

HP Auto Port Aggregation (APA) Support Guide

HP-UX 11.0, 11i v1, 11i v2



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Table of Contents

About This Document	13
Intended Audience.....	13
New and Changed Information in This Edition.....	13
Publishing History.....	13
Document Organization.....	14
Typographical Conventions.....	15
Related Documents.....	15
HP Encourages Your Comments.....	15
1 What Is HP Auto Port Aggregation?	
Overview.....	17
HP Auto Port Aggregation Features.....	17
Summary of HP APA and LAN Monitor Capabilities.....	18
Required Software.....	19
Supported Switches.....	20
Supported LAN Cards and Functions: HP-UX 11.00 and 11i v1.....	20
Supported LAN Cards and Functions: HP-UX 11i v2.....	21
HP APA Configuration Examples.....	21
Enterprise Intranet Client/Server Environment.....	22
Internet or Large Enterprise Environments Using Routers.....	23
Server-to-Server (Back-to-Back).....	25
Hot Standby for High Availability.....	26
Server-to-Server with Switch (Not Recommended).....	27
LAN Monitor Configuration Examples.....	28
LAN Monitor Failover Group.....	29
LAN Monitor Failover Group Using Link Aggregations to Increase Bandwidth.....	29
LAN Monitor with FDDI or Token Ring.....	30
2 Overview of Installation and Configuration	
Planning Your HP APA Configuration.....	33
Preparing to Install the Software.....	34
Installing the HP APA Software.....	34
Configuring HP APA Using SAM.....	35
Setting Port Aggregation Modes.....	35
Configuring HP Auto Port Aggregation.....	35
Port Aggregation Modes.....	35
Choosing a Configuration Method: SAM or Editing.....	36
Modifying Default Configuration Parameters.....	36
HP APA Parameters for Link Aggregates — hp_apaconf.....	37
APA and LAN Monitor Parameters for Physical Ports — hp_apaportconf.....	39
3 Configuring APA Using SAM	
Configuring HP APA Using SAM.....	41
Setting Port Aggregation Modes.....	41
Configuring an FEC_AUTO Mode Link Aggregate.....	41
Using SAM to Configure a MANUAL Mode Link Aggregate.....	46
4 Configuring HP APA by Editing Files	
Editing Configuration Files for All APA Modes.....	53
Edit Files for MANUAL, FEC_AUTO, or LACP_AUTO Modes.....	53
MANUAL Port Configuration Mode.....	53

FEC_AUTO Port Configuration Mode (Optional).....	54
LACP_AUTO Port Configuration Mode (Optional).....	54
Verifying Link Aggregate Status.....	55
Viewing Link Aggregate Characteristics Using lanscan.....	55
lanscan Output.....	56
Verifying Physical Port Status.....	57

5 What Is LAN Monitor?

LAN Monitor Overview.....	59
LAN Monitor Features.....	59
Proactive Failover (HP-UX 11i v1 (B.11.11.20) Only).....	59
IPv6 Support (HP-UX 11i v2 (B.11.23.10) Only).....	60
Configuring LAN Monitor Failover Groups.....	60
Example: Configuring a LAN Monitor Failover Group.....	61
Proactive Failover Examples.....	63
Configuration Files.....	65
ASCII File.....	65
Binary File.....	68
LAN Monitor Configuration Commands.....	68
lanqueryconf.....	68
Query the system and create an ASCII configuration file.....	68
Query the system for the binary file.....	68
lanapplyconf.....	68
lancheckconf.....	69
landeleteconf.....	69

6 Using HP Serviceguard with HP APA

Requirements for Use.....	71
---------------------------	----

7 Administering HP APA Using the lanadmin Command

Using lanadmin to Configure HP APA.....	73
Summary of lanadmin -x & -X Options.....	73
Link- and Port-Specific lanadmin Commands.....	74
lanadmin Syntax.....	74
Using lanadmin from the Command Line.....	79
Using lanadmin Interactively.....	81

8 Troubleshooting HP Auto Port Aggregation (APA) Software

Troubleshooting Overview.....	85
What Happens during Start Up?.....	85
MAC Addresses for Link Aggregates.....	86
Unsupported Way of Changing MAC Address.....	86
Diagnostic Flowcharts.....	86
Flowchart 1: Network Level Loopback Test.....	87
Flowchart 1 Procedures.....	88
Flowchart 2: Network Physical Port Connections/LED Test.....	89
Flowchart 2 Procedures.....	89
Flowchart 3: Network Physical Port Configuration Test.....	90
Flowchart 3 Procedures.....	90
Flowchart 4: Network Physical Port Configuration Test.....	92
Flowchart 4 Procedures.....	93
Flowchart 4A: Network Physical Port Configuration Test.....	94
Flowchart 4A Procedures.....	94
Flowchart 5: Link Aggregate Configuration Test.....	94
Flowchart 5 Procedures.....	95
HP-UX 11i (all versions).....	95

Flowchart 5A: Manual Configuration Test.....	97
Flowchart 5A Procedures.....	97
Flowchart 5B: PAgP Configurations Test.....	98
Flowchart 5B Procedures.....	98
Flowchart 5C: LAN Monitor Configuration Test.....	100
Flowchart 5C Procedures.....	100
Flowchart 5D: LACP Configuration Test.....	102
Flowchart 5D Procedures.....	102
Flowchart 6: Network Configuration Test.....	104
Flowchart 6 Procedures.....	104
Flowchart 7: ARP Verification.....	105
Flowchart 7: Procedures.....	105
Flowchart 8: Link Level Loopback Test.....	106
Flowchart 8 Procedures.....	106
Flowchart 9: Transport Level Loopback Test (using ARPA).....	108
Flowchart 9 Procedures.....	108
Flowchart 10: Bridge/Gateway Loopback Test.....	109
Flowchart 10 Procedures.....	109
Known Problems and Workarounds.....	110
HP 9000 T-600 (T-class server).....	110
Known Installation Problems.....	110
Known Problems with Switches.....	110

9 HP APA Statistics

HP Auto Port Aggregation Statistics.....	111
Link Aggregate Interface Statistics Display.....	111
LAN Interface Status Display, 32-Bit Statistics.....	111
LAN Interface Status Display, 64-Bit Statistics.....	112

10 TSO Support for Link Aggregations and Failover Groups

Summary of TSO behavior for Link Aggregation.....	113
TSO Example for Link Aggregation.....	113
Summary of TSO behavior for Failover Groups.....	114
TSO Example for Failover Groups.....	114
Nettl logs for TSO.....	114

A Load Balancing and Data Flow Algorithms..... 117

Supported Load Balancing and Data Flow Algorithms.....	117
Packet Ordering.....	117
Load Balancing Algorithm.....	117
Data Flow Distribution Algorithms.....	117

B HP APA Resources..... 119

HP-UX Manual Reference Pages (manpages).....	119
Error Messages.....	119
Logging Messages.....	119
Contacting Your HP Representative.....	120
Available Manuals.....	121
Software Product Numbers and Filesets.....	121

C Logging Messages to syslog.log..... 123

Examples.....	123
---------------	-----

Glossary..... 125

Index.....	127
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List of Figures

1-1 Sample Enterprise Intranet Client/Server Configuration.....	23
1-2 Sample Router and Server Configuration with No Switch.....	24
1-3 Sample Router and Server Configuration with Switch.....	25
1-4 Sample Server-to-Server Configuration (Back-to-Back).....	26
1-5 Sample Hot Standby Configuration for High Availability.....	27
1-6 Sample Server-to-Server Configuration with Switch (Not Recommended).....	28
1-7 Sample LAN Monitor Failover Group Configuration.....	29
1-8 Sample LAN Monitor Failover Group Using Link Aggregation Configuration.....	30
1-9 Sample LAN Monitor with FDDI or Token Ring Configuration.....	31
3-1 Displaying Link Aggregates.....	42
3-2 Configuring Link Aggregates.....	42
3-3 Link Aggregate Advanced Options	43
3-4 Network Physical Ports Supporting HP APA.....	43
3-5 Modify Network Physical Port Attributes.....	44
3-6 Example of Configured Link Aggregates.....	44
3-7 Status of Configured Link Aggregate is UP.....	45
3-8 Configuring Link Aggregates.....	45
3-9 Link Aggregate with Configured IP Address.....	46
3-10 Link Aggregates Supporting HP APA.....	47
3-11 Network Physical Ports Supporting APA.....	47
3-12 Modify Network Physical Port Attributes.....	48
3-13 Display Link Aggregates to Configure.....	48
3-14 Configuring Link Aggregates.....	49
3-15 Link Aggregate Advanced Options	49
3-16 Adding Ports to or Deleting Ports from Link Aggregate.....	50
3-17 Adding Ports to or Deleting Ports from Link Aggregate.....	50
3-18 Configured Link Aggregates Display.....	50
3-19 Link Aggregate Displays with Status UP.....	51
8-1 Flowchart 1: Network Level Loopback Test.....	88
8-2 Flowchart 2: Network Physical Port Connections/LED Test.....	89
8-3 Flowchart 3: Network Physical Port Configuration Test.....	90
8-4 Flowchart 4: Network Physical Port Configuration Test.....	93
8-5 Flowchart 4A: Network Physical Port Configuration Test.....	94
8-6 Flowchart 5: Link Aggregate Configuration Test.....	95
8-7 Flowchart 5A: Manual Configuration Test.....	97
8-8 Flowchart 5B: PAgP Configuration Test.....	98
8-9 Flowchart 5C: LAN Monitor Configuration Test.....	100
8-10 Flowchart 5D: LACP Configuration Test.....	102
8-11 Flowchart 6: Network Configuration Test.....	104
8-12 Flowchart 7: ARP Verification.....	105
8-13 Flowchart 8: Link Level Loopback Test.....	106
8-14 Flowchart 9: Transport Level Loopback Test (using ARPA).....	108
8-15 Flowchart 10: Bridge and Gateway Loopback Test.....	109

List of Tables

1 Publishing History Details.....	14
1-1 HP APA and LAN Monitor Features.....	18
1-2 Minimum Patches.....	19
2-1 Summary of Valid Parameter Values and Defaults.....	36
5-1 lan900 Events and Proactive Failover (Equal Network Costs).....	64
5-2 lan900 Events and Proactive Failover (Unequal Network Costs).....	65
7-1 Summary of lanadmin -x & -X Options.....	73
8-1 Flowchart Descriptions.....	87

List of Examples

4-1 Sample lanscan Command Output Without HP APA Installed.....	56
4-2 Sample lanscan Command Output with HP APA Installed.....	56
4-3 Sample lanscan Verbose Output.....	57
5-1 Sample lanconfig.ascii Configuration File.....	66
7-1 Using lanadmin to Configure an FEC_AUTO Mode Link Aggregation.....	81
8-1 Sample lanscan Output.....	86
8-2 Sample ioscan -f Output.....	91
8-3 Sample ioscan -f Output.....	92

About This Document

This document describes how to install, configure, and troubleshoot HP Auto Port Aggregation (APA) on HP-UX Version 11.0 or later platforms.

Document updates can be issued between editions to correct errors or document product changes. To ensure that you receive the updated or new editions, subscribe to the appropriate product support service. See your HP sales representative for details.

You can find the latest version of this document on line at <http://docs.hp.com>.

This document is not a tutorial.

Intended Audience

This document is intended for system and network administrators responsible for installing, configuring, and managing HP APA. Administrators are expected to have knowledge of operating system concepts, commands, and configuration.

A knowledge of Transmission Control Protocol/Internet Protocol (TCP/IP) networking concepts and network configuration is also helpful.

New and Changed Information in This Edition

HP APA now supports the TSO (TCP Segmentation Offload), or Large Send, feature if an aggregate is created with all TSO capable Ethernet cards. For more information, see [Chapter 10](#).

HP APA interfaces also support 64-bit MIB (RFC 2863) statistics if all the interfaces within a link aggregate or failover group support 64-bit statistics.

For the AR0505 release of HP-UX 11i v1 (B.11.11.20) and PHNE_33116 (B.11.11.17) patch release, HP APA supports the following:

- Proactive failover for LAN Monitor failover groups. For more information, see [Chapter 5](#).
- The logging of status messages to the `syslog.log` file. See “HP APA Parameters for Link Aggregates — `hp_apaconf`” (pg. 37) and [Appendix C](#) for more information.
- The ability to add and remove DOWN ports to and from a link aggregation, and to create and delete a failover group that has a DOWN port.
- The ability to choose the MAC address of the first LAN port or first LACP-enabled port as LACP System ID. See “HP APA Parameters for Link Aggregates — `hp_apaconf`” (pg. 37) for more information.

For the AR0512 release of HP-UX 11i v2 (B.11.23.10), HP APA supports the following:

- The aggregation of eight physical ports into MANUAL or FEC_AUTO mode link aggregates. For proper operation, the link partner (switch or server) must also be configured to create a trunk using same mode on those ports that are connected to the physical ports of the link aggregate.
- IPv6 addressing for link aggregates and LAN Monitor failover groups. You can now use port-based (LB_PORT) and IP-based (LB_IP) load balancing for IPv6 traffic on link aggregates. In addition, you can configure an IPv6 address on the primary port of a failover group.
- The logging of status messages to the `syslog.log` file. See “HP APA Parameters for Link Aggregates — `hp_apaconf`” (pg. 37) and [Appendix C](#) for more information.
- The ability to choose the MAC address of the first LAN port or first LACP-enabled port as LACP System ID. See “HP APA Parameters for Link Aggregates — `hp_apaconf`” (pg. 37) for more information.

Publishing History

In [Table 1](#), “Publishing History Details”, the document printing date and part number indicate the document's current edition. The printing date changes when a new edition is printed. Minor changes are made at reprint without changing the printing date. The document part number changes when extensive changes are made.

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Document Organization

The *HP Auto Port Aggregation (APA) Support Guide* is divided into the following chapters, each of which contains information about installing or configuring HP APA. This document also includes appendixes that contain supplemental information.

