



# **HPX-1600 USER GUIDE**

**Chapter 1-7:  
SONET Ring  
UPSR example configuration**

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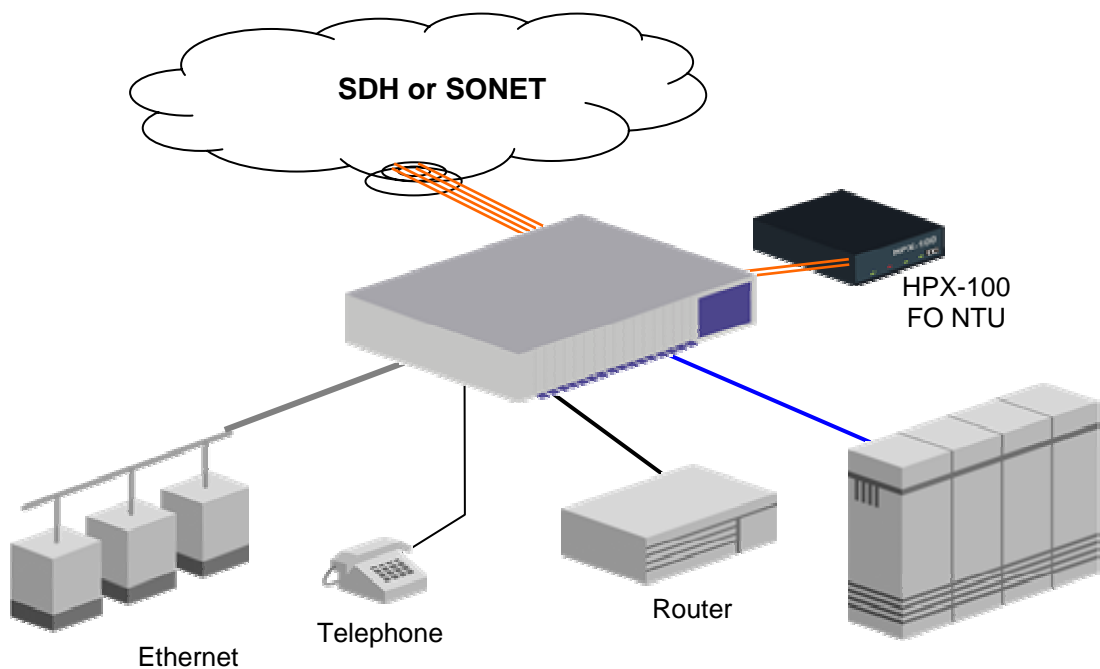
## 1. INTRODUCTION

The HPX-1600-SS integrates SDH/SONET transmission and multiplexing with Optical Multiplexing, Cross Connect and Integrated Access functionality.

The HPX-1600-SS allows users to connect traditional E&M, FXS, serial data (V.35/V.24/X.21/RS-530/RS-530A), n x 64K E1, Ethernet along with multiple E1/T1 circuits and E3/DS3 across trunks using SDH framing with STM-1 bandwidth or SONET framing with OC-3 bandwidth. Ethernet support includes dynamic concatenated bandwidth in multiples of T1/E1 and E3/DS3.

The inbuilt cross connect functionality allows customers to establish traditional Digital Data Networks (DDN) and integrate them with SDH/SONET facilities. The DDN functionality is built into the HPX-1600-SS allowing users to build new DDN infrastructure or integrate it with existing ones. The standard DACS is a 1024x1024 DS0 type.

The modular approach to the HPX-1600-SS allows network providers to mix and match multiple services using a wide variety of Interface Modules (IMs).



