

Migrating X.25 over PSI to XOL



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Introduction

X.25 is the International Telecommunication Union-Telecommunication Standardization Sector (ITU-T) protocol standard for WAN communication. X.25 defines how connections between user devices and network devices are established and maintained in a packet switched data network.

With Ethernet evolving as the preferred network backbone for all environments, X.25 customers are seeking solutions to run X.25 applications on Ethernet interfaces. Based on this feedback, HP offers the X.25 over LLC2 (XOL) solution to run X.25 applications using Ethernet cards, instead of PSI (Programmable Serial Interface) cards.

XOL enables easy migration of X.25 applications to LAN technology. XOL supports FDDI, token ring, and Ethernet cards. High-speed Ethernet cards are preferred because of the high throughput. Moreover, the total cost of ownership is lower when Ethernet cards are used, instead of PSI cards.

This document discusses the migration of X.25 over PSI to XOL using Ethernet cards. It also discusses the benefits of migrating to XOL.

Definition of terms

Term	Definition
API	Application Programming Interface
CCITT	International Telegraph and Telephone Consultative Committee
DCE	Data Circuit terminating Equipment
DLPI	Data Link Provider Interface
DSAP	Destination Service Access Point
DTE	Data Terminal Equipment
FDDI	Fiber-Distributed Data Interface
HA	High Availability
HDLCL	High level Data Link Control
IEEE	Institute of Electrical and Electronics Engineers
ITU-T	International Telecommunication Union-Telecommunication standardization Sector
LAN	Local Area Network
LAPB	Link Access Procedure Balanced
LLC	Logical Link Control
LLC2	Logical Link Control type 2
MTU	Maximum Transmission Unit
PLP	Packet Layer Protocol
PSI	Programmable Serial Interface
PSPDN	Packet Switched Public Data Network
SAP	Service Access Point
SAM	System Administration Manager
SSAP	Source Service Access Point