- Chapter 1 [“What Is HP Auto Port Aggregation?”](#) provides a summary of features, prerequisites, supported switches and LAN cards. It also contains typical configuration examples and LAN Monitor examples.
- Chapter 2 [“Overview of Installation and Configuration”](#) describes the steps to install, plan, and configure HP APA software; to set modes; and to modify default parameters.
- Chapter 3 [“Configuring APA Using SAM”](#) describes how to use SAM to configure HP APA and to set port aggregation MANUAL and FEC_AUTO modes.
- Chapter 4 [“Configuring HP APA by Editing Files”](#) provides information on how to edit configuration files for various HP APA modes.
- Chapter 5 [“What Is LAN Monitor?”](#) provides overview and configuration information for LAN Monitor and discusses LAN Monitor configuration commands.
- Chapter 6 [“Using HP Serviceguard with HP APA”](#) defines the requirements to use HP Serviceguard with APA.
- Chapter 7 [“Administering HP APA Using the lanadmin Command”](#) provides a summary of the lanadmin command options and syntax, and how describes to use it from the command line and interactively.
- Chapter 8 [“Troubleshooting HP Auto Port Aggregation \(APA\) Software”](#) provides an overview of troubleshooting techniques, and information on what happens during startup. It includes flowcharts and some known problems and workarounds.
- Chapter 9 [“HP APA Statistics”](#) describes how link aggregate level statistics are collected and reported, and provides sample output.
- Chapter 10 [“TSO Support for Link Aggregations and Failover Groups”](#) describes how the TCP Segmentation Offload (Large Send) feature is supported on link aggregates and failover groups.
- Appendix A [“Load Balancing and Data Flow Algorithms”](#) describes the load balancing and data flow algorithms supported in HP APA.

- Appendix B “HP APA Resources” describes the resources available to maintain and administer HP APA.
- Appendix C “Logging Messages to syslog.log” shows some sample `syslog.log` status messages and describes the events that cause them.

Typographical Conventions

This document uses the following conventions.

<code>audit(5)</code>	An HP-UX manpage. In this example, <i>audit</i> is the name and <i>5</i> is the section in the <i>HP-UX Reference</i> . On the Web and on the Instant Information CD, it can be a hot link to the manpage itself. From the HP-UX command line, you can enter either <code>man audit</code> or <code>man 5 audit</code> to view the manpage. Refer to <code>man(1)</code> .
<i>Book Title</i>	The title of a book. On the Web and on the Instant Information CD, it can be a hot link to the book itself.
Ctrl+X	A key sequence. A sequence such as Ctrl+X indicates that you must hold down the key labeled Ctrl while you press another key or mouse button.
Key	The name of a keyboard key. Return and Enter both refer to the same key.
<i>Emphasis</i>	Text that is emphasized.
Bold	Text that is strongly emphasized.
<i>Bold</i>	The defined use of an important word or phrase.
<code>ComputerOut</code>	Text displayed by the computer.
UserInput	Commands and other text that you enter.
<code>Command</code>	A command name or qualified command phrase.
<i>Variable</i>	The name of a variable that you replace in a command or function or information in a display that represents several possible values.
[]	The contents are optional in formats and command descriptions. If the contents are a list separated by , you must choose one of the items.
{ }	The contents are required in formats and command descriptions. If the contents are a list separated by , you must choose one of the items.
...	The preceding element may be repeated an arbitrary number of times.
	Separates items in a list of choices.

Related Documents

You can find additional information about HP APA in [docs.hp.com](http://www.docs.hp.com) in the *networking and communications* collection under *Auto Port Aggregation (APA)* at:

[http://www.docs.hp.com/hpux/netcom/index.html#Auto%20Port%20Aggregation%20\(APA\)](http://www.docs.hp.com/hpux/netcom/index.html#Auto%20Port%20Aggregation%20(APA))

Other documents in this collection include:

- *HP Auto Port Aggregation (APA) Release Notes*
- *Using APA to Build a Screaming Fast Network Server Connection*

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Include document title, manufacturing part number, and any comment, error found, or suggestion for improvement you have concerning this document, including what we did right, so we can incorporate it into other documents.

1 What Is HP Auto Port Aggregation?

Overview

HP Auto Port Aggregation (APA) is a software product that creates link aggregates, often called "trunks," which provide a logical grouping of two or more physical ports into a single "fat pipe." This port arrangement provides more data bandwidth than would otherwise be available.

Two additional features are automatic link failure detection and recovery; it also offers optional support for load balancing of network traffic across all of the links in the aggregation. This enables you to build large bandwidth "logical" links into the server that are highly available and completely transparent to the client and server applications.

The LAN Monitor mode of HP APA provides a failover capability with configuration tools similar to those in HP Serviceguard. LAN Monitor does not support HP Serviceguard. In the event of link failure, LAN Monitor automatically migrates the data flow from the primary link to one of the standby links in the failover group.

HP APA supports the TCP Segmentation Offload (Large Send) feature if an aggregate is created with all TCP Segmentation Offload (TSO) capable Ethernet cards.

HP APA interfaces also support 64-bit MIB (RFC 2863) statistics, if all the interfaces within a link aggregate or failover group support 64-bit statistics. In addition, for the AR0512 release of HP-UX 11i v2 (B.11.23.10), HP APA interfaces support the configuration of IPv6 addresses on a link aggregate or failover group. This release also allows you to aggregate eight physical ports into MANUAL or FEC_AUTO mode link aggregates.

For release-specific information, refer to the release notes on the World Wide Web at:

<http://www.docs.hp.com>

HP Auto Port Aggregation Features

Link aggregates, often called "trunks," provide a logical grouping of two or more physical ports into a single "fat pipe". Two primary features are automatic link failure detection and recovery as well as optional support for load balancing of network traffic across all of the links in the aggregation. This enables you to build large bandwidth "logical" links into the server that are highly available and completely transparent to the client and server applications.

On HP-UX 11.0 and all versions of 11i, HP APA supports Fast and Gigabit Ethernet with automatic fault detection and recovery as well as load balancing of network traffic.

On HP-UX 11.0 and 11i, HP APA link aggregates work with switches and routers using:

- Cisco proprietary Fast EtherChannel (FEC/PAgP) technology
- IEEE 802.3ad link aggregation control protocol (LACP)
- Manually configured port trunks

You can also configure FDDI and Token Ring links, as well as Fast and Gigabit Ethernet, as LAN Monitor failover groups, but with no load balancing of network traffic. This enables you to use HP APA throughout the environment to provide single system high availability for all networking components. To summarize, HP APA offers you a comprehensive solution to create fast, highly available network server connections with minimal IT support costs. HP APA enables this with four key benefits:

- Automatic link failure detection and recovery in case of network failures. A link aggregate will continue to operate as long as there is at least one port operating.
- Scalable high-performance link aggregates using Fast or Gigabit Ethernet and the HP APA load-balancing algorithms. Supported load-balancing algorithms include:
 - IP-based (server-to-router)
 - Port-based (server-to-server)
 - MAC-based (server-to-switch)
- Fault management and isolation with the HP MIB Monitor and `nettl` logging facilities.
- Lower IT costs with automated configuration and management tools using the IEEE 802.3ad or PAgP standards and the HP System Administration Manager (SAM) GUI.

Summary of HP APA and LAN Monitor Capabilities

Table 1-1 summarizes the capabilities of HP APA and LAN Monitor.

Table 1-1 HP APA and LAN Monitor Features

	HP APA (on HP-UX 11.x) in FEC_AUTO, LACP_AUTO, MANUAL ¹ Modes	HP APA (on HP-UX 11.x) in LAN_MONITOR Mode	Integration with HP Serviceguard in MANUAL ¹ and FEC_AUTO Modes Only
Min# of ports / LinkAgg	FEC_AUTO (2) LACP_AUTO (2) MANUAL (1)	2	2
Max# of ports / LinkAgg	FEC_AUTO (4) ² FEC_AUTO (8) ³ MANUAL (4) ² MANUAL (8) ³ LACP_AUTO (32)	32	4
Primary ports / LinkAgg	N/A	1	Min(2) Max(4)
Standby ports / LinkAgg	N/A	1 - 31	Min(1) Max(3)
Max# of LinkAggs / system	50 ⁴	50 ⁴	50 ⁴
Load balancing (LB) or Hot Standby (HS)	FEC_AUTO (LB) LACP_AUTO (LB) MANUAL (LB)	LB ⁵ (Ethernet only) and HS	LB ⁵ (Ethernet only) and HS
MIB monitor support	Yes	Yes	Yes
BUSES	For HP-UX 11.0 and 11i v1: PCI, HSC, HP-PB ⁶ , core100/1000BT For HP-UX 11i v2: PCI 100BT, TR, and FDDI	For HP-UX 11.0 and 11i v1: PCI, HSC, HP-PB, Core100BT PCI, HSC, HP-PB ⁶ , Core10/100/1000BT For HP-UX 11i v2: PCI 100BT, TR, and FDDI	
LINKS ⁷	100BT, Gigabit	100BT, Gigabit, 10 GbE Fiber (11i v2 only), FDDI, Token Ring ⁸	100BT, Gigabit (also Token Ring and FDDI when HP Serviceguard will coexist with LAN Monitor; future feature)
Workstation support	Yes	Yes	Yes
Switches/hubs	HP, Cisco, 3COM	All Types	HP, Cisco, 3COM (Hot Standby mode works with all types of switches and hubs)
Start PPA#	100 (11.0), 900 (11i)	100 (11.0), 900 (11i)	100 (11.0), 900 (11i)
HP Serviceguard version	A.11.09	Future feature	A.11.09
SAM/edit	SAM/edit files	lan*conf commands	Edit files
Instant Ignition	Yes	Yes	N/A
Full and half-duplex ⁹	Yes ⁴	Yes	Yes

1 MANUAL mode: Can be Load Balancing or Non-Load Balancing

- Load Balancing: MAC, IP, or LB_PORT algorithm
- Non-Load Balancing: Hot Standby mode

HP Serviceguard does not support LACP_AUTO mode link aggregates.

2 HP-UX 11.0 and 11i v1 only.

3 HP-UX 11i v2 (AR0512 release B.11.23.10) only.

4 LACP requires full duplex (FD) operation of the links.

5 Load Balancing is configurable on Ethernet links only. Hot Standby is the only choice for FDDI and Token Ring. Load Balancing is for outbound traffic only.

6 HP-PB 100BT adapters cannot be mixed with other non-HP-PB 100BT adapters.

7 Links must be of the same speed and type (100Base-T, 1000Base-T, Token Ring, or FDDI).

- 8 You cannot reset the speed, duplex mode, or MTU size over a link aggregate.
- 9 This is for the total of LinkAggs and LAN_MONITOR combined.

Required Software

The HP server can be running HP-UX 11.0 or 11i (all versions). See "Known Problems and Workarounds" (pg. 110) for any patches relating to HP-UX 11i-based systems.

Table 1-2 Minimum Patches

Driver	11.0	11i v1	11i v2
Kernel			
Various required items			PHKL_31500
Streams Patch			PHNE_32277 ¹
DLPi Patch			PHNE_33429 ¹
10/100BT			
PCI 1-port 100BT (RJ45), (b1lan5)	PHNE_24006		
PCI 1-port 100BT (AUI,BND,RJ45) (b1lan6)	PHNE_22245		
PCI 4-port 100BT (b1lan)	PHNE_24007		
PCI 100BT/SCSI Combo Card (b1lan3)	HP-UX 11.0 Additional Core Enhancement release of January 2000		
Core PCI 10/100BT (b1lan3)	HP-UX 11.0 Additional Core Enhancement release of January 2000		
EHSC/HSC 1-port, 2-port 100BT (b1lan4)	PHNE_22461 ²		
HP-PB 10/100BT (b1lan1)	PHNE_23982		
Gigabit			
PCI 1000SX (gelan)	March 2000 release		
PCI 1000BT (gelan)	N/A		
EHSC/HSC 1000SX (gelan)	March 2000 release		
FDDI			
PCI FDDI (fddi4)	June 2000 release		
EHSC/HSC FDDI (fddi3)	March 2000 release		
HP-PB FDDI (fddi)	March 2000 release		
Token Ring			
PCI Token Ring	June 2000 release		
HP-PB Token Ring	June 2000 release		
Core LAN			
Core LAN Patch	PHNE_24413 ²		PHNE_30773

¹ Recommended patch for AR0512 release if you want to use 8 ports for trunking.

² Required patch.



IMPORTANT Patches must be in place before you install the HP APA software. If the latest core LAN patch is not in place, the following problems will result:

- For the April 1999 release: Installation of the product will fail.
- For the June 1999 release and after: The product will install properly, but will not initialize. When the patch is installed, it causes the system to reboot. After the reboot, the product initializes and becomes usable.

For the AR0512 release of HP-UX 11i v2 (B.11.23.10), if you want to use 8 ports for trunking HP APA requires the following software:

- Transport Optional Upgrade Release (TOUR) 3.0
- Streams Advance Release (STAR) 1.0
- IPFilter version A.03.05.12, if you use IP Filter

Supported Switches

HP APA supports the Cisco FastEtherChannel (PAgP) protocol, the Link Aggregation Control Protocol (IEEE 802.3ad), and manual trunking mechanisms.

HP has tested switches from the following vendors to work with HP APA:

- 3Com
- Cisco
- HP
- Foundry
- Alteon
- Nortel
- Extreme



NOTE Both Hot Standby and LAN_MONITOR modes are supported with all switches. However, HP strongly recommends using LAN_MONITOR rather than Hot Standby mode.

Supported LAN Cards and Functions: HP-UX 11.00 and 11i v1

The following network adapter cards are supported:

- All HP HP-PB, HSC, and PCI 10/100Base cards (both FX and TX)
- All HP HSC and PCI 1000Base cards (both Base-T and SX)
- HP-PB and PCI Token Ring (LAN Monitor only)
- HP-PB, HSC, and PCI FDDI (LAN Monitor only)

The following functions are supported on HP APA for HP-UX 11.x:

- A total of 50 LinkAggs per server
- The following maximum number of ports per LinkAgg:
 - FEC_AUTO and MANUAL mode — 4
 - LACP_AUTO and LAN_MONITOR mode — 32
- Support for System Administration Manager (SAM) on HP-UX Versions 11.0, 11i v1, and 11i v2, for link aggregation
- 64-bit MIB (RFC 2863) statistics if all the interfaces within a link aggregation or failover group support 64-bit statistics
- For the AR0505 release of HP-UX 11i v1 (B.11.11.20) and the PHNE_33116 (B.11.11.17) patch release, the logging of status messages to the `syslog.log` file (for example, when a link aggregate or port fails or comes up)

Supported LAN Cards and Functions: HP-UX 11i v2

The following network adapter cards are supported:

- All HP PCI 10/100Base cards (both FX and TX)



NOTE HP APA does not support the 10/100 BT Standard/Management LAN interface found on some systems and controlled by the `int1100` driver, and any other devices controlled by the `int1100` driver.

