CHAPTER 7

Tiered Networks

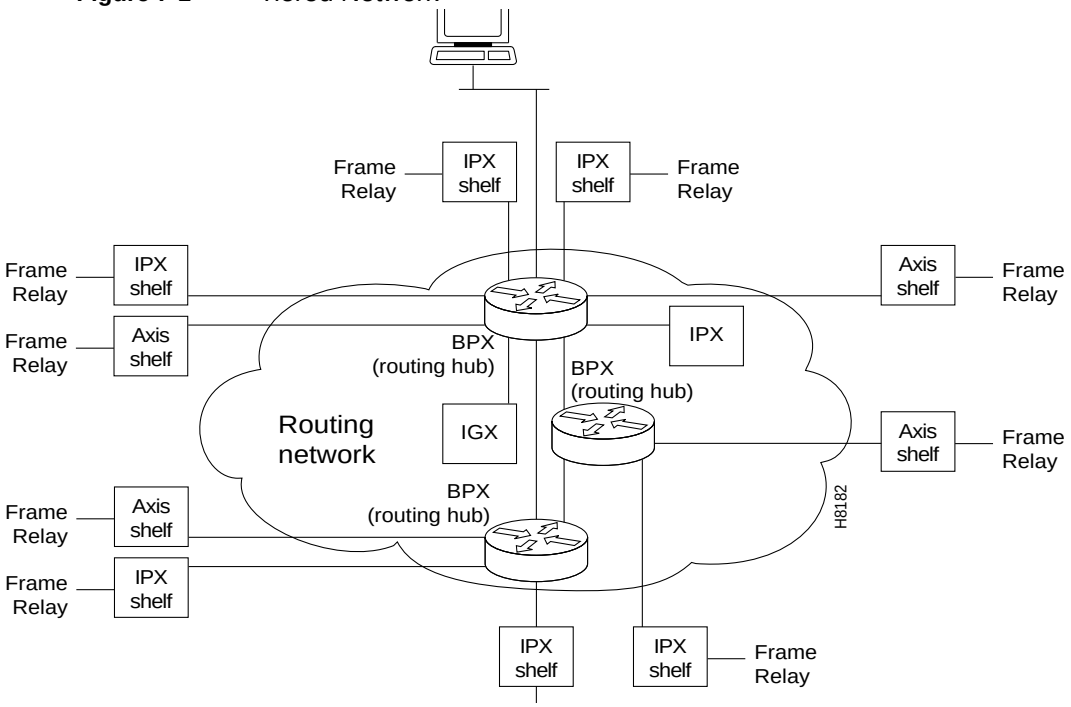
Introduction

Tiered networks have the capability of adding interface shelves/feeders (non-routing nodes) to an IPX/IGX/BPX routing network (Figure 7-1). The AXIS shelf, and IPX or IGX nodes configured as shelves are connected to BPX nodes. Interface shelves allow the network to support additional connections without adding additional routing nodes.

In Release 8.2, the AXIS supports frame T1/E1 frame relay, ATM T1/E1, and CES and ports, and is designed to support additional interfaces in the future. The IPX interface shelf supports frame relay ports, as does the IGX (option is available to configure as a shelf).

For Release 8.2, an IPX/BPX network can contain 100 nodes and up in a flat network, or 63 nodes per domain in a structured network.

Figure 7-1 Tiered Network



Tiered Network Implementation

The following requirements are necessary in order to implement tiered networks in Release 8.2:

- AXIS Release 3 level is required on all AXIS interface shelves.
- Only BPX nodes can act as routing hubs for Interface Shelves.
- Only one interface shelf trunk is supported between a Routing Hub and Interface Shelf.
- No direct trunking between Interface Shelves is supported.
- No routing trunk is supported between the Routing Network and Interface Shelves.
- The interface shelf trunks between BPX hubs and IPX or IGX Shelves are either T3 or E3.
- The interface shelf trunks between BPX hubs and AXIS Shelves are T3.
- Frame Relay Connection management to an IPX Interface Shelf is provided by SV+.
- Frame Relay and ATM connection management to an AXIS Shelf is provide by SV+.
- Telnet is supported to an Interface Shelve; the vt command is not.
- Remote printing by the Interface Shelf via a print command from the routing network is not supported.

General

Annex G, a bi-directional protocol, defined in Recommendation Q.2931, is used for monitoring the status of connections across a UNI interface. Tiered Networks use the Annex G protocol to pass connection status information between a Hub Node and attached Shelf.

Definitions

AXIS Interface Shelf—A standards based service interface shelf that connects to a BPX, aggregrates and concentrates traffic, and performs ATM adapation for transport over broadband ATM networks.

BPX Core Switch Shelf—Designation of a BPX node in a routing network.

BPX Interface Shelf—Designation for an IPX Interface Shelf or an AXIS Interface Shelf connected to a BPX Core Switch Shelf.

Interface Shelf Trunk—Refers to a trunk which interconnects an Interface Shelf with the Routing Network (i.e., BPX).

Hub Node—A node in the routing network which has attached Shelves. The BPX Core Switch Shelf is a hub node.