**Figure 1 - Application of HPX-1600-SS in SDH/SONET Networks**

**1.1.1. SONET MAPPING**

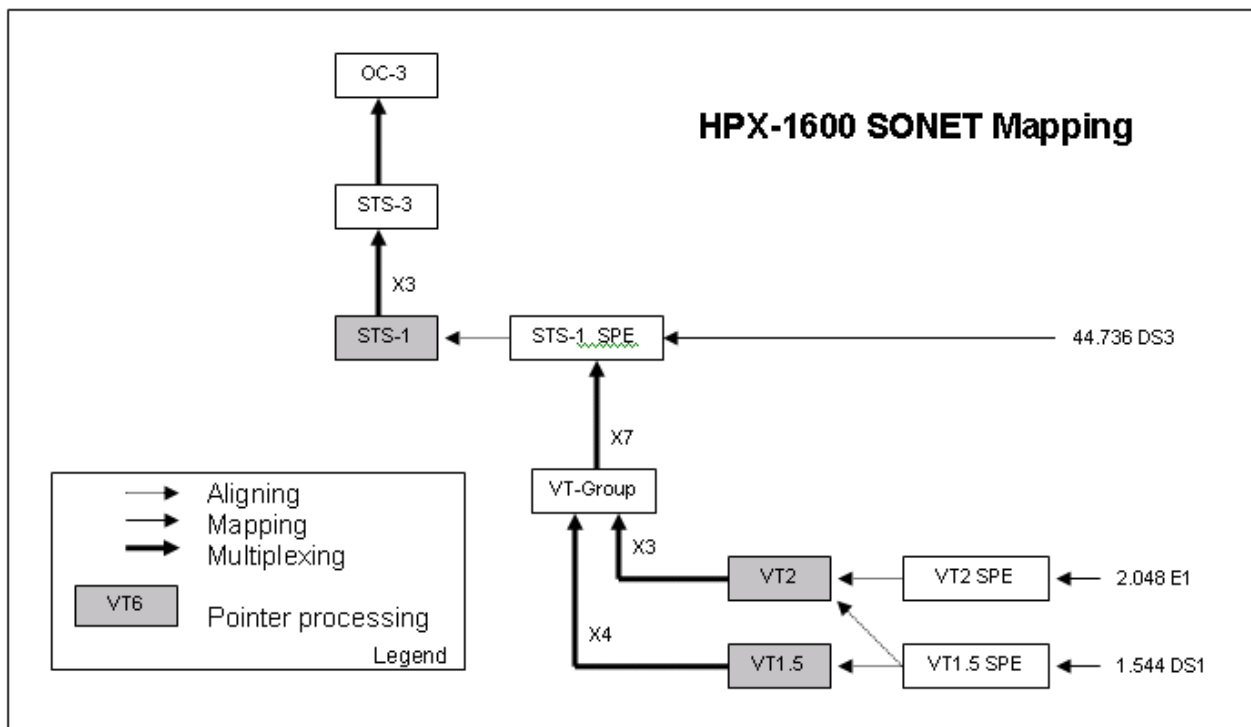
New and existing IM types can be installed and multiplexed over the SONET trunk. T1/E1 and DS3 circuits are mapped into SONET asynchronously as a default although the user can select each port on the IMs to be synchronised to one of a number of sources.

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

The HPX-1600-SS provides for SONET framing and mapping, aligning and multiplexing PDH signals. The PDH signals are mapped into virtual containers or virtual tributaries according to the following specifications.

SONET multiplexing and mapping is conducted in accordance with ANSI T1.105.02

- 2.048Mbps Mapped to VT2 SPE compliant to ANSI T1.105.02 section 5.1.4
- 1.544Mbps Mapped to VT1.5 SPE compliant to ANSI T1.105.02 section 5.1.1
- 44.736Mbps Mapped to STS-1 SPE compliant to ANSI T1.105.02 section 5.2.1



**Figure 2 – SONET Mapping**

## 2. NETWORK TOPOLOGY

The HPX-1600-SS can be connected as a linear Point-to-Point network or in a Ring topology. In linear or terminal mode the HPX-1600-SS can interface to a remote HPX-1600-SS or as a terminal of another SDH/SONET network.

The HPX-1600-SS can be configured as a ring of many HPX-1600-SS.

The following describes alternative methods of connecting the fibre optic interfaces to provide protected terminal (1+1) and ring (SNCP/UPSR) topologies.

### 2.1. SNCP/UPSR RING

When configured in a ring topology using the SNCP/UPSR APS, the HPX-600-SS nodes are connected using two contra-rotating, uni-directional fibre optic rings. Data is transmitted on both rings and the receiving HPX-1600-SS makes a selection one of the two data paths based on signal quality, overhead bytes and management interface controls. The ring with transmission in a clockwise direction is arbitrarily defined as the "Working ring" and the other ring as the "Protection Ring". There is no logical limit to the number of nodes within the ring, although physical distance limits exist for each section based on fibre optic plant and the choice of Haliplex fibre optic interface options.

#### 2.1.1. EAST & WEST

The SDH/SONET ring may have many member nodes, all of which may be accessed on the ring in either a clockwise or counter clockwise direction. The directional terminology used to describe the relative direction to the HPX-1600-SS is EAST or WEST.

- The FO interface transmitter in slot 15 is always facing WEST.
- The FO interface transmitter in slot 16 is always facing EAST.

#### 2.1.2. SPAN & RING

The HPX-1600-SS supports two physical fibre optic interface connection methods;

- Span per Interface Module
- Ring per Interface Module

As there are two methods of cabling the fibre optic interfaces into a ring, the direction the FO receiver faces will change accordingly.

- In Ring mode, (15 in, 15 out), each ring (working and protection) is contained within a single interface module.
  - WEST = 15 receives from, 16 transmits to
  - EAST = 16 receives from, 15 transmits to
- In Span mode, (15 in, 16 out), each ring (working and protection) transits both interface modules
  - WEST = 15 receives from, 15 transmits to
  - EAST = 16 receives from, 16 transmits to

**2.1.3. FIBRE OPTIC CONNECTION – SPAN MODE**

The Span per interface module connects to both working and protection rings of the same span with the same fibre optic interface module. Removal of the fibre optic module from slot 15 will cause the APS to switch to protection.