WAN	Wide Area Network
XOL	X.25 over LLC2

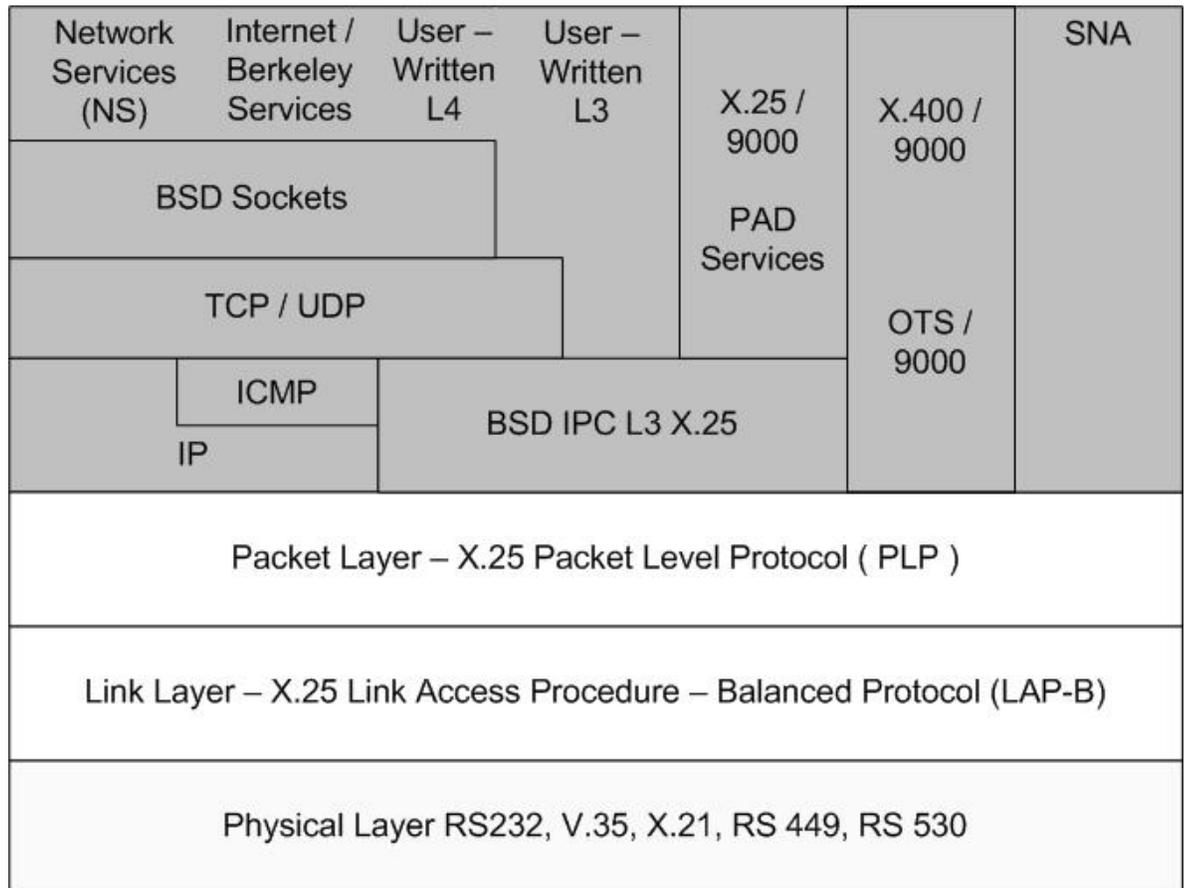
X.25 overview

The HP-UX X.25 link solution provides the hardware and software components that enable HP 9000 systems and Integrity systems to communicate with other HP and non-HP systems over X.25 packet switching networks.

The X.25 link implements the CCITT X.25 Recommendations and includes the components necessary to connect HP 9000 systems and Integrity systems to a public or private packet switching network or to another system in a back-to-back configuration that conforms to the CCITT X.25 Recommendations (1980, 1984 or 1988). The CCITT X.25 Recommendations specify the protocols to be used between a Data Terminal Equipment (DTE) and a Data Circuit terminating Equipment (DCE) in a Packet Switched Public Data Network (PSPDN), when accessed by a dedicated circuit.

HP-UX X.25 provides X.25 CCITT Socket APIs to write user applications. It also supports IP datagram transmission on the X.25 protocol. The X.25 architecture implements three layers of the OSI model. The three layers in the X.25 architecture are the physical layer, the data link layer, and the packet layer. Figure 1 illustrates the X.25 architecture.

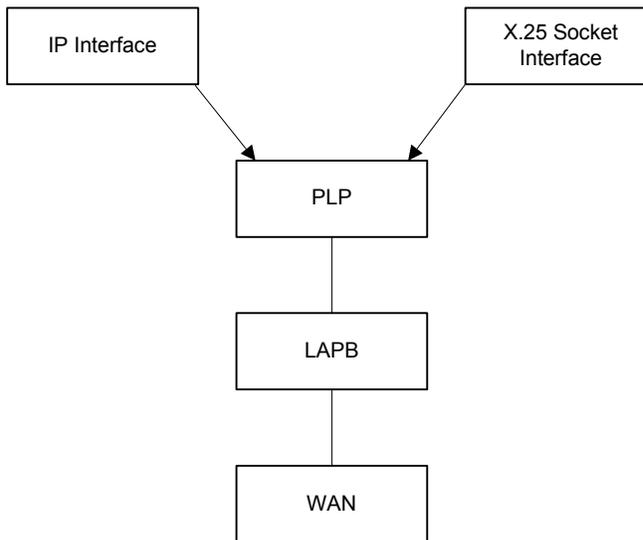
Figure 1. X.25 Link Architecture



X.25 over PSI

In accordance with CCITT X.25 Recommendations, three layers of protocol (Layer 1, Layer 2 and Layer 3) are functional when X.25 is used over PSI cards. Figure 2 shows the three protocol layers in X.25 over PSI.

Figure 2. Three layers of protocol in X.25 over PSI



Logical Link Control (LLC) Overview

The LLC sub-layer is the upper sub-layer in the data link layer and is common to the various medium access methods. The International Standard IEEE Std. 802.2 describes the functions, features, protocol, and services of the Logical Link Control (LLC) sub-layer in the ISO/IEC 8802 LAN Protocol Standard.

