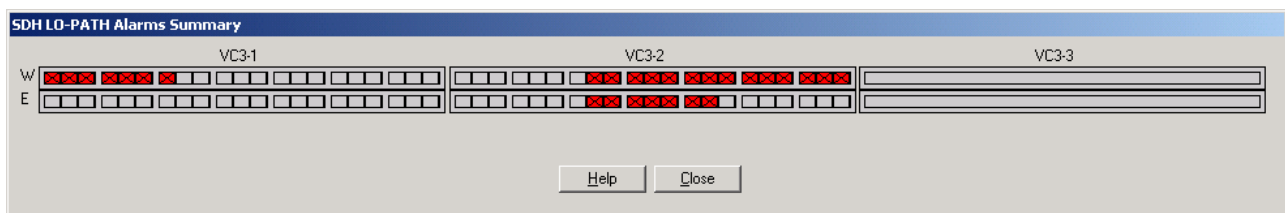


Figure 15 - Low Order Path

Alternatively, the Low Order Path window can be accessed from the “Cross Connect” window as in Figure 12. Haliplex recommends this approach as this is a more informative display from which the physical connections can be identified.

To configure the Low Order Path and “J2” bytes, a cross connect must be established from the DACS or an IM to the VC to be configured. Click “Install” to install the cross connect to the node. The Alarms panel will then be enabled.

To configure the Low Order Path and “J2” bytes, left click on the tributary unit button to select, then right click to display the window as below. Two sets of path information are shown in Figure 16 as this TU is transmitted both East and West.

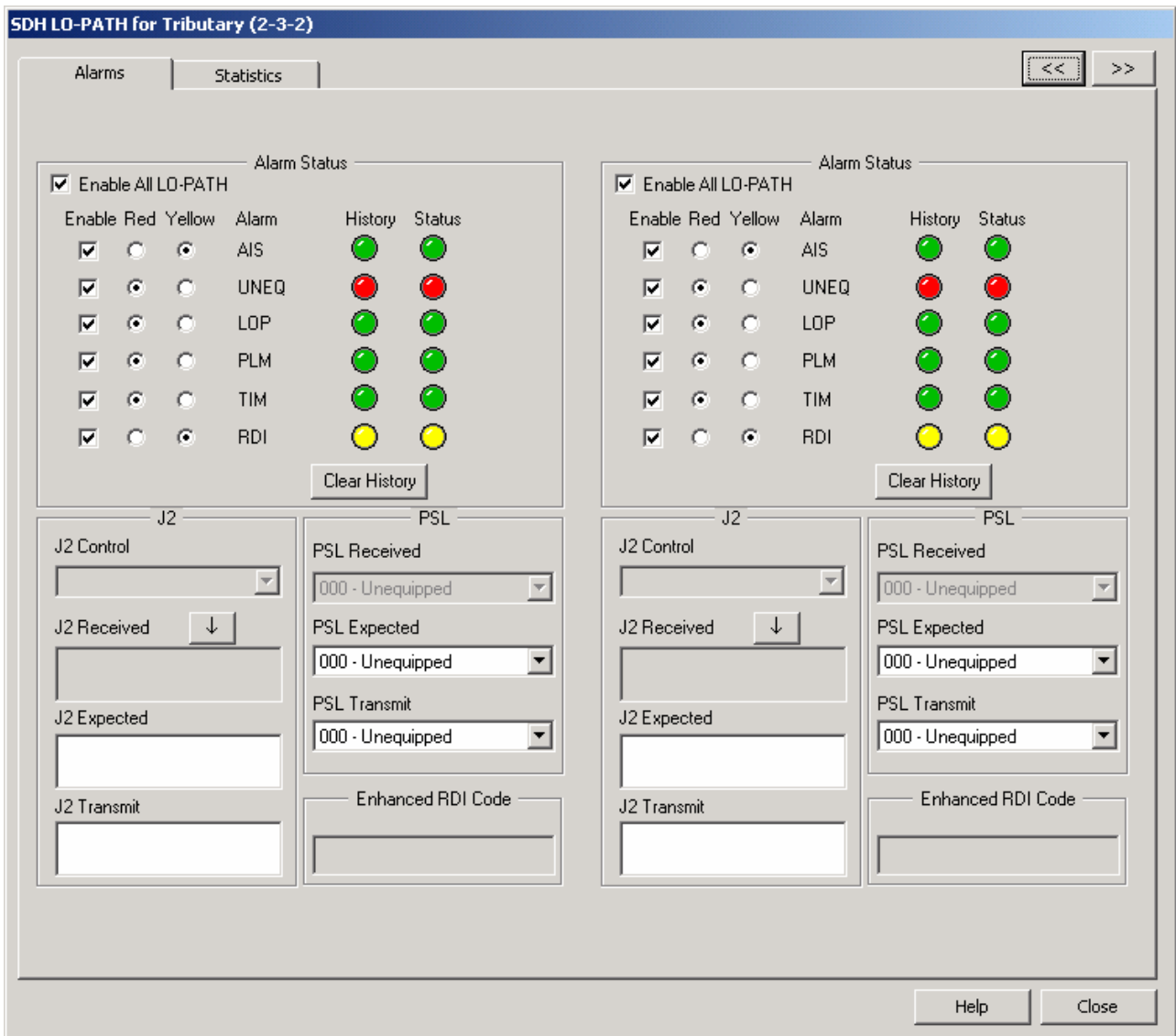


Figure 16 - Low Order Path Alarms and J2 bytes

The “J2” trace bytes are used to define the network ring end-to-end path information. After the LO Path alarms are configured, the tributary button will change from a grey appearance to the colour of the currently highest severity, active alarm.