- All HP PCI 1000Base cards (both Base-T and SX)
- PCI-X 10 GbE Fiber cards (LAN Monitor only)
- PCI Token Ring (LAN Monitor only)
- PCI FDDI (LAN Monitor only)

The following functions are supported on HP APA for HP-UX 11i v2:

- A total of 50 LinkAggs per server
- The following maximum number of ports per LinkAgg:
 - FEC_AUTO and MANUAL mode — 8 (AR0512 release only), 4 (previous releases)
 - LACP_AUTO and LAN_MONITOR mode — 32
- System Administration Manager (SAM) on HP-UX Versions 11.0, 11i v1, and 11i v2, for link aggregation
- 64-bit MIB (RFC 2863) statistics if all the interfaces within a link aggregation or failover group support 64-bit statistics
- Configuration of IPv6 addresses over link aggregates and failover groups for the AR0512 release of HP-UX 11i v2 (B.11.23.10)
- The logging of status messages to the `syslog.log` file (for example, when a link aggregate or port fails or comes up) for the AR0512 release of HP-UX 11i v2 (B.11.23.10)

HP APA Configuration Examples

Remember the following points when configuring HP APA:

- HP APA combines two to four (two to eight for the AR0512 release) physical link ports into one logical aggregation of links when you use FEC_AUTO or MANUAL link aggregation. This gives the link aggregation a theoretical bandwidth of four times that of a single physical link. When you use an LACP_AUTO link aggregation, you can have as many as 32 physical links in a link aggregation.



NOTE The examples in this chapter show two- to four-port configuration only.

- You can use 100BT or Gigabit devices in the link aggregation. However, all the devices in the link aggregation must be of one type: 100BT or Gigabit. And the physical devices in the link aggregation must be configured for the same speed and duplex.



NOTE EISA 100BT devices and 10/100 BT Standard/Management LAN interfaces found on some systems controlled by the `int1100` driver are not supported.

- The link aggregation has one or more IP addresses assigned to it in the `/etc/rc.config.d/netconf` file.
- The physical ports in the link aggregation use the same MAC address.
- HP APA distributes the outbound network traffic across the physical links in the link aggregation using a load balancing algorithm.

Effective APA load balancing requires many simultaneous, active client connections. See Figure 1-1 for a good example. The connections are distributed across the physical links. One client connection will have its traffic sent on one physical link. The connection is defined by the load-balancing algorithm.

- The link partners (switches, routers, or remote servers) completely control inbound load balancing.
- You can choose from three load balancing algorithms: MAC address, IP address, and TCP/UDP-port address load-balancing algorithms. See [Appendix A](#) for more information.
- HP APA link aggregations provide for migrating the network traffic on a failed physical link in the aggregation to the remaining operational links in the aggregation.
- The link partner (the switch, router, or server) connected to the link aggregation can inhibit the usefulness of HP APA in some environments. See the examples in the following sections.
- HP APA can support the TCP Segmentation Offload (TSO) feature if all the Ethernet cards on the aggregate are TSO capable.
- HP APA interfaces also supports 64-bit MIB (RFC 2863) statistics if all the interfaces within a link aggregate or failover group support 64-bit statistics.
- The link partner (the switch, router, or server) ports connected to the server ports must be configured for link aggregation (trunking). In addition, the mode on the link partner and the server must be the same. For example, if ports 1, 2, 3, and 4 are connected to a link partner switch's ports C1, C2, C3, and C4, respectively, and the server side is trunked using LACP_AUTO mode, the partner switch must be configured to trunk ports C1, C2, C3, and C4 using LACP_AUTO mode.



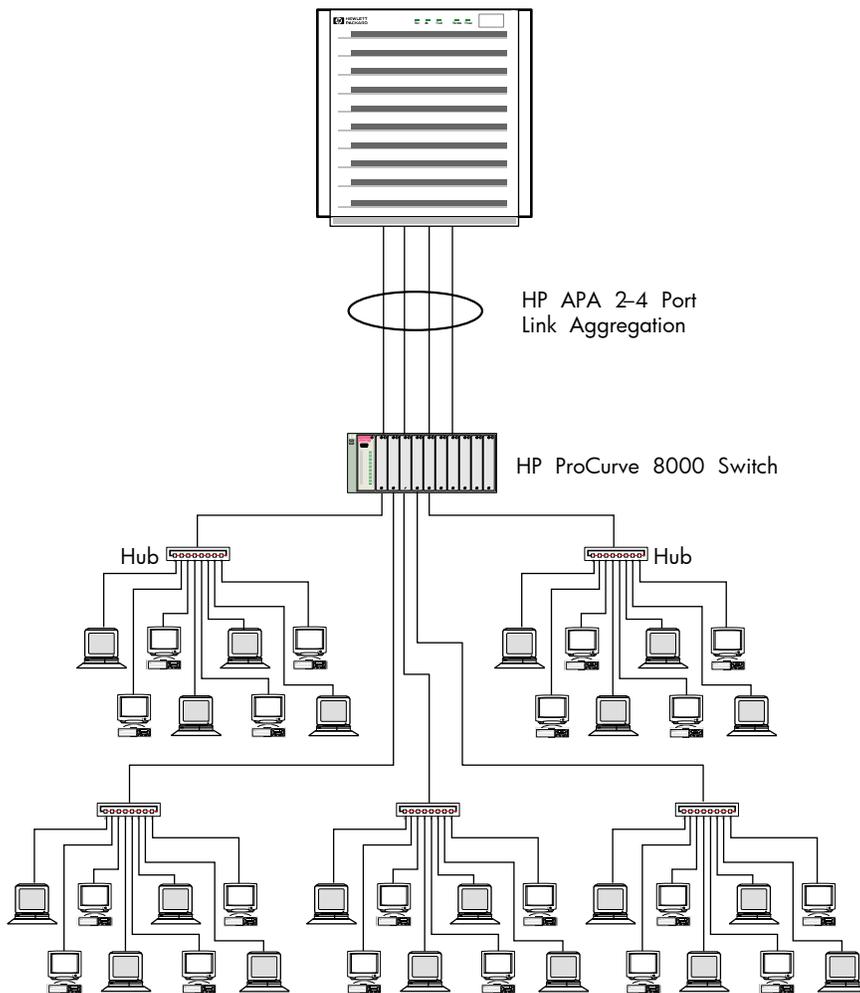
NOTE For a LAN Monitor failover group, the link partner does not require special configuration.

The following examples show some supported and unsupported uses for HP APA based on the preceding points.

Enterprise Intranet Client/Server Environment

Enterprise client/server environments are good candidates for HP APA link aggregations.

Figure 1-1 Sample Enterprise Intranet Client/Server Configuration



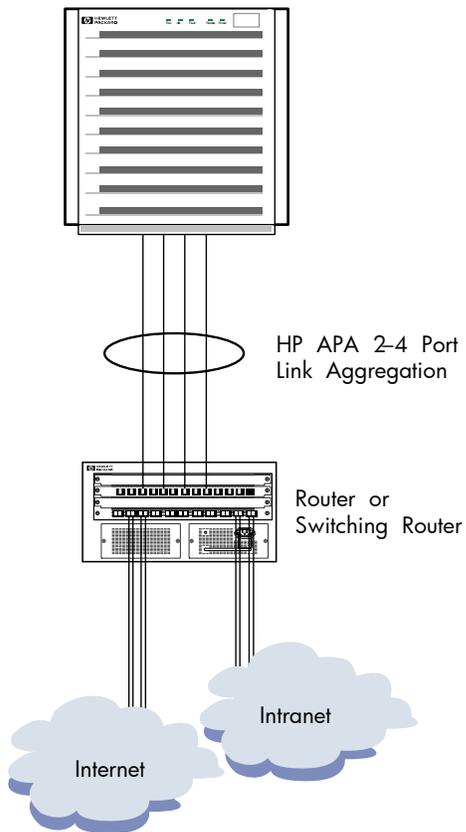
Points for Figure 1-1:

- This configuration requires a switch capable of trunking/load balancing.
- Many clients produce many connections. This makes effective use of the HP APA outbound network traffic distribution algorithms. The HP APA MAC address load-balancing algorithm is a good choice. The IP address and TCP/UDP port address load-balancing algorithm also works effectively in this configuration.
- The switch typically provides good inbound traffic distribution. Most switches use the data packet's source MAC address, or a combination of the packet's source and destination MAC addresses, to provide inbound load balancing.
- Depending on the network traffic bandwidth requirements, you can use two to four 100BT interfaces or two to four Gigabit interfaces in an PAgP link aggregation. With LACP, you can use up to 32 interfaces in the link aggregation. This enables bandwidth scalability as network loads increase as the organization grows.

Internet or Large Enterprise Environments Using Routers

You can use HP APA link aggregation successfully in certain environments employing routers. You must be careful because a particular router might not have a load balancing capability. Additionally, switches employed between the server employing HP APA and the router inject another level of complexity that you should analyze before determining that the environment is a candidate for HP APA link aggregations.

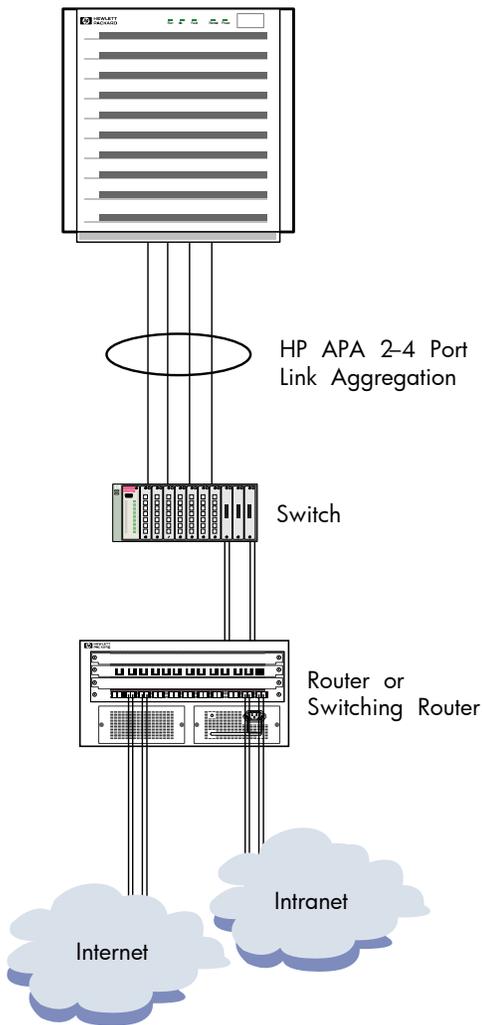
Figure 1-2 Sample Router and Server Configuration with No Switch



Points for Figure 1-2:

- Assumes the router or switching router connected to the server provides trunking/load balancing using an IP address load-balancing algorithm.
- Assumes there will be many TCP/UDP client connections. The HP APA IP address load-balancing algorithm provides effective outbound network traffic load balancing, as does the TCP/UDP port address algorithm. Do not use the MAC address algorithm because all packets arriving at the server would contain the same source and destination MAC addresses.

Figure 1-3 Sample Router and Server Configuration with Switch



Points for Figure 1-3:

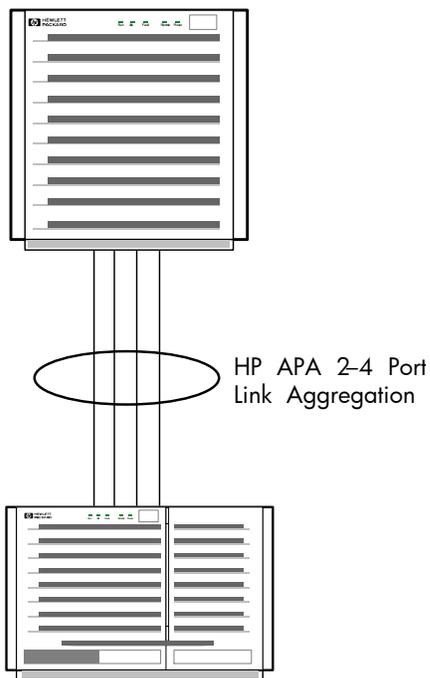
The switch in the configuration shown in Figure 1-3 might present problems. Switches typically use a MAC address load-balancing algorithm. This might make the switch a bottleneck point because the packets from the router and from the server will contain the same source and destination MAC addresses, thus defeating the load-balancing algorithm for both inbound and outbound data at the server.

This condition might be acceptable if the load balancing of inbound traffic to the server is not a concern and the link between the switch and the router has greater bandwidth capacity than the server's link aggregation. For example: The server's link aggregation is composed of 100BT links and the link between the switch and the router is a Gigabit link.

Server-to-Server (Back-to-Back)

You create server-to-server aggregations by directly connecting the physical ports in one server's link aggregation to the physical ports in the other server's link aggregation.

Figure 1-4 Sample Server-to-Server Configuration (Back-to-Back)



Points for Figure 1-4:

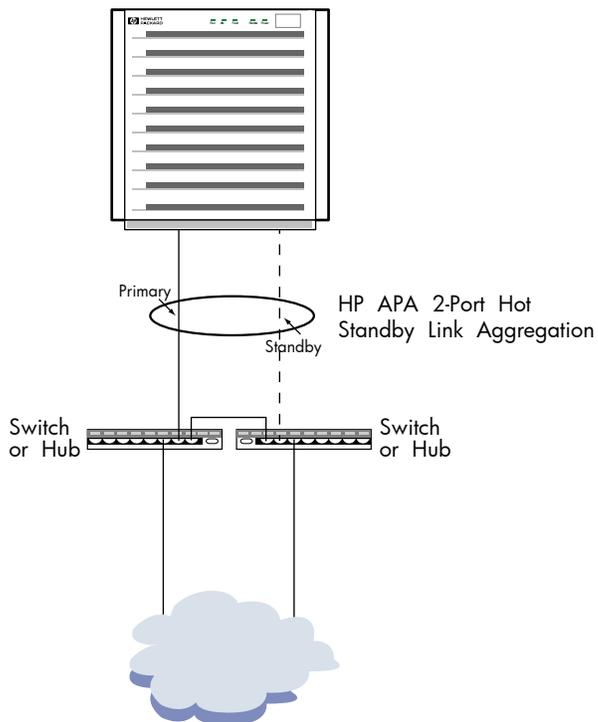
- This configuration requires that many TCP/UDP client connections exist between the servers for load balancing to be effective. Use the HP APA TCP/UDP port load-balancing algorithm.
- Depending on the network traffic bandwidth requirements, use two to four 100BT interfaces or two to four Gigabit interfaces in an PAgP link aggregation. With LACP, you can use up to 32 interfaces in the link aggregation. This enables bandwidth scalability as network loads increase as the organization grows.