IPX Interface Shelf—A special configuration of the IPX narrow band node designated as a BPX Interface Shelf. Sometimes referred to as IPX A/F.

IPX/AF—Another name for the IPX Interface Shelf

Routing Network—The portion of the IPX/IGX/BPX network which performs automatic routing between connection endpoints.

VPI—Virtual Path Identifier

VCI—Virtual Connection Identifier

SW and HW Requirements

A tiered network requires the following:

- Release 8.1 or later System Software for the IPX and BPX
- NPC cards in IPX nodes. (NPC Model __, revision __)
- AIT firmware Model A, revision D
- BNI firmware Model A, revision C.
- FRP firmware Model D, revision F, and Model E revision G.

Configuration Limits

The following configuration limits are applicable to Release 8.2:

• VCs per AXIS Shelf	2028
• VCs per IPX Shelf (NPC 16M processor card)	1024
• LCons per IPX Shelf (NPC 16M processor card)	850
• Connections per IPX Shelf (NPC 16M processor card)	850
• VCs per IPX Shelf (NPC 32 M processor card)	1024
• LCons per IPX Shelf (NPC 32M processor card)	1000
• Connections per IPX Shelf (NPC 32M processor card)	1000
• VCs per IPX Routing Node	1024
• VCs per IGX Routing Node	1024
• Connections per IPX Routing Node	1024
• Connections per IGX Routing Node	1024
• Interface Shelf trunks per Routing Hub	16
• Networking Trunks per Routing Hub (up to 16 of these can be used for Interface Shelf Trunks)	32
• VCs per Routing Hub (BCC 32M processor card)	5000
• LCons per Routing Hub (BCC 32M processor card)	1000
• Connections per Routing Hub (BCC 32M processor card)	5000 grouped connections
• Routing Nodes in a flat network (NPC 16M)	63
• Routing Nodes in a flat network (NPC 32M, BCC 32M)	100 and up
• Routing Nodes in a domain (BCC 32M, NPC 32)	63

Upgrades

Converting an IPX or IGX node to an Interface Shelf requires re-configuring connections on the node, as no upgrade path is provided in changing a routing node to an interface shelf.

Only BPX nodes are able to act as connection points (Hub Nodes) into Routing Network for Shelves. A BPX node, acting as a Hub Node, is not restricted from providing any other feature which is normally available on BPX nodes. A BPX Hub supports up to 16 Shelves.

Connections within Tiered Networks consist of distinct segments within each tier. A routing segment traverses the Routing Network, and a Shelf segment provides connectivity to the Shelf end-point. Each of these segments are added, configured and deleted independently of the other segments. The SV+ Connection manager provides management of these individual segments as a single end-to-end connection.

Shelves are attached to the Routing Network via a BPX node using a BNI trunk (T3/E3). The connection segments within the Routing Network are terminated on the BNI shelf trunks.

All frame relay connection types which can terminate on the BPX ASI card are supported on the BNI shelf trunk (currently VBR, CBR, ABR, and ATF types). (For the initial 8.1 Release, the IPX and AXIS Interface Shelves support the ATF connection type. Additional connection types will be supported in future releases.). No check is made by the Routing Network to validate whether the connection segment type being added to a BNI shelf trunk is actually supported by the attached Shelf.

Co-locating Routing Hubs and Shelves

The trunk between a Shelf and the Routing Network is a single point of failure, therefore, the Shelves should be co-located with their associated Hub Node. Card level redundancy is supported by the Y-Cable redundancy for the BNI and AIT.

Network Management

Communication between the Routing Network and the Interface Shelves is provided in accordance with Annex G of Recommendation Q.2931. This is a bidirectional protocol for monitoring the status of connections across a UNI interface (Note: the Interface Shelf Trunk uses the STI cell format to provide the ForeSight rate controlled congestion management feature.).

Communication includes the real time notification of the addition or deletion of a connection segment and the ability to pass the availability (active state) or unavailability (inactive state) of the connections crossing this interface.

A proprietary extension to the Annex G protocol is implemented which supports the exchange of node information between a Shelf and the Routing Network. This information is used to support the IP Relay feature and the Robust Update feature currently used by Network Management.

Network Management access to the Interface Shelves is through the IP Relay mechanism supported by the SNMP and TFTP projects or by direct attachment to the Shelf. The IP Relay mechanism is extended to relay traffic from the Routing Network to the attached Feeders. No IP Relay support is provided from the Shelves into the Routing Network.

The BPX as a Routing Hub is the source of the network clock for its associated feeder nodes. Feeders synchronize their time and date to match their routing hub.

Robust Object and Alarm Updates are sent to a Network Manager which has subscribed to Robust Updates feature. Object Updates are generated whenever a Shelf is added or removed from the Hub node and when the Shelf name or IP Address is modified on the Shelf. Alarm Updates are generated whenever the alarm state of the Shelf changes between Unreachable, Major, Minor and OK alarm states.

A Shelf is displayed as a unique icon in the SV+ Network Management topology displays. The colors of the icon and connecting trunks indicate the alarm state of each. Channel statistics are supported by FRP, ASI, and AXIS endpoints. BNIs and AITs do not support channel statistics. Trunk Statistics are supported for the shelf trunk and are identical to the existing BNI trunk statistics.