The Path Signal Label (PSL) section is used to compare the received and expected payload types, to protect against mis-configuration. The payload type used should be set so that both ends of the link are set to “Equipped”.

In the case of a TU that has only a uni-directional mapping, only a single set of Tu information is displayed as in Figure 17.

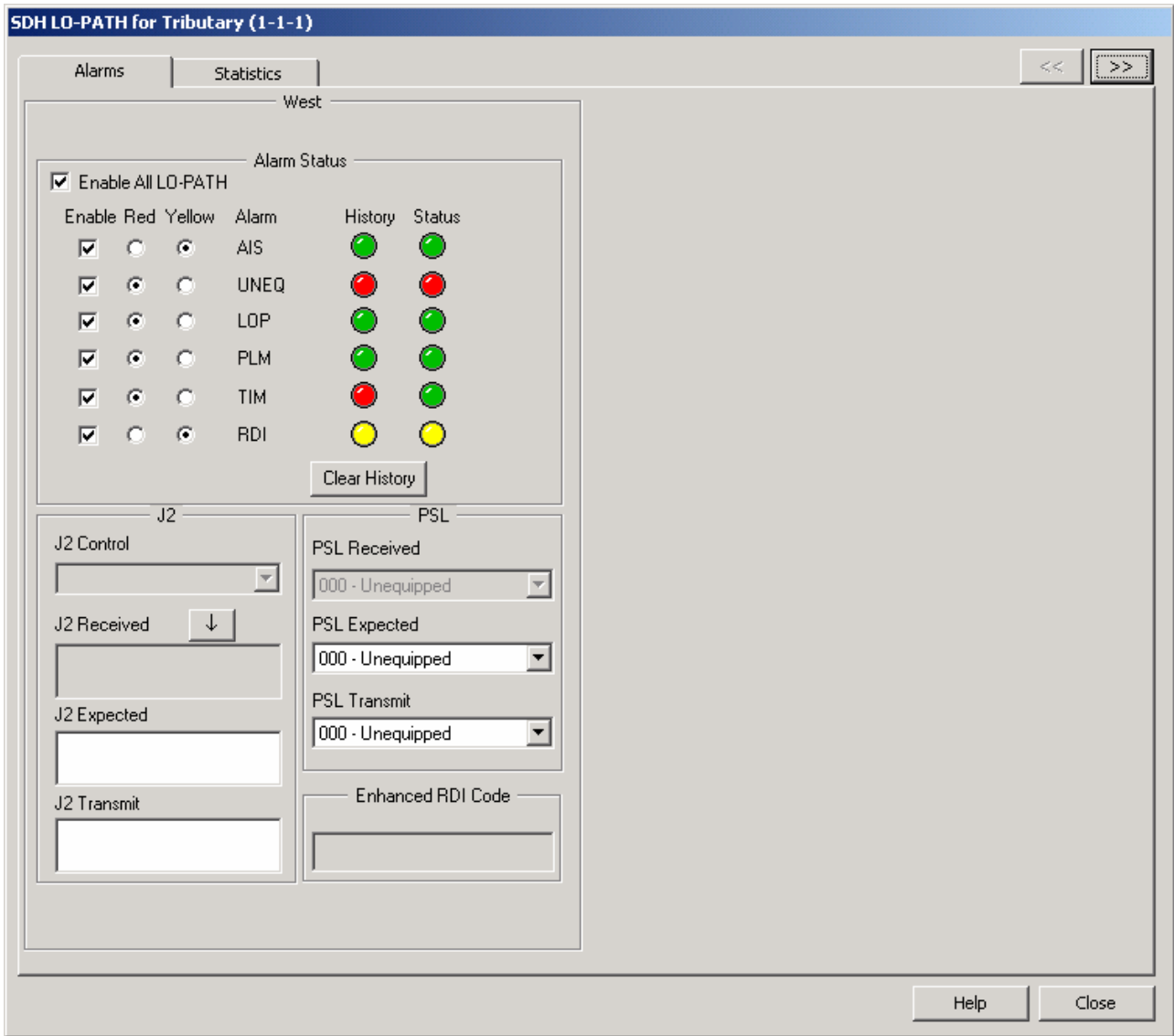


Figure 17 : Uni-directional TU - LO path properties

2. ADDITIONAL NOTES

The following notes relate to other configurations and applications of linear SDH/SONET networks, not covered in the example network.

2.1. ETHERNET MAPPER

Ethernet Mapper circuits can use a virtual circuit to either the East or the West but not re-use the same virtual circuit in both directions.