Hot Standby for High Availability

HP APA Hot Standby mode link aggregations provide high availability network access via a primary link and a standby link.

HP strongly recommends using LAN_MONITOR mode rather than Hot Standby mode

Figure 1-5 Sample Hot Standby Configuration for High Availability



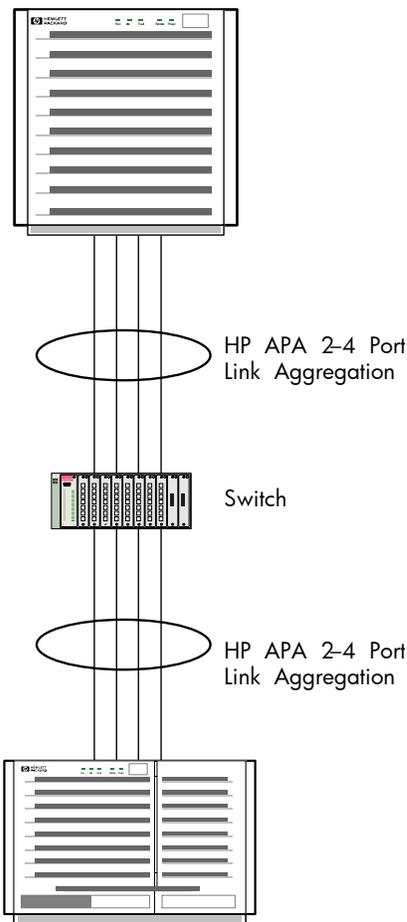
Points for Figure 1-5:

- The Hot Standby primary link carries network traffic until it or its link partner fails. In that event, the standby link takes over the responsibility for delivering network traffic. If the primary link is configured with a higher port priority than the standby link, then when it recovers it resumes being the active link delivering the network traffic. If the port priorities are the same, the standby link continues as the active link.
- The primary and standby links must both be the same type of device: 100Base-T or Gigabit.
- Hot Standby link aggregations can be connected to any switch or hub. The ports must be cabled to a switch and the switch ports must not be configured for an aggregation.
- Dual switches or hubs (as used in Figure 1-5) are not required. But dual switches and hubs provide a more reliable network environment by removing single points of failure. Both switches or hubs must be on the same subnet.

Server-to-Server with Switch (Not Recommended)

A server-to-server HP APA link aggregation configuration with a switch between the servers will not work as intended.

Figure 1-6 Sample Server-to-Server Configuration with Switch (Not Recommended)



Points for Figure 1-6:

- The switch will nullify any load balancing of network traffic provided by HP APA.
- The switch will use a MAC address load-balancing algorithm. Because the servers' link aggregations will have fixed MAC addresses, the switch will not load balance, and thus will only transmit data on one physical link.

LAN Monitor Configuration Examples

Keep the following points in mind when you use LAN Monitor with HP APA:

- LAN Monitor failover groups are the same as HP APA Hot Standby link aggregates except for some additional features:
 - LAN Monitor periodically exchanges APA packets between the links making up the failover group. This enables better detection of nonoperational links in the failover group.
 - You configure LAN Monitor with LAN Monitor configuration commands. See [Chapter 5](#) for information. Do not use SAM to configure LAN Monitor failover groups.
 - You can use FDDI or Token Ring devices in the failover group.
- LAN Monitor combines 2 to 32 physical link ports into one failover group. One port is the primary port, and the others are standby ports. Network traffic is sent and received on the primary port (the port with the highest HP APA port priority). If the primary port or its link partner fails, the traffic is migrated to one of the standby ports. When the primary port link recovers, the network traffic is migrated back to the primary port. Sometimes, it is desirable to have the network traffic remain on the standby after the failure and recovery of the primary. To achieve this, set the HP APA port priorities the same for all ports in the failover group.
- You can use 100BT, FDDI, Token Ring, or Gigabit devices in the failover group. However, all the devices in the failover group must be of one type: 100BT, Gigabit, FDDI, or Token Ring.

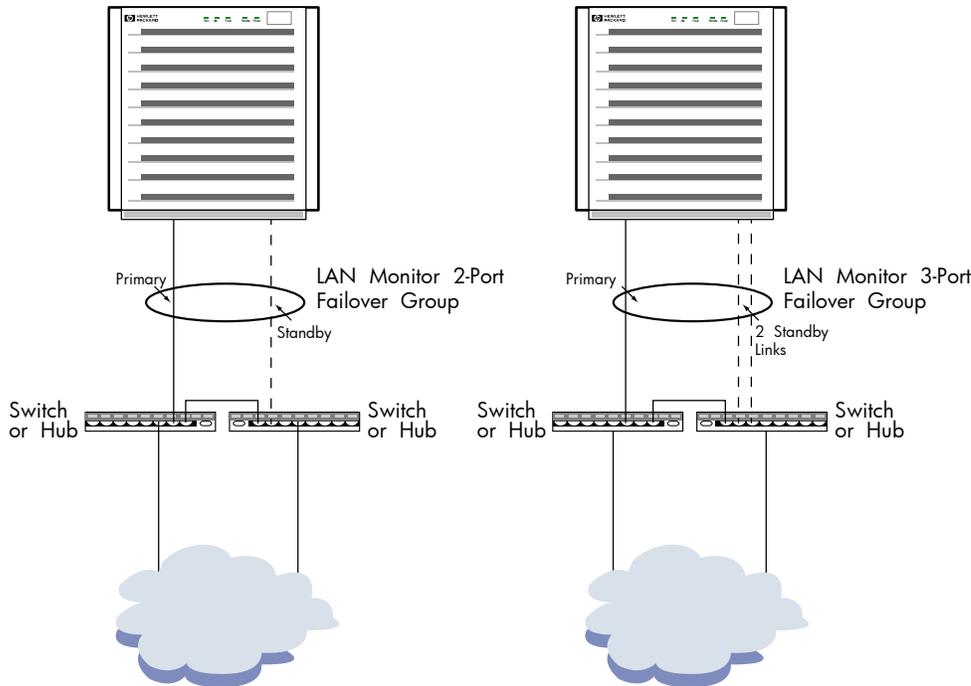
- The failover group has one or more IP addresses assigned to it.
- The physical ports in the link aggregation do not share a common MAC address.
- LAN Monitor supports the use of an HP APA link aggregation as a device in the failover group. This enables increased bandwidth and load balancing in a failover group.
- You must use a linkloop between the devices in the failover group.

The following examples show some uses for LAN Monitor failover groups based on the preceding points.

LAN Monitor Failover Group

LAN Monitor failover groups provide high availability network access via a primary link and a standby link.

Figure 1-7 Sample LAN Monitor Failover Group Configuration



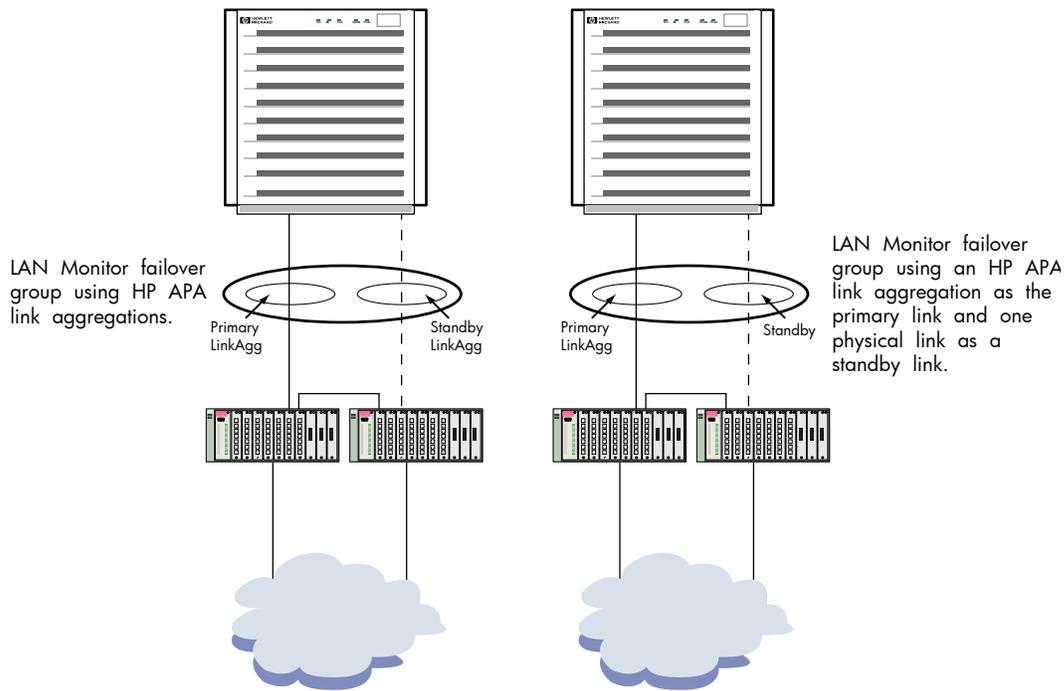
Points for Figure 1-7:

- Dual switches or hubs (as used in Figure 1-7) are not required. But dual switches and hubs provide a more reliable network environment by removing single points of failure. If two switches or hubs are used, then there must be a data path between them allowing them to be on the same subnet.
- You can connect LAN Monitor failover groups to any switch or hub.
- The failover group primary link carries network traffic until it or its link partner fails. In that event the standby link takes over the responsibility for delivering network traffic. When the primary link recovers, it resumes being the active link delivering the network traffic.
- The primary and standby links must both be the same type of device: 100BT, Gigabit, FDDI, or Token Ring.
- You must use a linkloop between the devices in the failover group.

LAN Monitor Failover Group Using Link Aggregations to Increase Bandwidth

To increase the network bandwidth of a LAN Monitor failover group you can use link aggregations as the primary and standby devices.

Figure 1-8 Sample LAN Monitor Failover Group Using Link Aggregation Configuration



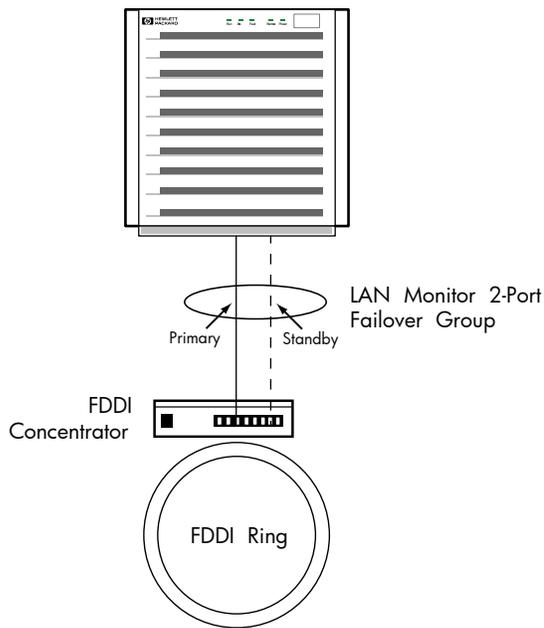
Points for Figure 1-8:

- You can use any HP APA link aggregation, except Hot Standby, as a device in the LAN Monitor failover group. This enables increasing the bandwidth of the group device through load balancing across the physical links making up the aggregation.
- The standby link does not have to be a link aggregation. It can be a single physical link of the same type as used in the link aggregation.
- Dual switches (as used in Figure 1-8) are not required. But dual switches provide a more reliable network environment by removing single points of failure. If two switches are used, then there must be a data path between them.
- LAN Monitor failover groups using link aggregates are restricted to switches supported by HP APA link aggregates.
- The failover group primary link carries network traffic until it or its link partner fails. In that event, the standby link takes over the responsibility for delivering network traffic. When the primary link recovers, it resumes being the active link delivering the network traffic.
- The primary and standby links must both be the same type of device: 100BT or Gigabit.
- You must use a linkloop between the devices in the failover group.

LAN Monitor with FDDI or Token Ring

LAN Monitor supports FDDI and Token Ring devices.

Figure 1-9 Sample LAN Monitor with FDDI or Token Ring Configuration



Points for Figure 1-9:

- The failover group primary link carries network traffic until it or its link partner fails. In that event the standby link takes over the responsibility for delivering network traffic. When the primary link recovers, it resumes being the active link delivering the network traffic.
- The primary and standby links must both be the same type of device: FDDI or Token Ring.
- You must use a linkloop between the devices in the failover group.

2 Overview of Installation and Configuration

This chapter contains the following sections:

- "Planning Your HP APA Configuration"
- "Preparing to Install the Software"
- "Installing the HP APA Software"
- "Configuring HP APA Using SAM"
- "Configuring HP Auto Port Aggregation"
- "Port Aggregation Modes"
- "Choosing a Configuration Method: SAM or Editing"
- "Modifying Default Configuration Parameters"

Planning Your HP APA Configuration

1. Before configuring HP APA, obtain the following information:
 - Determine which network physical interfaces installed in the HP server can be used for the HP APA link aggregation.
 - Use only those interfaces supported by HP APA. HP APA supports all 100BT interfaces except the EISA 100BT interfaces are supported. Note that HP-PB 100BT does not exist on 11i v2. All Gigabit interfaces are supported.
 - All link aggregation devices must be of the same type: all 100BT or all 1000BASE-x.
 - All the devices in the link aggregation must be configured for the same speed and duplex.
 - Determine the number of physical interfaces required in the link aggregation. Use present and future bandwidth requirements to determine this number.
 - Determine the mode of the link aggregate. You can use FEC_AUTO, LACP_AUTO, or MANUAL. Your choice will be determined by the capabilities of the link partner (such as a switch, a server, or a router) to which the link aggregate physical interfaces will be connected. Refer to your link partner's documentation to determine which modes it supports. If auto (FEC_AUTO or LACP_AUTO) and MANUAL modes are available, use one of the auto modes.
 - If the link aggregate will be set for FEC_AUTO (11i v1 & 11iv2) or MANUAL(11i v1), a *group capability* value is needed. The easiest way to choose this is to take the PPA number of the link aggregate and use it as the group capability. The same group capability must be used for ports that intend to join this link aggregate.
 - If the link aggregate will be set for LACP_AUTO, a *key* value is needed. The easiest way to choose this is to take the PPA number of the link aggregate and use it as the *key*. You must use the same *key* value for all of the ports that join this link aggregate.
 - Determine the load-balancing algorithm to use from the following list:
 - LB_MAC (default)
Works well in most configurations, and is recommended for server-to-switch configurations.
 - LB_IP
Is recommended for server-to-router configurations.