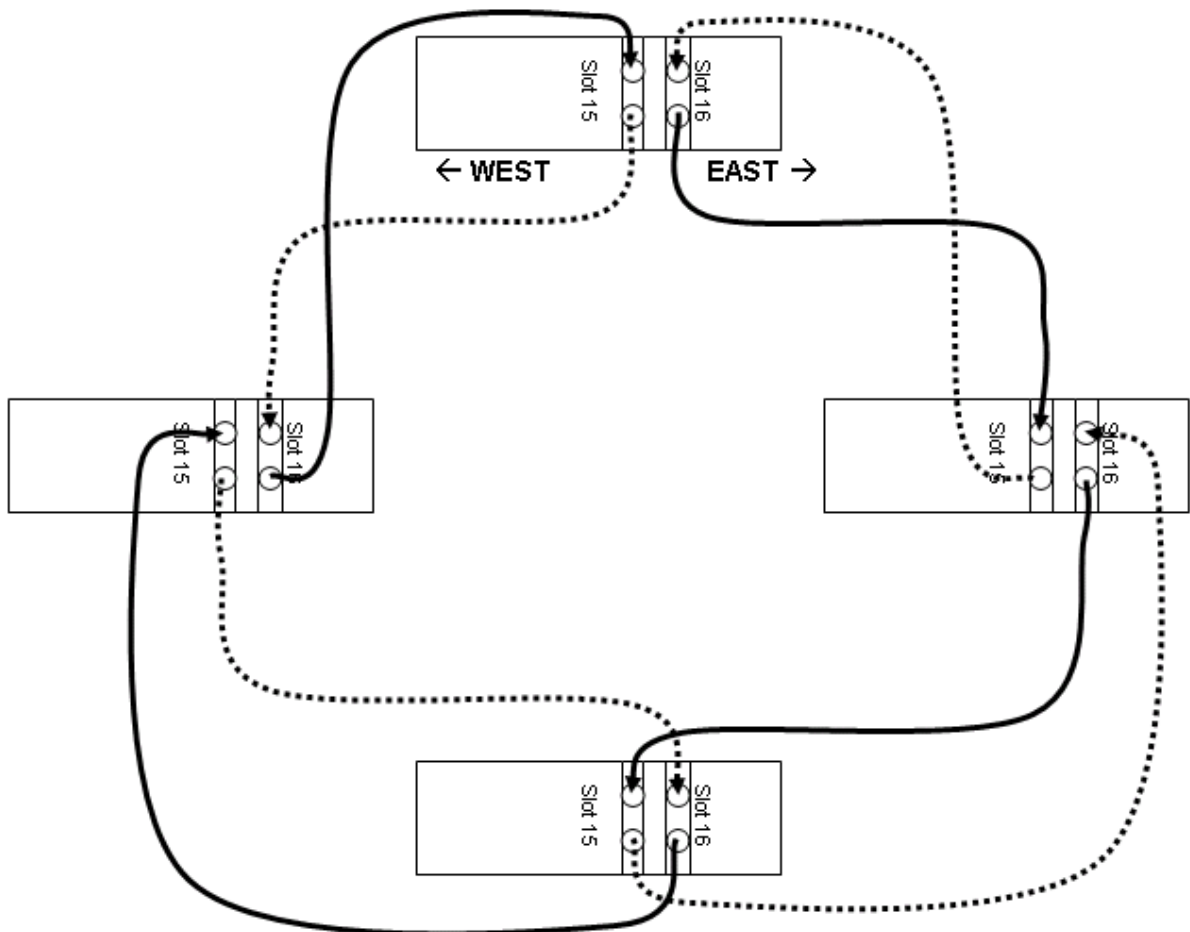
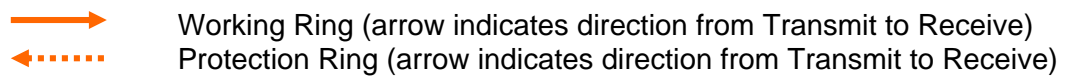
The span mode of connection is suitable for applications of the WDM fibre optic interface option. The WDM interface uses different transmit and receive wavelengths within a common fibre optic trunk. The standard fibre optic interface module uses the same wavelength for both receive and transmit but separated in two fibre optic trunks.

**Working Ring**

- Received by slot 15
- Transmitted from slot 16

**Protection Ring**

- Received by slot 16
- Transmitted from slot 15



**Figure 3 – SNCP/UPSR Fibre Optic Ring connections to STM-1(OC-3) - IM SPAN mode**

**2.1.4. FIBRE OPTIC CONNECTION – RING MODE**

The Ring per interface module connects to both receiver and transmission paths of the same ring with the same fibre optic interface module.

The ring mode of connection is suitable for applications where the working and protection rings follow diverse network paths. The ring connection mode allows removal of all of the components of one ring without interruption to the functioning ring. For example, the protection fibre optic module can be removed from slot 16 without causing any interruption to the working ring. This feature can be utilised when adding HPX-1600-SS nodes to an existing network ring.



The optional WDM fibre optic interface uses different transmit and receive wavelengths within a common fibre optic trunk and cannot be used in this configuration.