LLC1 (Type 1 operation): LLC1 provides a connectionless-mode service across a data link with minimum protocol complexity. This operation is useful when higher layers, instead of the data link layer, provide essential recovery and sequencing services. This operation is also useful in applications where guaranteed delivery of every data unit in the data link layer is not critical.

LLC2 (Type 2 operation): LLC2 provides a connection-mode service across a data link, comparable to the data link control procedures provided in HDLC. This operation supports the sequenced delivery of data units in the data link layer and includes a comprehensive set of data link layer error recovery techniques.

LLC3 (Type 3 operation): LLC3 provides an acknowledged-connectionless-mode data unit exchange service across a data link. This operation enables a station to concurrently send data and request acknowledgment for the receipt of data. Although the exchange service is connectionless, this operation supports guaranteed and sequenced delivery of data sent by the initiating station.

X.25 over LLC2

X.25 over LLC2 (XOL) enables X.25 communication over Ethernet LAN cards. The ISO 8881 standard specifies the implementation of X.25 communication over the LAN interface. The X.25 over LLC2 architecture is similar to the X.25 over PSI architecture. The protocol implementation in XOL is as follows:

- The serial WAN interface (Layer 1) in X.25 over PSI is replaced by the LAN interface in XOL.
- The LAP-B layer (Layer 2) in X.25 over PSI is replaced by LLC2 in XOL.
- The PLP layer (Layer 3) is the same in X.25 over PSI and XOL. The PLP layer uses DLPI primitives to communicate over LLC2. At the physical interface level, the X.25 packets are transmitted over the LAN card to a router that supports XOL routing functionality.

Figure 3 shows the three layers of protocols in XOL.

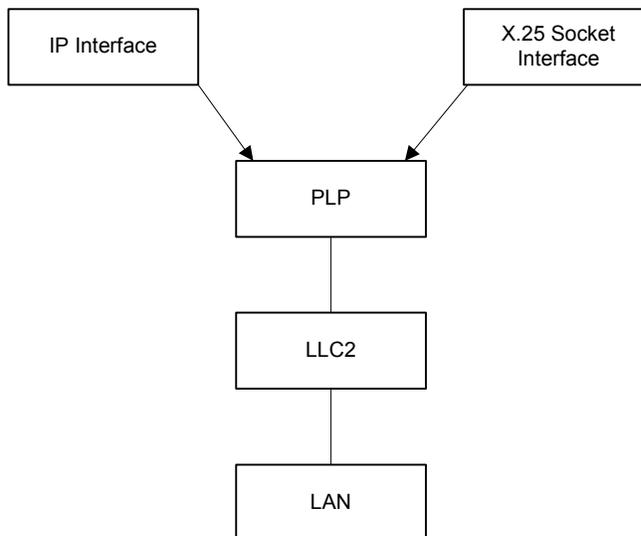


Figure 3. Three layers of protocol in XOL

Features of XOL

XOL supports the following features:

- **Number of XOL logical ports supported**

XOL allows a maximum of eight XOL logical ports per LAN interface if configurable SAP support is available on the XOL router. If configurable SAP support is not available on the XOL router, XOL allows one XOL logical port per LAN interface.

- **Number of XOL logical ports per server slot supported**

The maximum number of XOL logical ports supported on each server slot is 32 (4 * 8). This limit requires a 4-port Ethernet card in the slot and configurable SAP support on the router. With PSI cards, four X.25 ports are available with the 4-port J3526A card.

- **Level 3 packet size supported**

The maximum Level 3 packet size is 1024 bytes when an Ethernet card is used. The maximum Level 3 packet size is 4096 bytes when native LAPB is used on a PSI card. The MTU size for Ethernet (1500) limits the maximum Level 3 packet size in Ethernet cards.

- **Level-2 modulo value supported**

At level 2, LLC2 supports only 128 as the Level-2 modulo value. Native LAPB supports 8 or 128 as the Level-2 modulo values.

Note:

Currently, there is no SAM support for XOL configuration. The X.25 configuration files are edited manually. The X.25 interface must be started and stopped manually.