ForeSight

Foresight for IPX Shelf terminated Frame Relay connections is provided end-to-end between Frame Relay ports, regardless as to whether these ports reside on an IPX Shelf or within the Routing Network.

Preferred Routing

Preferred routing within the Routing Network can be used on all connections. Priority bumping is supported within the Routing Network, but not in the Interface Shelves. All other connection features such as conditioning, **rrtcon, upcon, dncon**, etc. are also supported.

Local and Remote Loopbacks

Connection local and remote loopbacks are managed at the user interface of the FRP endpoint Routing Node or Shelf. The existing IPX Frame Relay port loopback feature is supported on the IPX Shelf. Remote loopbacks are not supported for DAX connections. A new command **addlocrmtlp** is added to support remote loopbacks at FRP DAX endpoints.

Testcon and Testdly

Tstcon is supported at the FRP endpoints in a non-integrated fashion and is limited to a pass/fail loopback test. Fault isolation is not performed. This is the same limitation currently imposed on inter-domain connections. Intermediate endpoints at the AIT and BNI cards do not support the tstcon feature. Tstdelay is also supported for the FRP and ASI in a non-integrated fashion similar to that of the tstcon command.

IPX Shelf Description

The IPX Interface Shelf supports the termination of Frame Relay connections to an AIT. DAX voice and low speed data connections are also supported, but they can’t terminate on an AIT. The IPX Shelf connects to the Routing Network via an AIT card on the IPX and a BNI card on the BPX Routing Hub.

Admission control and ForeSight rate control for IPX Shelf terminated Frame Relay connections is performed at the FRP port on the IPX Shelf. Only a single trunk line is supported between the IPX Shelf and the Routing Network. Trunks on the IPX Shelf linking other nodes are not supported.

Frame Relay type connections, remotely or locally terminated are supported on IPX Shelves. Shelf connections for which both endpoints reside on the same Shelf are not known to the Routing Network and will not route through the Routing Network.

IPX Shelves support the following network management features:

- Interval Statistics enable/disable/collection
- IP Relay
- Robust Object Updates
- Robust Alarm Updates
- Real-time Counters
- Event Logging
- Software/Firmware Downloads
- Configuration Save/Restore
- SNMP

Configuration and Management

The Shelves attached to each Hub must have unique names. Each Shelf must also be assigned a unique IP address.

A Shelf communicates with a Routing Hub over a new type of NNI. It is similar to the existing Frame Relay NNI in purpose and function, and is based on the ATM LMI message set described by Recommendation 2931, Annex G. A Routing Hub and Shelf use this NNI to maintain a control session with each other. Any change to the status of the shelf trunk affects this control session.

Interface Shelf Trunks are the communication path between the Routing Hub and the Feeder. These shelf trunks are supported by the AIT trunk card on the IPX Shelf and the BNI trunk card on the BPX Routing Hub. Shelf trunks are upped using the **uptrk** command. Shelf trunks must be upped on both the Routing Hub and the Shelf before the Shelf can be joined to the Routing Network.

Once an IPX has been converted to a Shelf, it can be joined to the BPX Routing Hub, by executing the **addshelf** command at the BPX Routing Hub. The addshelf command has the following syntax:

addshelf <trunk> <shelf_type> [<vpi> <vci>]

trunkslot.port

shelf_type I (IPX/AF) or A (AXIS)

<vpi>for AXIS only, 0-255, default = 0 ??????????

<vci>for AXIS only, 0-1023, default = 15 ???????????

Shelf Management

delshelf <trunk> | <shelf_name> deletes Feeder

dspnode—displays Shelf trunk status. BPX Hub nodes display the status of all attached Interface shelves. IPX Shelves display a single status item, that of the attached BPX Hub node.

Alarm Management of Interface Shelf on the BPX Hub Node

dspalms—A new field, Interface Shelf Alarms, shows a count of the number of Shelves which are Unreachable, in Minor Alarm, or in Major Alarm. The nnn-A bit status failures for shelf connections are also shown.

Alarm Management on the IPX Shelf

dspalms—A new field, Routing Network Alarms, shows a count of major and minor alarms in the routing network. Feeder A-bit connection status reported by Feeder NNI is shown in the "Connection A-Bit Alarms field.

dspnode—shows if the routing network is reachable and the attached BPX hub node.

Port Management

Uses existing commands

Connection Management

Parameters entered at SV+ when adding connection.

Bandwidth Management

Parameters entered at SV+ when adding connection. Bandwidth performance monitored by viewing selected statistics at SV+ NMS.

Statistics

Enabled an monitored via StrataView Plus.

Diagnostics

SV+ Interface

Interface Shelf and Interface Shelf Trunk information is reported to StrataView Plus by the Hub Node and Interface Shelf. SV+ can virtually connect to any node in the network via a TCP/IP connection. The SV+ Connection Manager is used to add, delete, and monitor Frame Relay connections. A sample of the Connection Manager GUI is shown in Figure 7-2.

Figure 7-2 SV+ Connection Manager