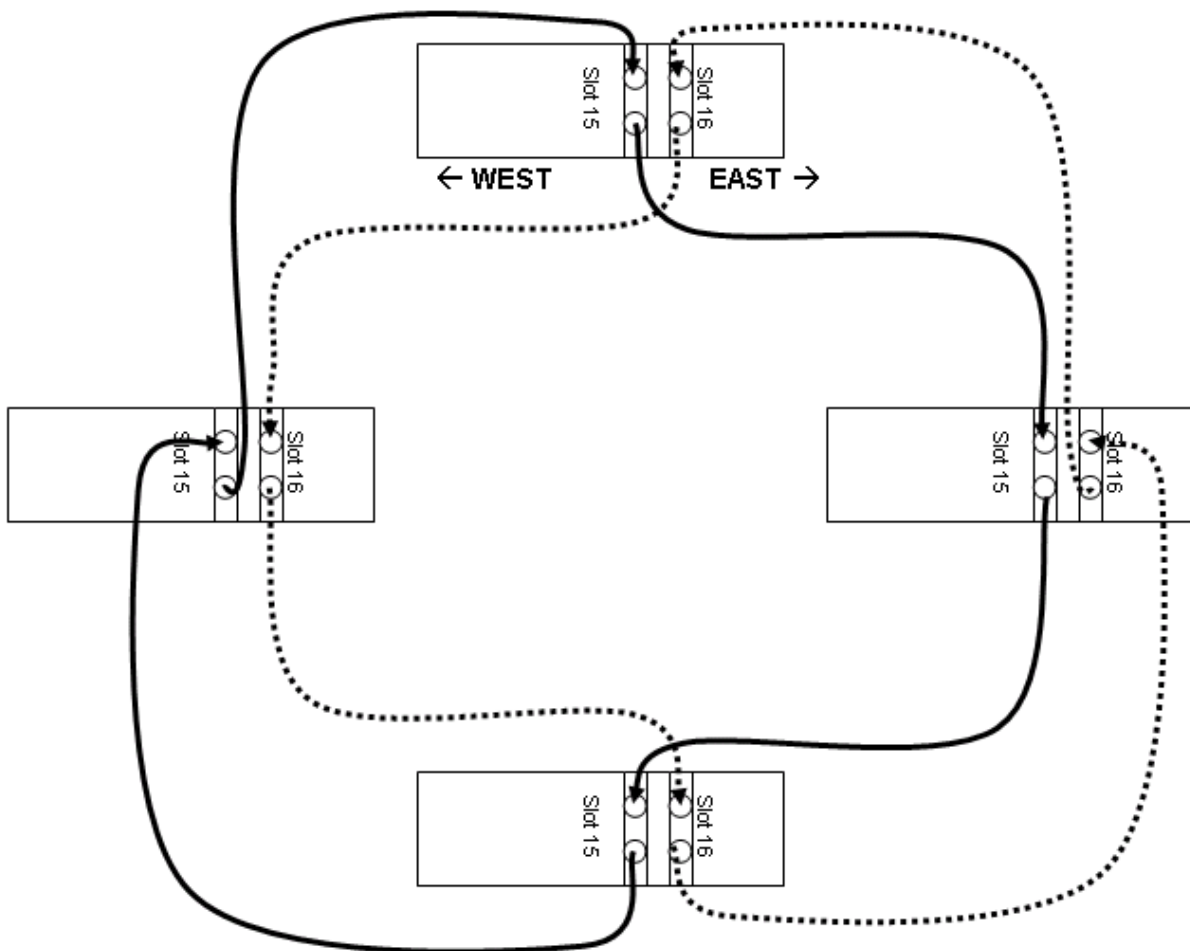
**Working Ring**

- Received by slot 15
- Transmitted from slot 15

**Protection Ring**

- Received by slot 16
- Transmitted from slot 16

 Working Ring (arrow indicates direction from Transmit to Receive)  
 Protection Ring (arrow indicates direction from Transmit to Receive)