Benefits of XOL

Following are the advantages of using XOL instead of X.25 over PSI card:

- **Lower hardware cost**

Ethernet cards cost less compared to PSI cards. Moreover, the extensive use and large demand for Ethernet cards is expected to lower the cost of Ethernet cards.

- **Lower operational cost**

The administration, management, and maintenance costs involved in implementing XOL systems with Ethernet cards are significantly lesser than the costs involved in implementing X.25 over PSI. Moreover, skilled Ethernet network administrators are easily available in contrast to administrators with working knowledge of X.25 over PSI. This reduces the total cost of ownership.

- **Higher performance**

The maximum throughput of XOL systems using Ethernet cards is 10 Gbps. The maximum throughput of X.25 systems using PSI cards is only 2 Mbps. Tests show that X.25 applications perform better on XOL systems than on X.25 systems over PSI. The exact performance improvement metric depends on the model of Ethernet card used.

- **Seamless application migration**

Migration of legacy X.25 applications to XOL requires minimal or no application changes.

Migrating X.25 over PSI to XOL

XOL is supported on Ethernet, FDDI and Token Ring LAN cards. However, Ethernet cards are preferred because they offer high throughput. This section discusses how to migrate X.25 over PSI to XOL using Ethernet cards. The migration of X.25 over PSI to XOL involves the following:

- Hardware migration
- Configuration migration
- Application migration

Hardware Migration

The following hardware elements, which are a part of the X.25 network, are impacted in the migration process:

- Cards
- Cables
- Switches and routers

Figure 4 illustrates the network configuration with X.25 over PSI.

Figure 5 illustrates the network configuration after migration to XOL.

Figure 4. X.25 setup with PSI

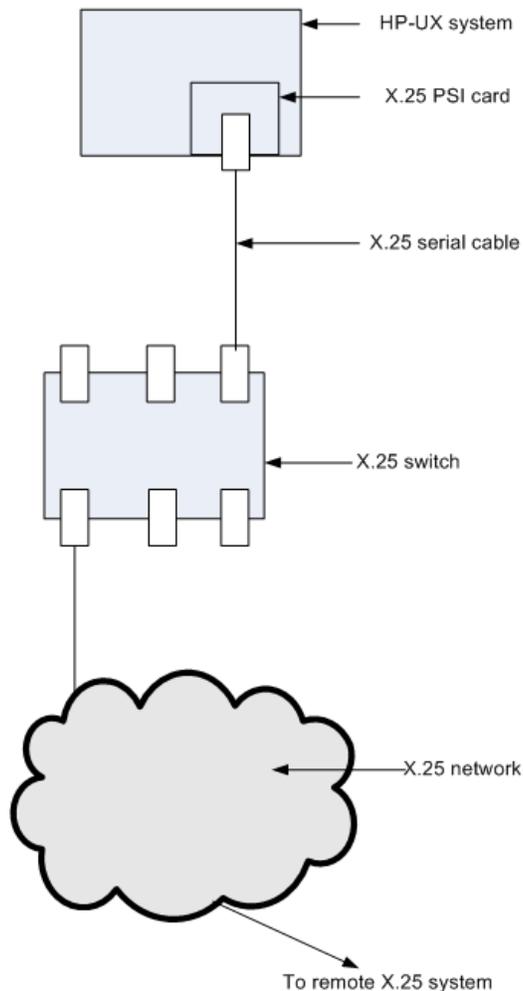
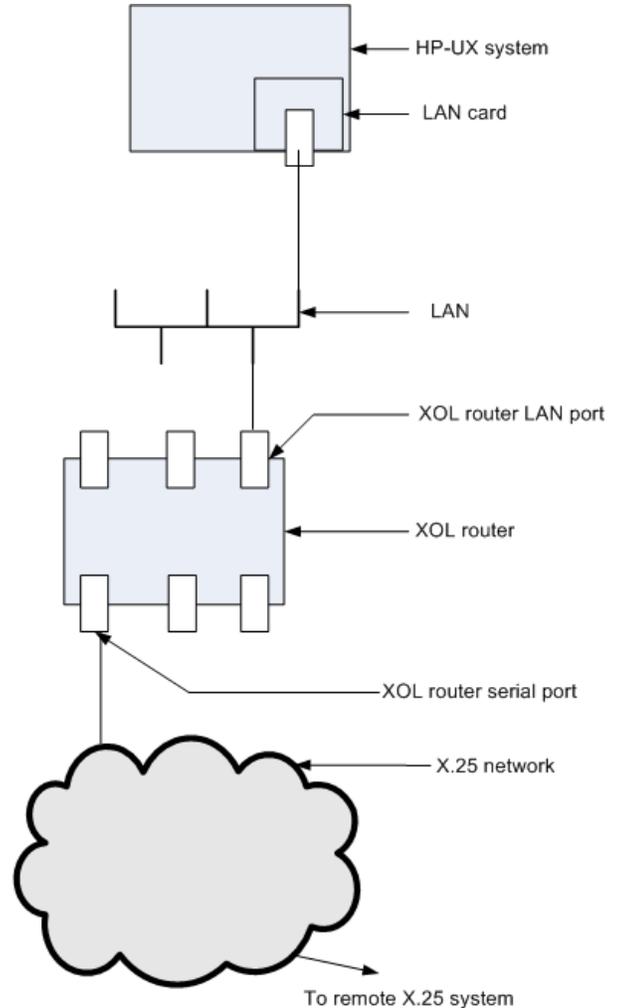