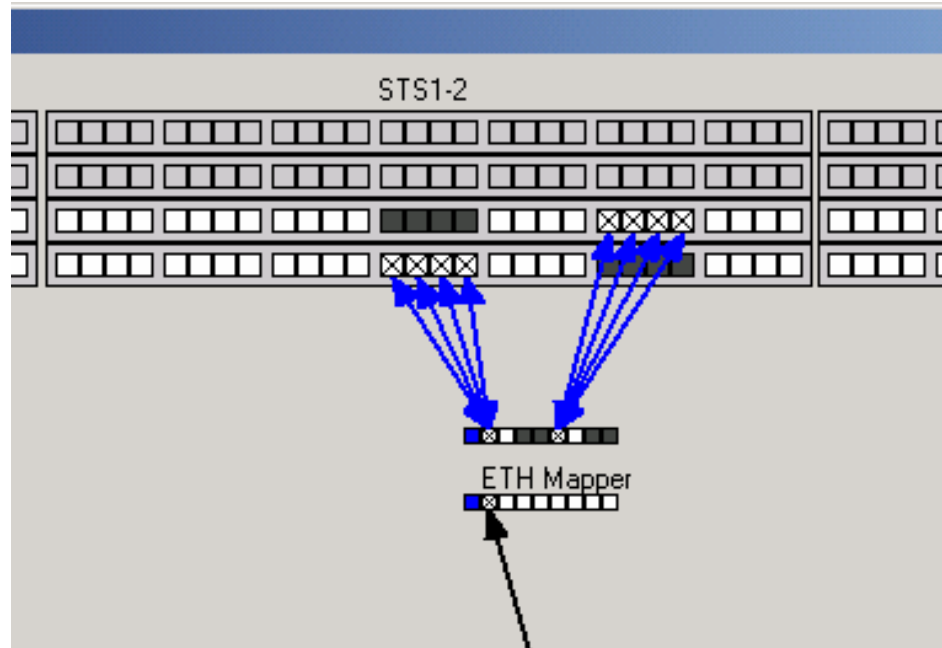


Figure 18 :
Ethernet Mapper
circuits to East

and West

All member circuits within a VCAT group must be connected in the same direction, either all East or all West.

2.2. DACS CONNECTIONS

A traditional PDH E1/T1 add/Drop Multiplexer function can be configured with virtual circuit re-use East and West. The example in Figure 19 drops an T1 from the West into the Digital Access Cross-connect Switch, grooms at a DS0 timeslot level and adds the T1 back into the same numbered circuit to the East.

This method can be utilised to broadcast voice traffic to radio transmitters or public address systems at every network node.

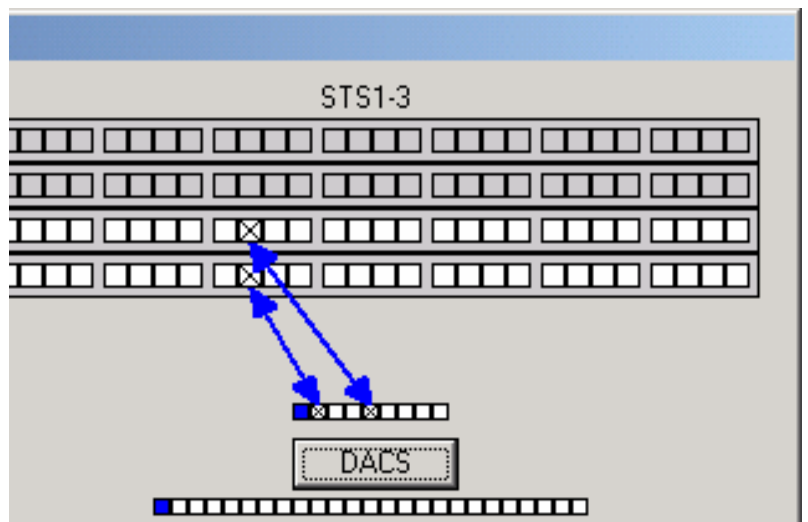


Figure 19 : VC Add Drop using the same VC

2.3. ELECTRICAL STM-1 / STS-3

Linear networks with electrical STM-1 / STS-3 trunk interfaces are supported but only in a non-protected configuration.

2.4. PROTECTED AND UNPROTECTED TRUNKS

A linear network may be configured with part of the network having 1+1 protected trunks and the balance unprotected trunks. Configuration of the node at the edge of the protected network should be configured with trunk protection and alarms from the unprotected direction not enabled.

2.5. USE OF STANDARD TRUNK INTERFACES

Standard optical and electrical trunk interfaces may be used in linear networks without protection.

In the terminal node standard trunk interfaces may be used to provide both working and protection. Terminal nodes using the standard trunk interface modules; slot 15 is defined as “working” trunk and slot 16 as “protection”.

NOTE that terminal node APS does function correctly. However if connected to a mid-span node that uses a Linear (1+1) trunk interface module, management over the DCC may fail to operate in the protection mode without operation action. Other alternative transport such as a timeslot in the payload may be considered.