**Figure 4 – SNCP/UPSR Fibre Optic Ring connections to STM-1(OC-3) - IM Ring mode Network protection**

## 2.2. NETWORK PROTECTION

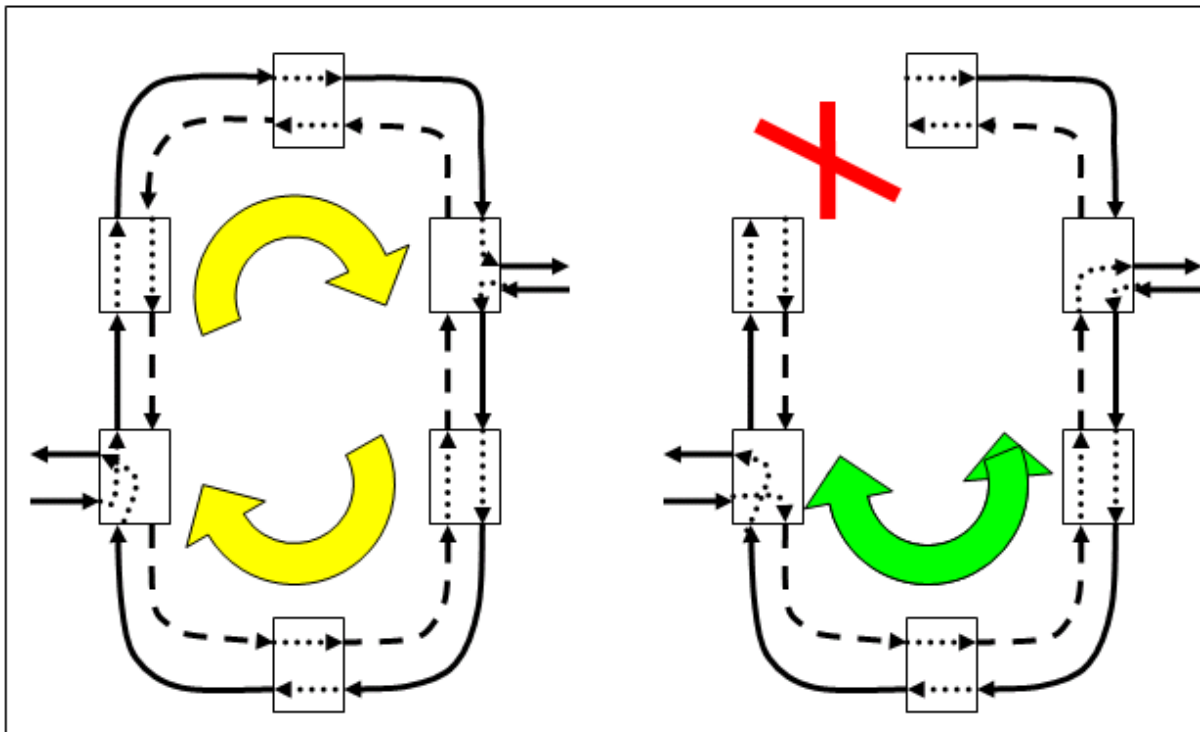
In a ring structure, the HPX-1600-SS supports path protection in SDH SNCP and SONET UPSR. Protection of linear networks is supported for SDH multiplexer (ITU-T G.783), Multiplexer Section Protection (MSP) 1+1 APS and SONET line, SWITCHED 1+1 APS.

The automatic protection functionality is derived from the SDH/SONET Daughter Card (SDC) and supports protection of STM-1 trunks against trunk associated failures within a multiplexed trunk link. This function complies with ITU-T G.783 and can be configured to use either:

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

**2.2.1. SNCP UPSR (RING)**

The HPX-1600-SS supports path based ring protection systems in SDH SNCP (Sub-Network Connection Protection) or SONET UPSR (Unidirectional Path Switched Ring). This consists of two contra-rotating rings. The SNCP/UPSR configuration protects against total failure of both of the fibre spans within the same section and failure of a fibre optic interface IM. In UPSR, one ring is the “working” ring while the second ring is the “protection” ring. During normal operation data is transmitted in both rings. There exists two disparate network paths between the network source and destination nodes, one in each direction around the ring, and sometimes referred to as the “short path” and the “long path”. From the source node a tributary is transmitted on both paths. Intermediate nodes pass the traffic through. At the destination node, one path is selected and connected to the tributary. Detection of a network failure such as signal failure or signal degradation will cause the destination node to switch to the alternative received data path. Mismatched trace information (TIM) errors in SDH will also cause a protection switch.



**Figure 5 – Ring APS SNCP/UPSR**

An example six node ring topology network showing the alternative data paths is in figure 6. The tributary circuits entering the network at the lower left, take the working ring path clockwise across the upper nodes in the network and exit at the network node in the upper right. A ring failure is shown in the second part of the diagram with the data path switched to the protection ring path.

## 2.2.2. SONET TRUNK AND DATA PATH CONFIGURATION

Configure the overhead bytes in the following order, Section/Line, Path then VT. In the case of the Section, Path and VT, there is a "J" field to enter a unique text string that is to be associated with the payload at that layer. This field has both a "transmitted", and "expected" string field.

The "expected" value is compared with the incoming J bytes, the transmitted value is forwarded on 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/trace labels are provided for the Section (Are we connected to the correct node?), at the Path (Are we connected to the correct HO payload?) and the VT (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 (Section, Line, Path, VT), 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.

### 2.2.2.1. SECTION AND LINE ALARM CONFIGURATION

The HPX-1600-SS is also a fully featured SONET access multiplexer that has access to the SONET Section Overhead Bytes. Section and Line alarms can be configured individually. The “J0” bytes are used to trace between the HPX-1600-SS adjacent nodes. Each node in the ring should transmit “J0” bytes to identify the upstream (adjacent) unit. Haliplex suggest that the user configure node number 0 first then proceed to node number 1 and each incremental node.