Figure 5. X.25 setup with LLC2



Cards:

The HP-UX X.25 PSI card (Part numbers J2792A, J2794A, J2815A, J3525A, or J3526A) is replaced with a supported LAN card. The supported LAN cards are Fast Ethernet cards and Gigabit Ethernet cards.

For more information on Ethernet cards, see the *Ethernet Adapters and Related Software Solutions* webpage at:

<http://www.hp.com/products1/serverconnectivity/adapters/index>

Cables:

The X.25 cable used with the X.25 PSI card is replaced with a LAN cable, which is compatible with the LAN adapter used. The LAN cable is connected to the LAN network either through a LAN switch or a LAN hub.

Switch / Router:

In X.25 over PSI, an X.25 switch is used as the DCE. The DCE routes X.25 to the remote DTE. For XOL, a router supporting the XOL feature (such as Cisco 3600 series) is required. The router and the XOL LAN card on the HP system are connected to the same LAN. Multiple HP-UX XOL interfaces communicate with the common XOL router through the LAN. The X.25 serial port in the XOL router communicates with the X.25 cloud. As a result, the X.25 connection is routed from the HP-UX XOL interface through the X.25 network. The peer for an XOL client is either an XOL interface or an X.25 PSI serial port.

Note:

HP-UX XOL supports all routers supporting XOL that conform to the Standard ISO – 8881 definition.

Configuration Migration

The XOL functionality on HP-UX 11iv1 and HP-UX 11iv2 is delivered along with the GR patches for the X.25 product. The AR0706 release of X.25 J2793B bundle will include the XOL functionality on HP-UX 11iv1 and HP-UX 11iv2.

To configure the LLC2 feature, the following configuration files must be edited or added manually:

- Generic X.25 configuration file
- LLC2 specific configuration file

Both X.25 over PSI and XOL support the same set of commands. The X.25 commands, such as `x25init` and `x25stop`, are supported by the XOL interface. After adding or editing the configuration files, the XOL interface can be initialized using the `x25init` command.

Generic X.25 Configuration file

You can use the same generic X.25 configuration file for X.25 over PSI and XOL by including the additional parameters that are specific to the XOL interface. Table 1 describes the additional parameters that must be specified in the generic X.25 configuration file.