- **LB_PORT**
Is recommended for server-to-server configurations.
 - If you are using a MANUAL link aggregation using Hot Standby, no load-balancing algorithm is used.
 - Determine the IP address and subnet mask of the aggregate.
Links to be included in aggregations must not be bound to any protocol, such as having an IP address. If you try to aggregate a link bound to a protocol, it will fail.
2. From the information collected in step 1, make a list containing:
 - The PPA number of the link aggregate (use 900 for lan900).
 - The configuration mode of the aggregation (FEC_AUTO, LACP_AUTO, MANUAL, or none).
 - The PPA numbers of the ports that will be in the link aggregation.
 - The information for each port, including:
 - The port's *priority*, if the link aggregation mode will be MANUAL and will use Hot Standby. The port with the highest priority will be the primary port.
 - The *group capability*, if the link aggregate will be set for FEC_AUTO. This should match the value specified for the group capability of the link aggregate.
 - The *key*, if the link aggregate will be set for LACP_AUTO. This should match the value specified for the link aggregate *key*.



NOTE HP APA also requires that you configure your switches' trunking mode (AUTO or MANUAL) to match the mode being used on the server: Cisco Fast EtherChannel (FEC), IEEE 802.3ad Link Aggregation Control Protocol (LACP), or MANUAL mode.

NOTE The starting PPA number for HP-UX 11i v2 link aggregates is 900.

Preparing to Install the Software

1. Log in to the HP-UX server as superuser.
2. Confirm that the `/usr/bin`, `/usr/sbin`, and `/sbin` directories are in your PATH by logging in as root and using the `echo $PATH` command.
3. Use the `uname -a` command to determine the HP-UX version of your system.
4. Install the required patches for your system as described in the "Required Patches" section of the release notes.

Installing the HP APA Software

Skip this section if you ordered product option OD1 —preinstallation.

1. To install the software from the installation media, enter the following command:
swinstall
2. Choose the appropriate Source Depot Type (for example, Local CD, Local tape, Local Directory, Network Directory/CDROM).
3. Choose Source Host Name.
4. Choose Source Depot Path. If you do not know the exact path, you can click the Source Depot Path button to display a list of valid choices.
5. Highlight the HP APA software:
J4240AA
6. Choose **Mark for Install** from the Actions menu, then select the products to be installed.
7. Choose **Install** from the Actions menu to begin product installation and to display the Install Analysis window.
8. Click **OK** in the Install Analysis window when the Status field displays a Ready message.

9. Click **YES** at the Confirmation window to confirm that you want to install the software. `swinstall` loads the files, runs the control scripts for the files, and builds the kernel. The estimated time for processing is 3 to 5 minutes depending on the complexity of your system. When the status field indicates Ready, a Note window opens. Click **OK** on the Note window to reboot the system.
10. After you have installed HP APA, it will be in MANUAL port configuration mode until you configure it to aggregate eligible ports.

Auto aggregation also requires that you configure your switch to enable either the Cisco Fast EtherChannel (FEC) or the IEEE 802.3ad Link Aggregation Control Protocol (LACP).

If your switch supports only manual port configuration, you must also set the server ports to MANUAL mode (the default configuration). Continue to edit your server's configuration file as described in the following section.

If you want to configure Hot Standby on an aggregation, do not configure the switch ports for an aggregation.

Configuring HP APA Using SAM

SAM permanently saves HP APA configuration values in the following files:

- `/etc/rc.config.d/hp_apaconf`
- `/etc/rc.config.d/hp_apaportconf`

Setting Port Aggregation Modes

You can use the SAM to configure HP APA so that it will aggregate ports in any of the following port aggregation modes:

- FEC_AUTO or LACP_AUTO Port Aggregation Modes
- MANUAL Port Aggregation Mode

After you have installed HP APA, it will be in MANUAL port-aggregation mode unless you configure it to automatically aggregate eligible ports.



NOTE HP APA also requires that you configure your switches' trunking mode (AUTO or MANUAL) to match the mode being used on the server: the Cisco Fast EtherChannel (FEC), IEEE 802.3ad Link Aggregation Control Protocol (LACP), or MANUAL mode.

Configuring HP Auto Port Aggregation

The default HP APA port-configuration mode is set to MANUAL mode; it does not automatically aggregate ports. If you do not modify the default configuration, nothing will happen. See Chapter 3 and Chapter 4 for information about configuring APA and Chapter 5 for information about configuring LAN Monitor.

Port Aggregation Modes

The following port aggregation modes are supported by HP APA:

MANUAL	Use this mode to configure link aggregates if the server connects to a switch that supports only manual configuration. This mode requires the switch to support link aggregation. In the event of a link failure, APA automatically migrates the data flow from the failed link to another link in the aggregation.
FEC_AUTO	Use this mode to configure link aggregates connected to a switch that supports the Cisco Fast EtherChannel protocol (PAgP). This mode requires the switch to support the PAgP (FEC) protocol. In the event of a link failure, PAgP automatically migrates the data flow from the failed link to another link in the aggregation.
LACP_AUTO	Use this mode to automatically aggregate links connected to IEEE 802.3ad (LACP) supported switches. This mode requires the switch to support the LACP protocol. In the event of a link failure, LACP automatically migrates the data flow(s) from the failed link to another link in the aggregation.
LAN_MONITOR	Use this mode to configure failover groups. In the event of a link failure, the LAN Monitor software automatically migrates the data flow from the primary link to one of the standby

links in the failover group. Failover groups do not support HP Serviceguard. The mode does not strictly require the switch to support link aggregation, although some configurations might require the switch to support link aggregation.

Choosing a Configuration Method: SAM or Editing

Using the GUI-based System Administration Manager (SAM) results in fewer configuration errors and is the recommended method for configuring HP APA.

1. To permanently save your configurations, do either of the following:
 - Use the GUI-based System Administration Manager (SAM). To use SAM, see the instructions in [Chapter 3](#) for details, and then follow the steps for verifying link aggregates.
 - Edit the configuration files using an editor, such as `vi`. See [Chapter 4](#) for instructions on editing the files for APA and LAN Monitor.
 - Both APA and LAN Monitor require that you edit the `/etc/rc.config.d/hp_apaconf` and `/etc/rc.config.d/hp_apaportconf` files.
 - LAN Monitor also requires that you edit the `/etc/rc.config.d/netconf`, and `/etc/lanmon/lanconfig.ascii` files.
2. If you are configuring more than one of the four port configuration modes described here, minimize the number of stops (which can interrupt traffic on existing link aggregates) by editing all configuration files first. You then need to run only one series of `hplm stop` (optional), `hpapa stop`, `hpapa start`, and `hplm start` (optional) commands to activate the link aggregates and (if using LAN Monitor) failover groups.

APA configuration takes effect immediately and does not require a system reboot.



CAUTION You can also enter the `lanadmin` command from the HP-UX command line prompt to make temporary changes to HP APA. However, if you change some variables using the `lanadmin` command, those changes are not preserved across reboots.

Table 2-1 Summary of Valid Parameter Values and Defaults

Parameters	Valid Values and Default
<code>group_capability</code>	1, 2, ... 5 (default), ...
<code>load_balance_algorithm</code>	LB_MAC (default), LB_IP, LB_PORT, LB_CPU (LB_CPU is obsolete in 11i v2)
<code>config_mode</code>	MANUAL (default), FEC_AUTO, LACP_AUTO, LAN_MONITOR
<code>port_priority</code>	0 (default), 1, 2, 3, ...
<code>admin_key</code>	0xffff (default), 0, 1, 2, ...
<code>system_priority</code>	0 (default), 1, 2, 3, ...

Modifying Default Configuration Parameters

Beginning with the December 2001 release, the HP APA default port configuration mode is set to MANUAL mode; it does not automatically aggregate ports. If you do not modify the default configuration, nothing will happen—you have to modify and save the configuration by either using SAM or editing the files that are listed here. See [Chapter 3](#) or [Chapter 4](#) to set up or modify these files. SAM does not configure LAN Monitor.

HP Auto Port Aggregation uses the following configuration files:

- `/etc/rc.config.d/hp_apaconf`—This file contains configuration values for link aggregates.
- `/etc/rc.config.d/hp_apaportconf`—This file contains configuration values for specific physical ports that are supported by HP APA.

LAN Monitor uses the `hp_apaportconf` file and the following files:

- /etc/rc.config.d/netconf
- /etc/lanmon/lanconfig.ascii

The following subsections describe the configurable parameters in each of these files.

HP APA Parameters for Link Aggregates — hp_apaconf

Following are the descriptions of the parameters in the /etc/rc.config.d/hp_apaconf file:



NOTE You must set each of the supported parameters on a specific link aggregate prior to aggregating any physical ports. All of the link aggregate configuration parameters begin with HP_APA.

HP_APA_DEFAULT_PORT_MODE The default way to configure link aggregates is now through MANUAL port configuration mode—formerly it was automatic (FEC_AUTO). Ensure that switch ports and server ports are set to the same trunking mode (MANUAL or AUTO), duplexity, and speed. Disable PAgP or LACP on any switch ports not intended to be used with APA. There are two variables governing the mode of ports:

- **HP_APA_DEFAULT_PORT_MODE** in the /etc/rc.config.d/hp_apaconf file. Sets the default APA configuration mode for all ports. The recommended mode is MANUAL. The APA product is shipped with the entry in the hp_apaconf file set to:
HP_APA_DEFAULT_PORT_MODE=MANUAL.
- **HP_APAPORT_CONFIG_MODE** in the /etc/rc.config.d/hp_apaportconf file. Sets the APA configuration mode for a single port. This variable takes precedence.

A port's mode will be set to the value of HP_APA_DEFAULT_PORT_MODE, unless you specify its mode using the HP_APAPORT_CONFIG_MODE variable. The HP_APA_DEFAULT_PORT_MODE parameter sets the mode for all ports. However, HP_APAPORT_CONFIG_MODE can override it.

Example 1:

Suppose the configuration mode of a port is not set with HP_APAPORT_CONFIG_MODE and HP_APA_DEFAULT_PORT_MODE is not set. For HP-UX 11.0 and 11i v1, this results in the port's configuration mode being FEC_AUTO. For HP-UX 11i v2, this results in the port's configuration mode being MANUAL.

Example 2:

Suppose the configuration mode of a port is not set with HP_APAPORT_CONFIG_MODE, and HP_APA_DEFAULT_PORT_MODE is set to MANUAL. This results in the port's configuration mode being MANUAL.

Example 3:

Suppose the configuration mode of a port is set to FEC_AUTO with HP_APAPORT_CONFIG_MODE, and HP_APA_DEFAULT_PORT_MODE is set to MANUAL. This results in the port's configuration mode being FEC_AUTO.

HP_APA_GROUP_CAPABILITY FEC_AUTO (11i v1 & 11iv2) or MANUAL (11i v1) only. An integer value used to determine which network physical ports can be aggregated into a common PAgP link aggregate. Set the group capability to be the same for all network physical ports in the same link aggregate. Ports going to different link aggregates should have different group capabilities. This value must match the value of

HP_APA_HOT_STANDBY	<p>HP_APAPORT_GROUP_CAPABILITY in the <code>/etc/rc.config.d/hp_apaportconf</code> file.</p> <p>Configure a link aggregate for Hot Standby mode. This parameter is mutually exclusive with the HP_APA_LOAD_BALANCE parameter. In addition, HP_APA_HOT_STANDBY takes precedence over the HP_APA_LOAD_BALANCE parameter. The permissible values are <code>on</code> and <code>off</code>. The default is <code>off</code>. For HP APA releases prior to March 2002:</p>
	<hr/> <p> CAUTION For most versions of HP-UX, use lowercase text when specifying <code>on/off</code> for HP_APA_HOT_STANDBY in <code>/etc/rc.config.d/hp_apaconf</code>. Uppercase might cause errors. This caution does not apply to HP APA running on HP-UX 11i v2 systems.</p> <hr/>
HP_APA_INIT_ARGS	<p>The HP_APA_INIT_ARGS are reserved by HP; they are not customer changeable.</p>
HP_APA_INTERFACE_NAME	<p>Name of link aggregate (lan900, lan901, and so on).</p>
HP_APA_KEY	<p>LACP_AUTO only. An integer value that determines which network physical ports can be aggregated into a common LACP link aggregate. Set the <i>key</i> to be the same for all network physical ports in the same link aggregate. Ports going to different link aggregates should have different keys. Must match the value of HP_APAPORT_KEY in the <code>/etc/rc.config.d/hp_apaportconf</code> file.</p>
HP_APA_LACP_SYSTEM_ID_MODE	<p>LACP_AUTO only. Directs APA how to set up the LACP System ID. For the AR0505 release of HP-UX 11i v1 (B.11.11.20), PHNE_33116 (B.11.11.17) patch release, and the AR0512 release of HP-UX 11i v2 (B.11.23.10) only. The supported values are as follows:</p> <p>FIRST_APA_PORT Sets the LACP System ID to the first supported HP APA port. This is the default.</p> <p>FIRST_LACP_PORT Sets the LACP System ID to the first active (UP) port that starts LACP.</p>
HP_APA_LOAD_BALANCE_MODE	<p>Defines the load-balancing mode for the specified link aggregate (HP_APA_INTERFACE_NAME). The supported values are as follows:</p> <p>LB_MAC This algorithm uses a portion of the destination MAC address to determine how data flows are distributed across physical ports in a link aggregate. This option is recommended for server-to-switch configurations. This is the default.</p> <p>LB_IP This algorithm uses a portion of the source and destination IP address to determine how data flows are distributed across physical ports in a link aggregate. This option is recommended for server-to-router configurations.</p> <p>LB_PORT This algorithm uses the TCP/UDP source and destination port numbers to distribute traffic across the ports in a link aggregate. This algorithm is recommended for use when connecting two servers in a back-to-back configuration. LB_PORT is the recommended option for this purpose instead of LB_CPU. LB_CPU is obsolete in 11i v2.</p>
	<hr/> <p> NOTE Some IP applications might not have TCP/UDP port numbers, or the TCP/UDP port numbers are encrypted. For such cases, even if you choose LB_PORT, it will fall back to the default LB_MAC.</p> <hr/>
HP_APA_MANUAL_LA	<p>Manually set ports for the specified link aggregate. Specify the ports with PPA numbers. Separate each port by a comma (,).</p>

HP_APA_MAX_LINKAGGS	Sets the maximum number of LinkAggs for the server. The valid range is from 5 to 50. The default value is 50. This value takes effect only after a reboot.
HP_APA_USE_SYSLOG	Enables (1) or disables (0) the logging of status messages to the <code>syslog.log</code> file (for example, when a link aggregate or port fails or comes up). The default value is 0. See Appendix C for sample <code>syslog.log</code> messages and their meaning. For the AR0505 release of HP-UX 11i v1 (B.11.11.20), PHNE_33116 (B.11.11.17) patch release, and the AR0512 release of HP-UX 11i v2 (B.11.23.10) only.