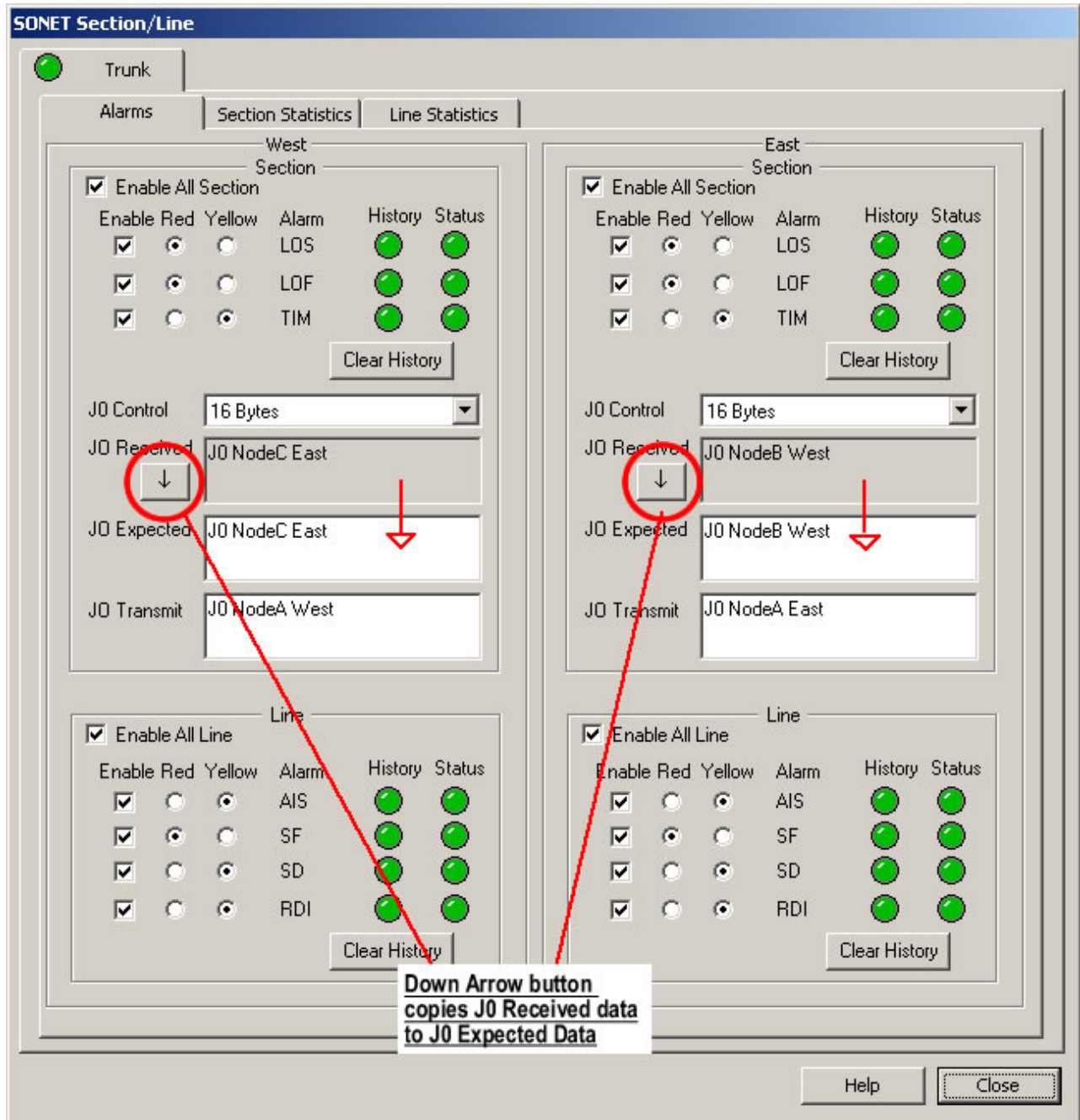
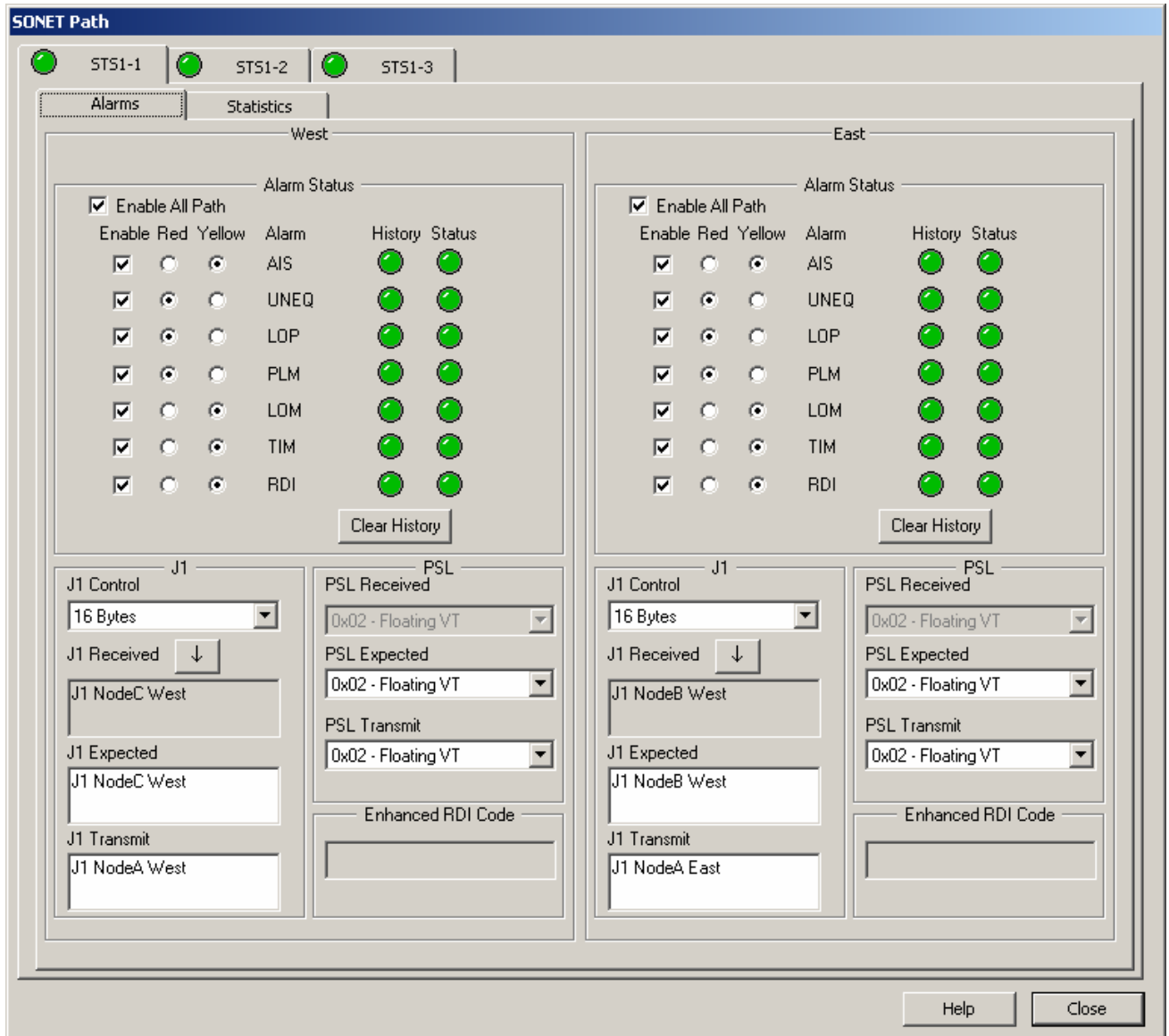