Table 1. Additional XOL specific configuration parameters

Field	Format	Description
device	Device name string. Example: lan1	Device name of the LAN card where the XOL interface is configured
XOL_logical_port_id	Integer value (0-7) Example: 3	The XOL logical port identifier for the XOL interface on the given LAN interface
XOL_destination_macaddr	Hexadecimal value. This value must be prefixed with 0x.	The destination MAC address to which the XOL interface is connected
XOL_DSAP	Hexadecimal value. This value must be prefixed with 0x.	The destination SAP value of the peer XOL interface. Set the value of DSAP to any even value in the range 0x70 - 0x7e, both inclusive.
XOL_SSAP	Hexadecimal value. This value must be prefixed with	The source SAP value of the local XOL interface. Set the value of SSAP to any even value in the range 0x70 -

Field	Format	Description
	0x.	0x7e, both inclusive. If the value for SSAP is not provided, then SSAP takes the value of DSAP.
standby_device**	Device name string. Example: lan2	Name of the standby LAN device used for local failover. Required only for local failover support. For more information about this parameter, see <i>HP X.25/9000 User's Guide</i> available at: http://docs.hp.com/en/netcom.html#X.25
XOL_floating_macaddr**	Hexadecimal value This value must be prefixed with 0x	The unique MAC address for the LAN card in the LAN subnet. Required only for local failover support. For more information about this parameter, see <i>HP X.25/9000 User's Guide</i> available at: http://docs.hp.com/en/netcom.html#X.25

** Required for the High Availability feature

The XOL interface does not support packet sizes greater than 1024 bytes in Layer 3. If the Layer 3 packet size is reduced after migration to XOL, the reduced packet size must conform to the application requirements.

The following parameters do not support values greater than 1024 in the configuration file:

```
def_inpacketize
def_outpacketize
neg_inpacketize
neg_outpacketize
```

Configuration file for an X.25 interface over PSI

Following is the generic configuration file for an X.25 interface over PSI:

```
#cat /etc/x25/x25config
#
#X.25 Initialization File      Created: Thu Jul 13 15:19:38 2006
#
#
#           Global Parameters
#
x.121          35011
x.121_packetaddr 35011
device        x25_lp2
name          x25_interface_name
#
#           Level 2 Parameters
#
t1            3000
t3            60000
framesize    149
n2           20
l2window     7
#
#           Level 3 Parameters
#
networktype   DTE_88
#
#           Circuit Table Definition
#
#           LCI   TYPE   HOW MANY
```

```

lci 1      svc 255
#
#Flow Control, Throughput Class, Fast Select and Reverse Charge Settings
#
flowcontrol      off
thruputclass     off
fast_select_accept disabled
reverse_charge   disabled
def_inpacketsize 128
def_outpacketsize 128
def_inwindow     2
def_outwindow    2
def_inthruputclass 11
def_outthruputclass 11
#
#           IP Parameters
#
ipaddress        192.168.8.1      255.255.255.0
idletimer        600
holdtimer        300
mtu              1024

```

Configuration file after migration to XOL

Following is the generic configuration file for an X.25 interface over LLC2:

```

#cat /etc/x25/x25config
#
#X.25 Initialization File      Created: Thu Jul 13 15:19:38 2006
#
#           Global Parameters
#
x.121            35011
x.121_packetaddr 35011
device           lan0
name             x25_interface_name
XOL_logical_port_id 0          # logical port id for lan interface
XOL_DSAP         0x7E          # destination SAP id
XOL_SSAP         0x7E          # source SAP id
XOL_destination_macaddr 0x001083967181 # Remote mac address
#
#           Level 2 Parameters
#
t1               3000
t3               60000
framesize        149
n2               20
l2window         7
#
#           Level 3 Parameters
#
networktype      DTE_88
#
#           Circuit Table Definition
#
#   LCI  TYPE  HOW MANY
lci  1     svc  255
#
#Flow Control, Throughput Class, Fast Select and Reverse Charge Settings
#

```

```

flowcontrol      off
thruputclass     off
fast_select_accept disabled
reverse_charge   disabled
def_inpacketsize 128
def_outpacketsize 128
def_inwindow      2
def_outwindow     2
def_inthruputclass 11
def_outthruputclass 11
#
#           IP Parameters
#
ipaddress        192.168.8.1      255.255.255.0
idletimer        600
holdtimer        300
mtu              1024

```

LLC2 specific configuration file

The LLC2 specific configuration file is created in the `/etc/x25` directory. The filename of the LLC2 specific configuration file is user-defined. The filename of the LLC2 specific configuration file is `llc2_conf_def` by default. This file contains the maximum number of XOL interfaces allowed on each LAN interface in the system and is unique to the host system.