Examples:

- To set the load-balancing mode to port based (LB_PORT) on lan900:


```
HP_APA_INTERFACE_NAME[0]="lan900"
HP_APA_LOAD_BALANCE_MODE[0]="LB_PORT"
HP_APA_HOT_STANDBY[0]="off"
```
- To create a manually formed link aggregate having ports with PPA 2, 3, and 4:


```
HP_APA_INTERFACE_NAME[1]="lan900"
HP_APA_LOAD_BALANCE_MODE[1]="LB_PORT"
HP_APA_HOT_STANDBY[1]="off"
HP_APA_MANUAL_LA[1]="2,3,4"
```



NOTE Ensure that the server and switch are set to the same mode—MANUAL.

APA and LAN Monitor Parameters for Physical Ports — `hp_apaportconf`



NOTE All configuration parameters for physical ports start with `HP_APAPORT`.

Following are the descriptions of the parameters in the `/etc/rc.config.d/hp_apaportconf` file:

HP_APAPORT_CONFIG_MODE	<p>Set the configuration mode for a physical port. The supported values are as follows:</p> <ul style="list-style-type: none"> • <code>FEC_AUTO</code>—Cisco Fast EtherChannel (FEC) will be started on the port. • <code>LACP_AUTO</code>—IEEE 802.3ad Link Aggregation Control Protocol (LACP) will be started on the port. • <code>LAN_MONITOR</code>—FEC or IEEE 802.3ad LACP will be disabled, and the port will be used for LAN Monitor aggregates. • <code>MANUAL</code>—FEC or IEEE 802.3ad LACP will be disabled on the port, and you must therefore manually add or remove it from a specific link aggregate. This is the default configuration mode for all ports that support the HP APA product.
HP_APAPORT_GROUP_CAPABILITY	<p><code>FEC_AUTO</code> (11i v1 & 11i v2) or <code>MANUAL</code> (11i v1) only. An integer value used to determine which network physical ports can be aggregated into a common PAgP link aggregate. Set the group capability to be the same for all network physical ports. The group capability must match the group capability of the desired aggregate that the user wants the port to join. This value is set in the <code>/etc/rc.config.d/hp_apaportconf</code> file. “Planning Your HP APA Configuration” (pg. 33) describes how to choose the group capability for link aggregates. Ports going to different link aggregates should have different group capabilities.</p> <p>The default group capability is 5.</p>
HP_APAPORT_INIT_ARGS	<p>The <code>HP_APAPORT_INIT_ARGS</code> are reserved by HP; they are not customer changeable.</p>

HP_APAPORT_INTERFACE_NAME	Name of physical interface (lan0, lan1, and so on).
HP_APAPORT_KEY	For LACP_AUTO only. An integer value that determines which network physical ports can be aggregated into a common LACP link aggregate. Set the <i>key</i> to be the same for all network physical ports. The key must match the key of the desired aggregate that the user wants the port to join. This value is set in the <code>/etc/rc.config.d/hp_apaconf</code> file. “Planning Your HP APA Configuration” (pg. 33) describes how to choose the key. The default administrative key is 0.
HP_APAPORT_PRIORITY	Set the port priority for the port. The port priority determines which port in a link aggregate will be the primary interface when the link aggregate is set to Hot Standby mode (<code>HP_APA_HOT_STANDBY=on</code>). The default port priority is 0.
HP_APAPORT_SYSTEM_PRIORITY	For LACP_AUTO only. Set the port system priority for the port specified by <code>HP_APAPORT_INTERFACE_NAME</code> . The system priority gives control to the system to resolve waiting ports to be added in a link aggregate. The default system priority is 0.

See [Chapter 4](#) for examples.

3 Configuring APA Using SAM

This chapter contains the following sections:

- "Configuring HP APA Using SAM"
- "Configuring an FEC_AUTO Mode Link Aggregate"
- "Using SAM to Configure a MANUAL Mode Link Aggregate"

Configuring HP APA Using SAM

The GUI-based System Administration Manager (SAM) is the recommended method for configuring HP APA. SAM produces fewer errors and saves your configuration data permanently so configuration does not require a reboot to take effect.

SAM is supported on HP-UX 11.0, 11i v1, and 11i v2 for link aggregation.

SAM permanently saves HP APA configuration values in the following files:

- `/etc/rc.config.d/hp_apaconf`
- `/etc/rc.config.d/hp_apaportconf`

Setting Port Aggregation Modes

You can use the SAM to configure HP APA so that it will aggregate ports in any of the following port aggregation modes:

- FEC_AUTO
- LACP_AUTO
- MANUAL

After you have installed HP APA, it will be in MANUAL port aggregation mode unless you configure it to automatically aggregate eligible ports.



NOTE HP APA also requires that you configure your switches' trunking mode (AUTO or MANUAL) to match the mode being used on the server: Cisco Fast EtherChannel (FEC), IEEE 802.3ad Link Aggregation Control Protocol (LACP), or MANUAL mode.

NOTE You cannot use SAM to configure LAN Monitor. See [Chapter 4](#) for information about editing configuration files for all APA modes and "What Is LAN Monitor?" (pg. 59) information about configuring LAN Monitor mode.

Configuring an FEC_AUTO Mode Link Aggregate

When configuring an automatic link aggregate (FEC_AUTO or LACP_AUTO) using SAM, you configure the link aggregation characteristics first, followed by the port's modes and characteristics.

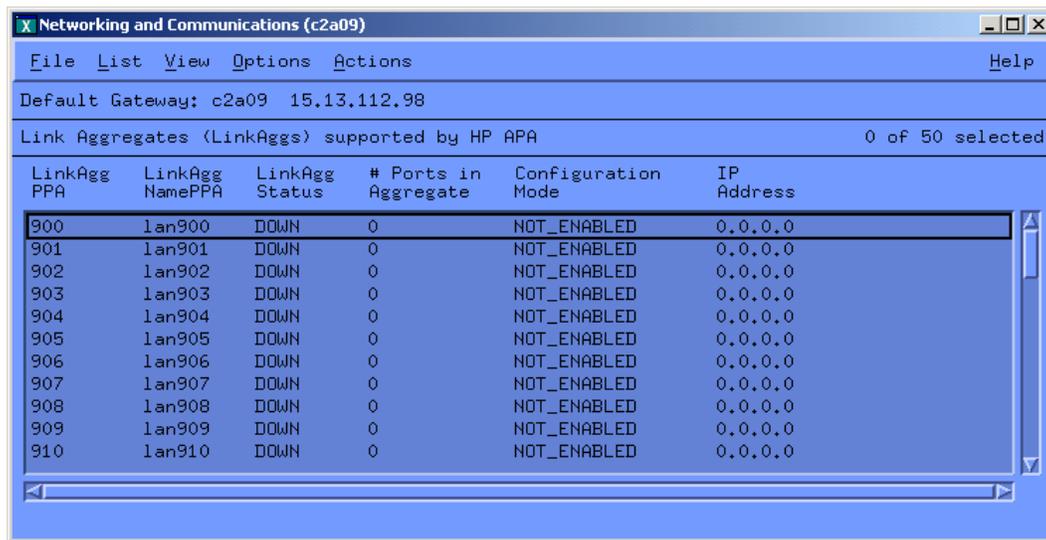
The following example configures an FEC_AUTO link aggregate. Use the same process to configure an LACP_AUTO link aggregate by substituting LACP_AUTO for FEC_AUTO, and *key* for *group_capability*.

1. Log in as superuser.
2. Enter `sam` at the HP-UX system prompt.
3. Double-click **Networking and Communications**, and then **Auto Port Aggregation**. A window like the one in [Figure 3-1](#) appears. The Networking and Communications screen's **List** pull-down menu displays one of the following:
 - Link Aggregates supported by HP APA. This is the list of all available link aggregates in the system.
 - Network Physical Ports that Support HP APA. This is the list of all physical ports in the system that support HP APA.



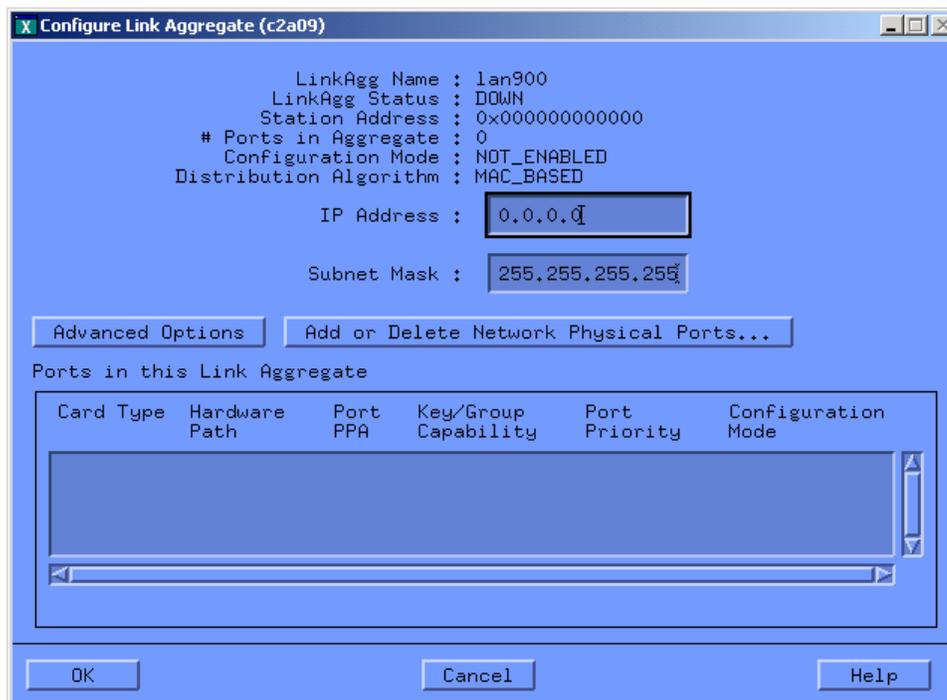
NOTE The starting PPA number for link aggregates varies with the operating system installed: for HP-UX 11.0, it is 100; and for all versions of 11i, it is 900.

Figure 3-1 Displaying Link Aggregates



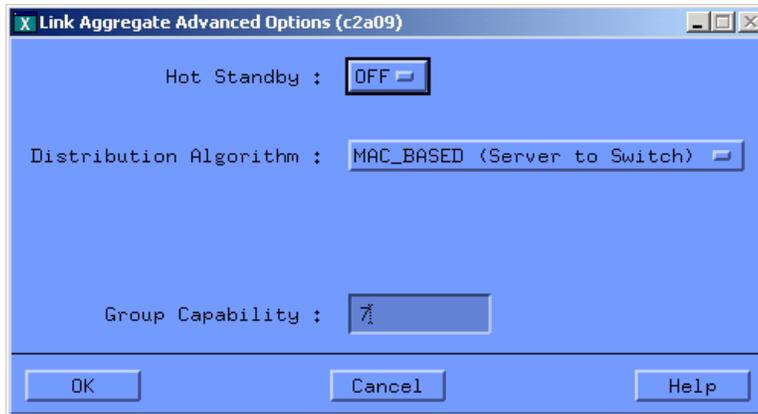
4. Click on the link aggregate to be configured. From the **Actions** pull-down menu choose the **Configure Link Aggregate** option. A window similar to Figure 3-2 will appear.

Figure 3-2 Configuring Link Aggregates



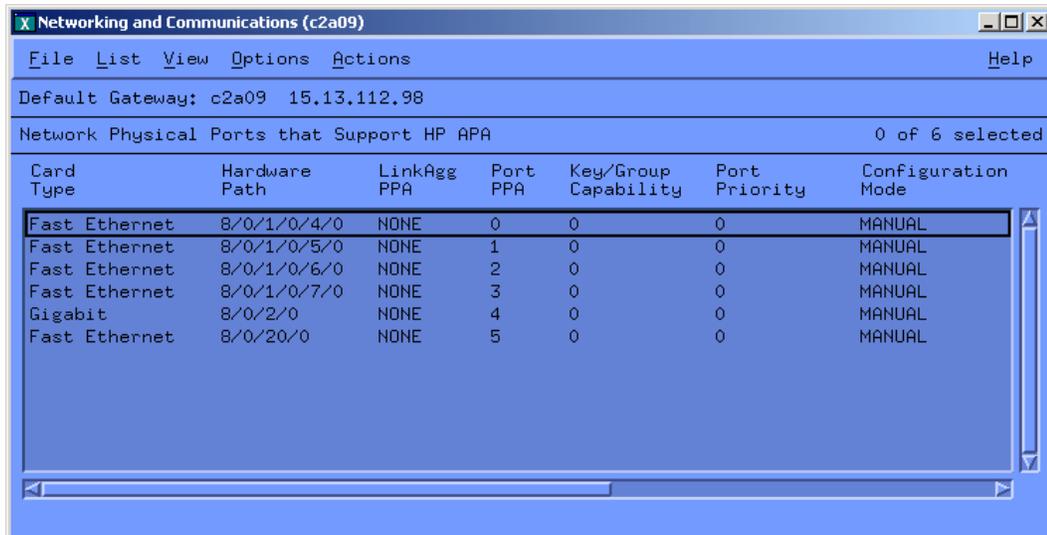
- Click **Advanced Options** to get a window similar to Figure 3-3.

Figure 3-3 Link Aggregate Advanced Options



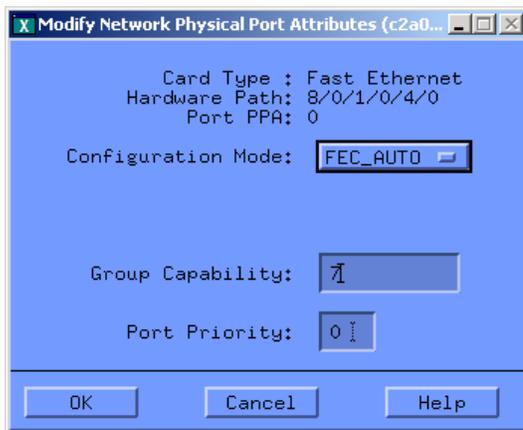
- Verify the correct settings for the load-balancing (distribution) algorithm. If required, make the necessary changes.
- Change the group capability of this link aggregate as required. The group capability should be a nonzero number that differs from the group capability of any other link aggregate. It should also match the group capability that will be assigned later to the ports intended to join the link aggregate. Click **OK**, then click **OK** in the Configure Link Aggregate window.
- Choose the **Network Physical Ports that Support HP APA** option from the **List** pull-down menu. The displayed port configuration mode (column 7 in Figure 3-4) determines the mode for the link aggregation. In Figure 3-4 the configuration mode for the ports that support APA is, by default, set to MANUAL mode. You might need to adjust the horizontal scroll bar to see all the window's fields.