Figure 6 – Section/Line alarms and J0 bytes

At each node the received J0 bytes can be copied to the “Expected “ field by clicking on the down arrow button. The Transmit field should be simple to identify as a trace between the two adjacent nodes. An example between nodes “A” and “B” would be “A-B”.

**2.2.2.2. PATH ALARM CONFIGURATION**



**Figure 7 – Path alarms and J1 bytes**

**2.2.2.2.1. DS3 TRIBUTARIES**

The High Order (J1) bytes are used to define and trace the actual path end to end between nodes on the SONET ring. The Path Signal Label values should be selected as “0x04 Async for DS3”.

**2.2.2.2.2. E1 AND T1 TRIBUTARIES**

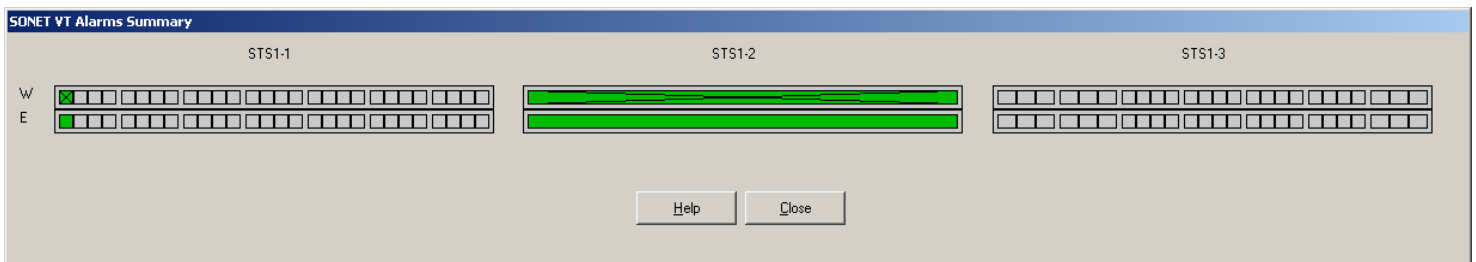
The High Order (J1) bytes are used to define and trace the path between adjacent nodes on the SONET ring. The Path Signal Label values should match or be selected as “Equipped.”

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

### 2.2.2.3. TRIBUTARY CIRCUIT CONFIGURATION

The Virtual Tributary (VT) 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 (Installed) to the selected Synchronous Transport Signal (STS) before the VT path can be configured. Tributary circuits can be T1/T3 or E1/E3 IM interfaces or framed T1 stream outputs from the Digital Access Cross Connect. Refer to Chapter 3 for details on cross connect of tributaries and DACS.