In X.25 over PSI, the X.25 interface maps to a physical interface on the PSI card. In X.25 over LLC2, the XOL interface (identified by the XOL logical port ID) maps to a logical interface on the physical LAN interface. Each LAN interface allows a maximum of eight XOL logical interfaces if configurable SAP support is available in the XOL router. The maximum number of XOL interfaces allowed on each LAN interface can be modified in the LLC2 specific configuration file.

Following is the syntax of the LLC2 specific configuration file:

```
lan<#>      <max number of XOL interfaces>
```

Following is a sample LLC2 specific configuration file:

```
lan0        3
lan1        1
```

Application Migration

After the XOL interface is configured, the X.25 application uses the XOL interface to communicate with the peer X.25 systems (an XOL or a PSI port.) The migration of X.25 from PSI to LLC2 is seamless. The X.25 applications require minimal or no changes after migration to XOL.

XOL does not support packet sizes greater than 1024 bytes in Layer 3. Any X.25 application that explicitly uses more than 1024 bytes of packet size in Layer 3 must be modified and re-compiled after migrating to XOL.

The application can use the same interface name for XOL and X.25 over PSI or use a new interface name. However, it must be modified and re-compiled if the interface name is altered after migration.

X.25 applications are binary compatible if the applications require no change in the packet size or the interface name while migrating to XOL.

For more information on configuring XOL, see the *X.25 User Guide* available at:

<http://docs.hp.com/en/netcom.html#X.25>

High Availability with XOL

The high availability (HA) feature is available in the XOL interface. The `x25ifstate` command integrates the XOL interface with the ServiceGuard (SG) scripts to create the SG package in an SG cluster environment. The SG package protects mission critical applications from hardware and software failures through the HA feature. In an HA environment, the standby resources automatically take over if the primary resource fails.

To use the XOL HA feature, the user must provide a user-defined unique MAC address for the LAN interface. When the XOL interface fails over to the standby LAN interface, this unique MAC address is used to configure the standby LAN interface.

XOL supports the HA feature for the following failovers:

Local failover

A primary LAN card and a standby LAN card are used to make the XOL interface highly available on a system. The XOL interface migrates from the primary LAN card to the standby LAN card when the primary card fails. This HA feature can be configured by editing the values of the parameters, `standby_device` and `XOL_floating_macaddr`, in the XOL configuration file. The ServiceGuard product is not required for this feature to be available on the local system.

Remote failover

When XOL is integrated with the ServiceGuard package, the XOL interface becomes highly available in a cluster of nodes. The XOL interface migrates along with the ServiceGuard package to the standby node if the LAN card on the primary node fails. This feature requires that the ServiceGuard product is available and configured on all the nodes in the cluster.

Remote Failover with Local Failover

When the primary LAN card on the primary node fails, the HA feature attempts to activate the XOL interface on the standby LAN card on the primary node. If the XOL interface is not activated on either the primary or the standby LAN card on the primary node, the ServiceGuard package activates the XOL interface on the LAN card on the standby node in the SG cluster. This feature requires that the ServiceGuard product is available and configured on all the nodes in the cluster.

Important:

The failover is not transparent and results in loss of existing XOL connections and loss of data. After failover, the XOL connections must be re-established.

For more information on the HA feature available with XOL, see *X.25 User Guide* at:

<http://docs.hp.com/en/netcom.html#X.25>

Conclusion

The migration from X.25 over native PSI cards to XOL offers the following benefits:

- Eliminates legacy X.25 infrastructure on the HP-UX host side
- Reduces maintenance and operational costs
- Enables seamless migration of legacy X.25 applications to XOL
- Provides higher throughput with the use of LAN cards
- Enables the use of the same set of commands for XOL and X.25 over PSI

For more information

For more information on XOL, see the latest documentation for X.25 at

<http://docs.hp.com/en/netcom.html#X.25>

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