Figure 3-4 Network Physical Ports Supporting HP APA



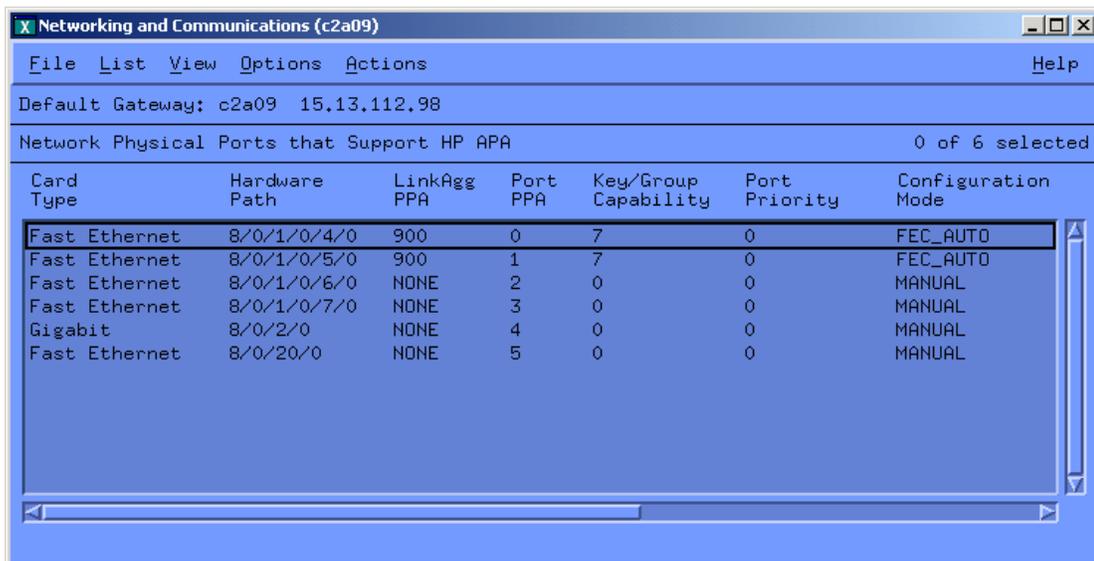
- For each port to be configured in the automatic link aggregation, verify that the port's configuration mode is set to the desired mode: FEC_AUTO. Check that the port's group capability matches the group capability that was previously assigned to the link aggregation. If changes are needed, go to the next step.
- Highlight the port to configure by clicking on the port designated by its PPA.
- In the **Actions** pull-down menu, choose the **Modify Network Physical Port Attributes** option. You will see a window like the one in Figure 3-5.

Figure 3-5 Modify Network Physical Port Attributes



12. In this window, make the necessary changes and click **OK**.
13. Repeat steps 8 through 12 to configure the remaining ports to be in the aggregate. Figure 3-6 shows a sample FEC_AUTO configuration using ports 0 and 1 with a group capability of 7.

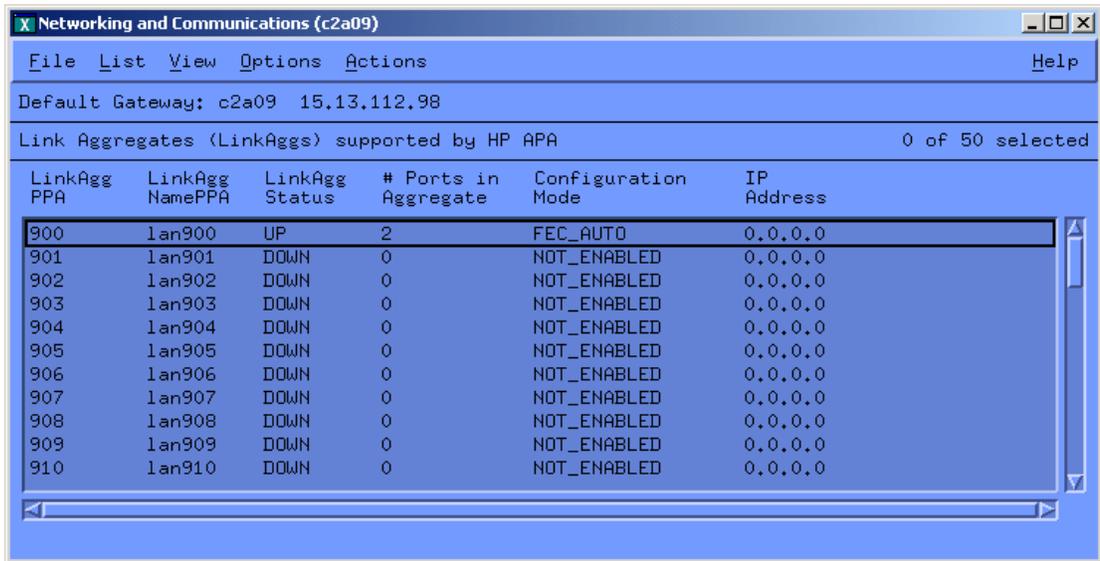
Figure 3-6 Example of Configured Link Aggregates



14. From the **List** pull-down menu, choose the **Link Aggregates Supported by HP APA** option. A window similar to Figure 3-7 will appear. Note that the link aggregate might not have a status of UP immediately because HP APA and the switch or link partner might not have completed the negotiation required for forming the link aggregation.

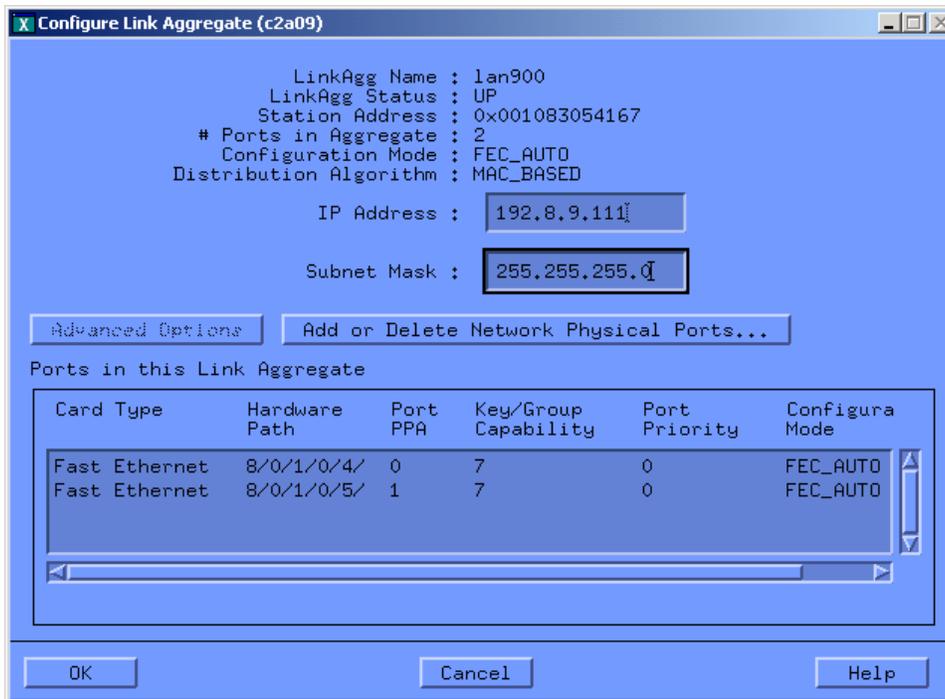
Wait for the link aggregate to change status to LINK_UP. Then, configure the IP address on the link aggregate and continue with the next step.

Figure 3-7 Status of Configured Link Aggregate is UP



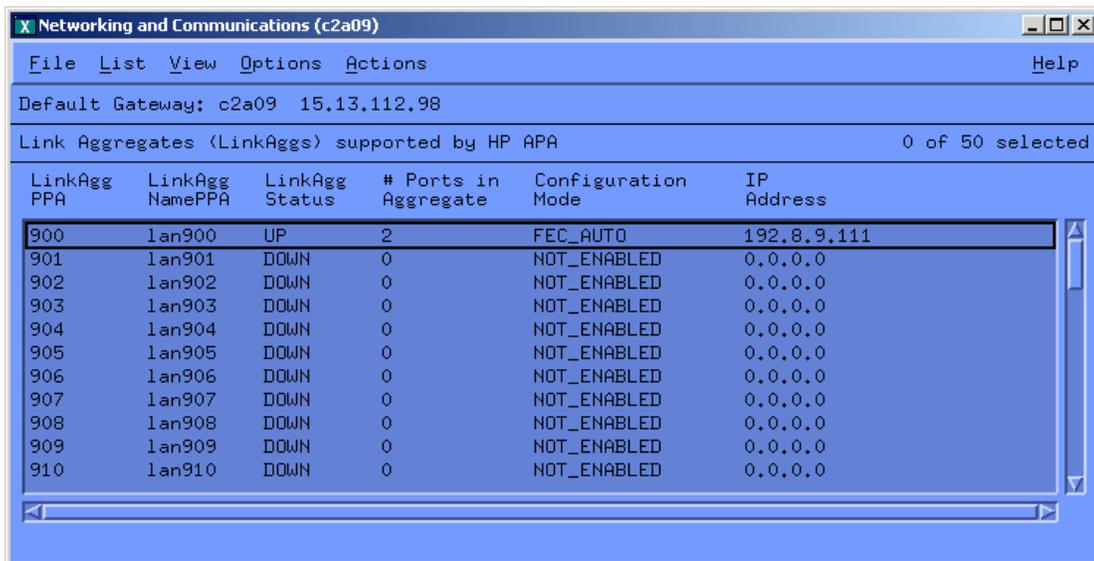
- Click once again on the link aggregate being configured. Then from the **Actions** pull-down menu, choose the **Configure Link Aggregate** option. A window like that in Figure 3-8 will appear.

Figure 3-8 Configuring Link Aggregates



- Fill in the desired IP address and subnet mask to be used for the link aggregate. Then click **OK**. A window like that in Figure 3-9 will appear.

Figure 3-9 Link Aggregate with Configured IP Address



Perform one of the following:

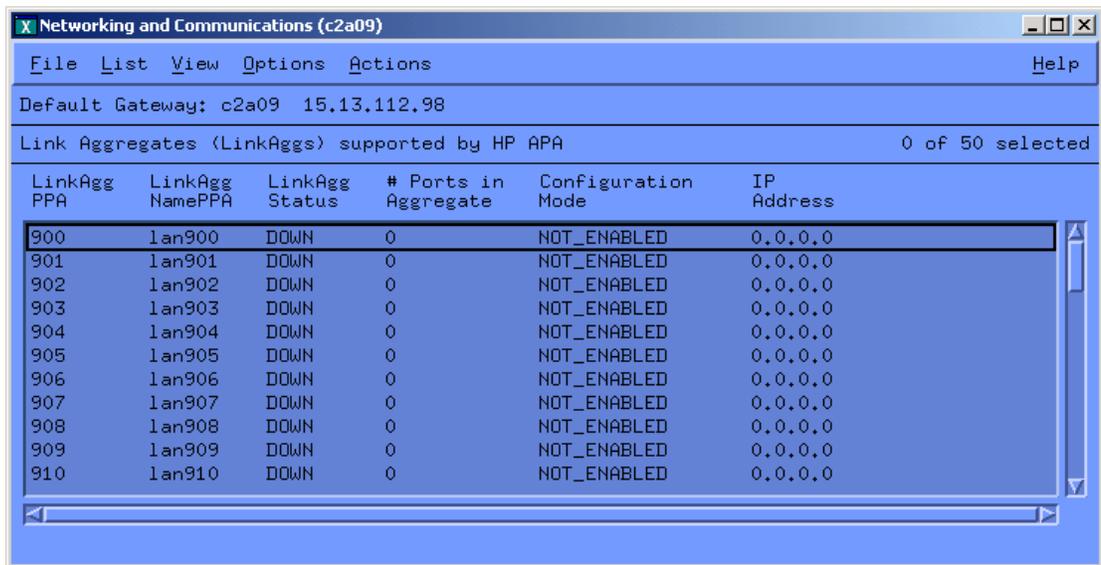
- If the link aggregate has a status of UP
the configuration is complete. Exit SAM. Verify that the proper ports are configured in the proper link aggregation with the `lanadmin -x -v 900` command.
- If the link aggregate is DOWN
If the switch has not been configured, then exit SAM and configure the switch. The APA configuration will have been permanently saved and can be modified later if needed. If the switch has been configured, verify the switch and HP APA configuration and make the required changes to bring them into agreement. If the link aggregate still does not form correctly, see Chapter 8.

Using SAM to Configure a MANUAL Mode Link Aggregate

When configuring a manual link aggregate using SAM, you first configure the port's modes and characteristics, then configure the link aggregate characteristics.