The STS-1 groups are displayed as the three possible addressable STS-1 payloads. Each STS-1 frame contains 7 Virtual Tributary Groups (VTG). Tributaries may be mapped to VT1.5, VT2 or VT3 Virtual Tributaries. The HPX-1600-SS will dynamically distribute the payloads across the installed mapper daughter boards. There is no direct relationship between the VTG group addressing and the installed mapper hardware. A user can define VT into STS1-1, STS1-2 and STS1-3 with only a single E1/T1 mapper installed.



**Figure 8 – Virtual Tributary**

The VT display is arranged as the 3x STS-1 payload of OC-3. Each STS-1 is represented with the sub-ordinate DS3 or E1, T1 virtual tributaries. Illustrated in figure 8, STS1-1 is shown as 28xVT1.5, STS1-2 is shown as 1xDS3, STS1-3 is a mix of VT1.5's and VT2's. The lower row represents the internal VT connection to the DACS or interface module.

The upper two rows represent the West and East alternative paths for each VT. West is the upper row. An “X” marks the active path, which in Figure 8 is West.

To configure the Virtual Tributary and “J2” bytes, left click on the tributary uni button to select, then right click to display the window shown in Figure 9. The “J2” trace bytes are used to define the network ring end-to-end path information. After the VT alarms are configured, the tributary button will change from a grey appearance to the colour of the currently highest severity, active alarm.

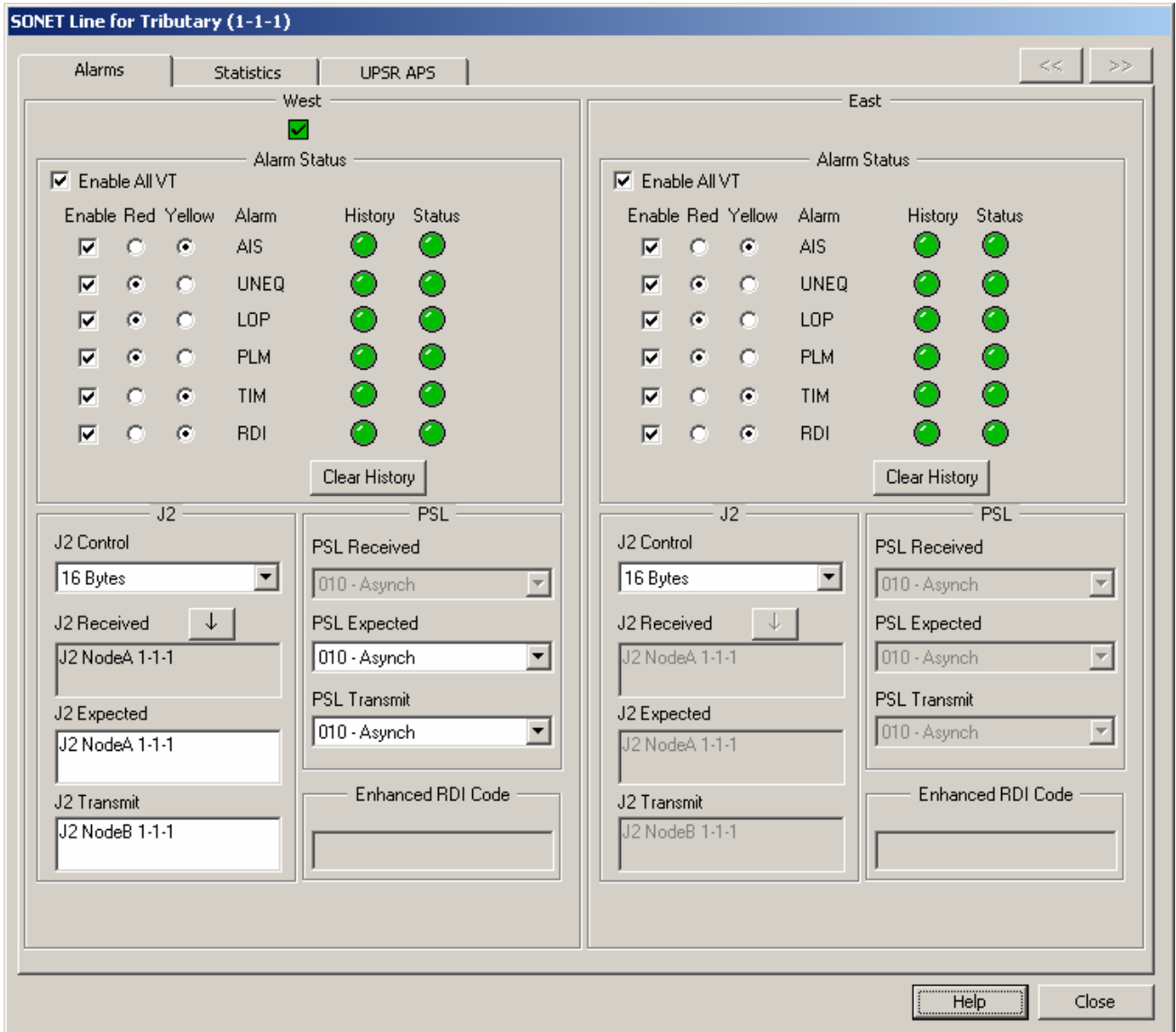


Figure 9 – VT alarms and J2 bytes