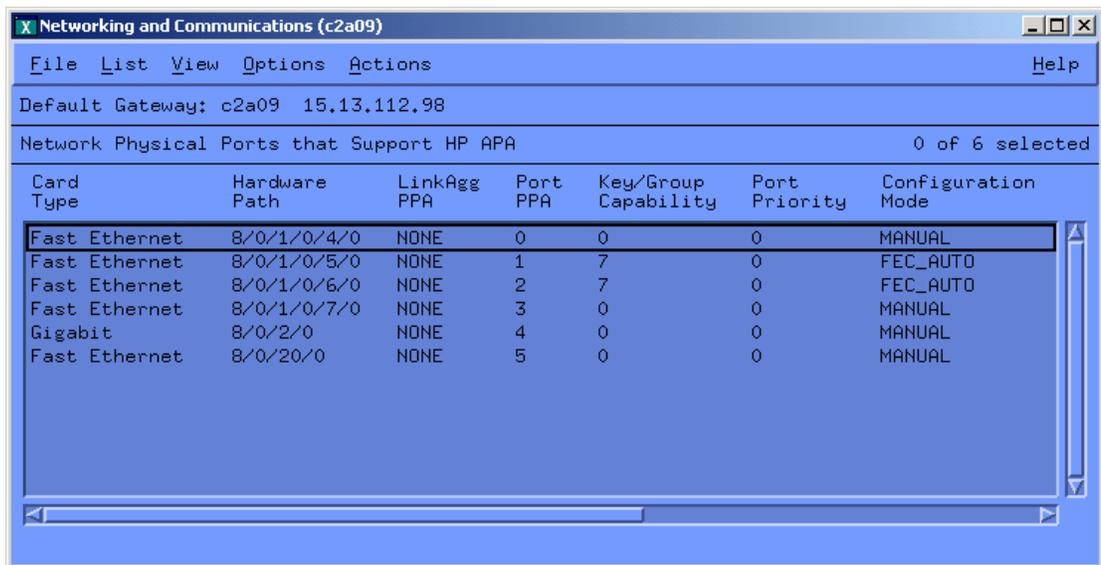
1. Log in as superuser.
2. Enter `sam` at the HP-UX system prompt.
3. Double-click **Networking and Communications**, and then **Auto Port Aggregation**. A window like the one in Figure 3-10 appears. The Networking and Communications screen **List** pull-down menu (Figure 3-10) displays either of the following:
 - Link Aggregates supported by HP APA. This is the list of all available link aggregates in the system.
 - Network Physical Ports that Support HP APA. This is the list of all physical ports in the system that support HP APA.

Figure 3-10 Link Aggregates Supporting HP APA



- Choose the **Network Physical Ports that Support HP APA** option from the **List** pull-down menu. The port configuration mode (shown in column 7 in Figure 3-11) determines the mode for the link aggregate. In Figure 3-11, the configuration mode for the ports that support HP APA is, by default, set to MANUAL mode. You might need to adjust the horizontal scroll bar to see all the window's fields.

Figure 3-11 Network Physical Ports Supporting APA



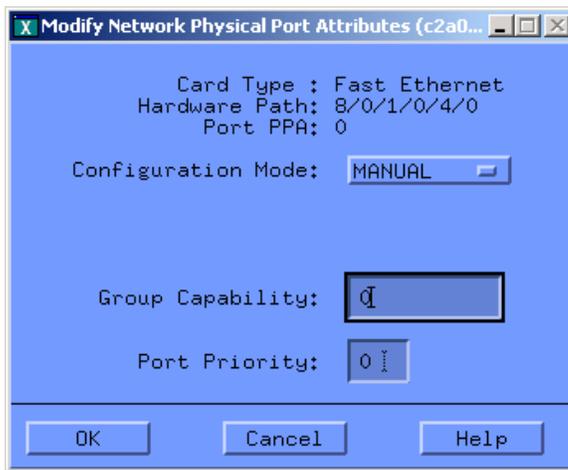
- For each port to be configured in the manual link aggregate, verify that the port's configuration mode is set to the desired mode: MANUAL. Choose a **Group Capability Number** for each port and also for the aggregation. If changes are needed, go to the next step.



NOTE Set the group capability to be the same as that of the link aggregate to which it belongs. Ports going to different link aggregates should have different group capability numbers.

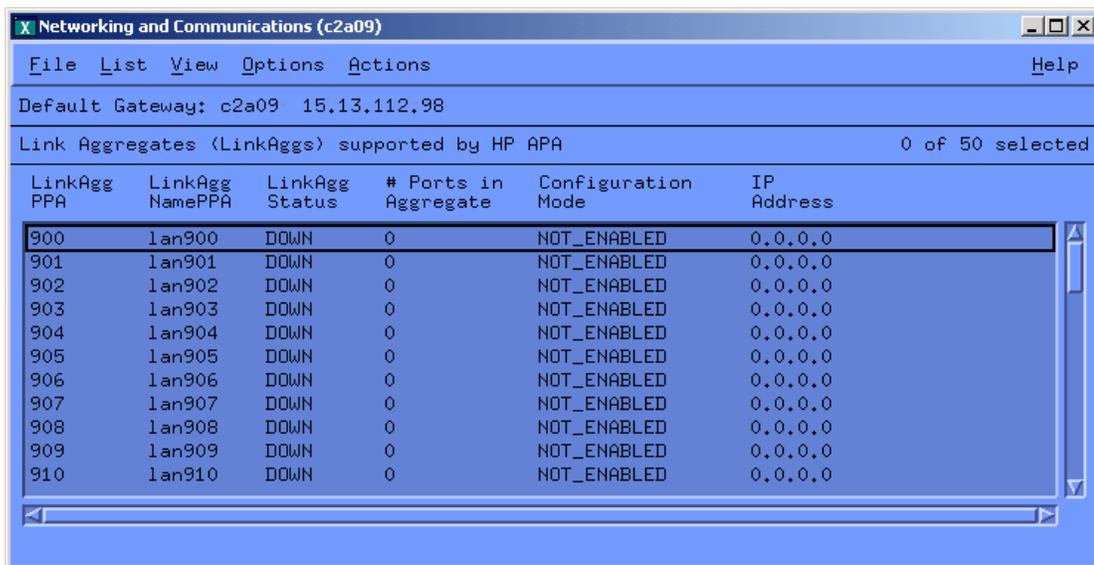
- Highlight the port to configure by clicking on the port designated by its PPA.
- In the **Actions** pull-down menu, choose the **Modify Network Physical Port Attributes** option. A window similar to the one in Figure 3-12 appears.

Figure 3-12 Modify Network Physical Port Attributes



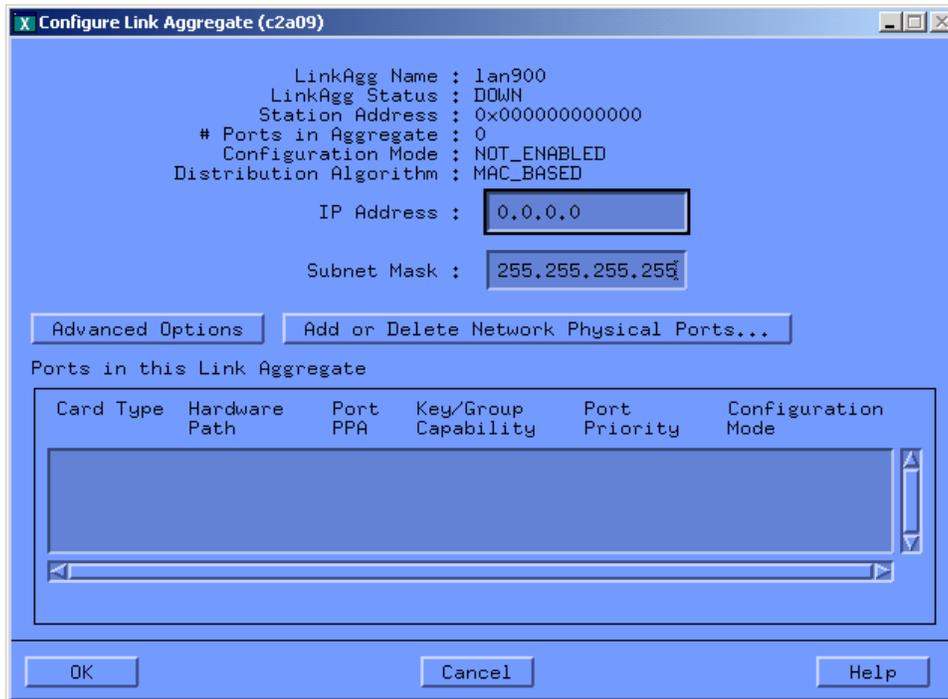
8. In this window make the necessary changes and click **OK**.
9. Repeat steps 4 through 7 to configure the remaining ports to be in the aggregate.
10. To configure the link aggregate characteristics, choose the **Link Aggregates supported by HP APA** option from the **List** pull-down menu. A window similar to Figure 3-13 appears.

Figure 3-13 Display Link Aggregates to Configure



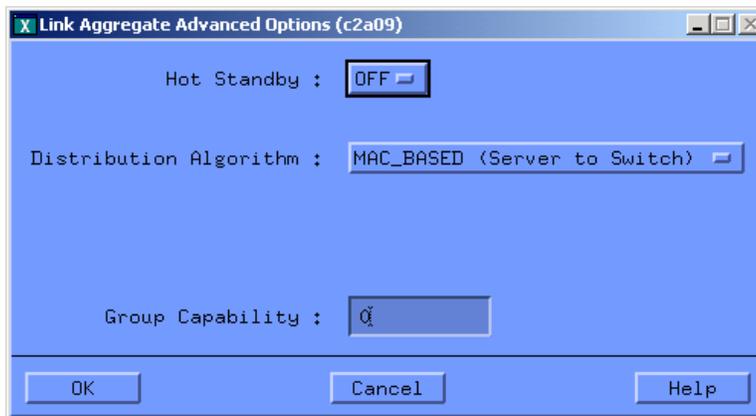
11. Click on the link aggregate being configured. Then, from the **Actions** pull-down menu, choose the **Configure Link Aggregate** option. A window similar to Figure 3-14 appears.

Figure 3-14 Configuring Link Aggregates



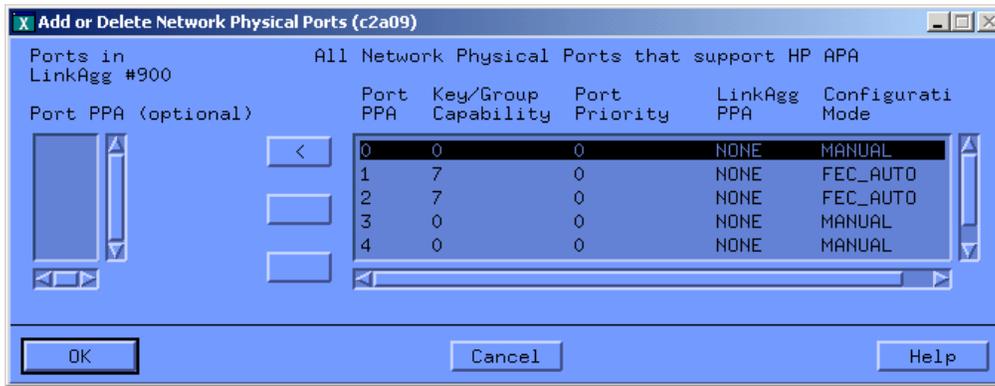
12. Fill in the desired IP address and subnet mask to be used for the link aggregate.
13. Click the **Advanced Options** button to display a window similar to Figure 3-15.

Figure 3-15 Link Aggregate Advanced Options



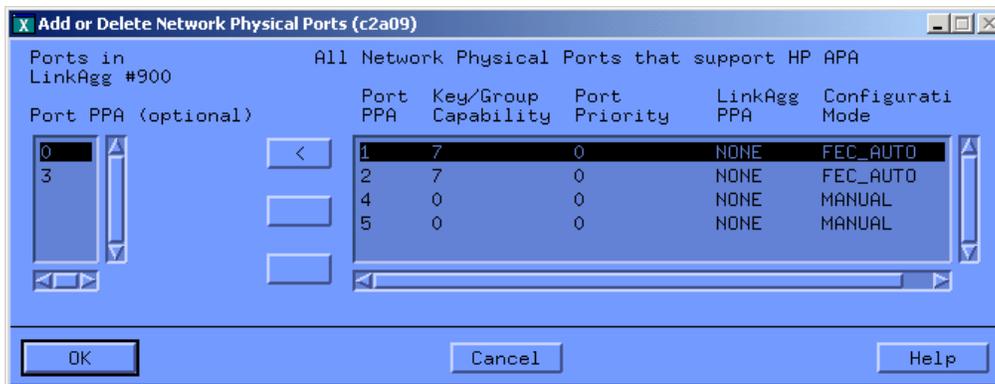
14. Verify the correct settings for the Group Capability (11i v1), assigned in step 4, and either Hot Standby or the load balancing (distribution) algorithm (not both). Make the necessary changes, if required. Then click **OK**.
15. Click **Add or Delete Network Physical Ports**. A window similar to Figure 3-16 appears.

Figure 3-16 Adding Ports to or Deleting Ports from Link Aggregate



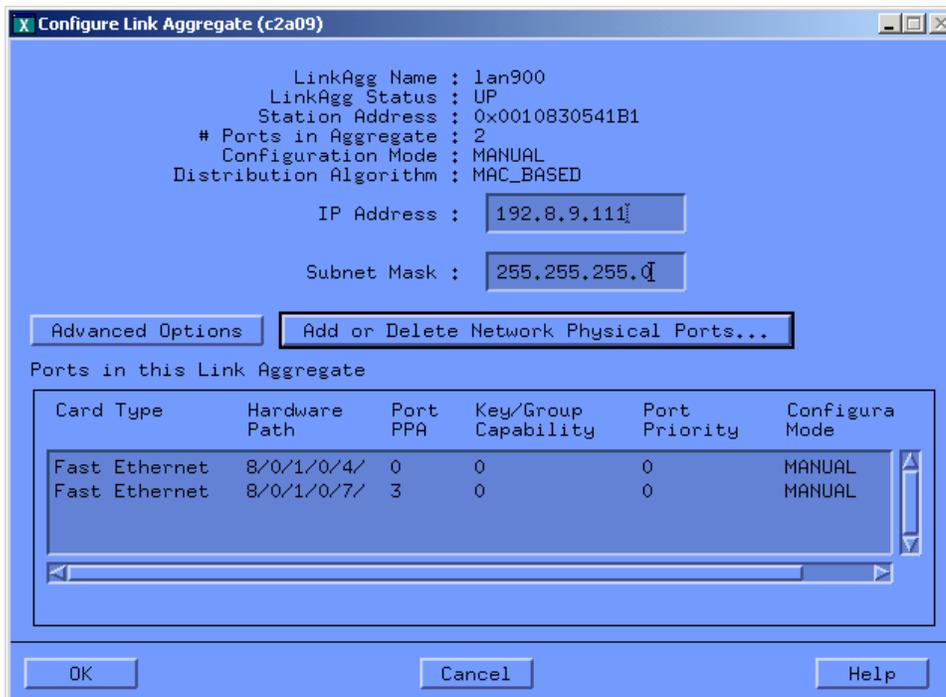
- Highlight a port to be included in the link aggregate. Then use < to move it into the link aggregate. Figure 3-17 shows the result of moving 1an0 and 1an3 into the link aggregate, 1an900.

Figure 3-17 Adding Ports to or Deleting Ports from Link Aggregate



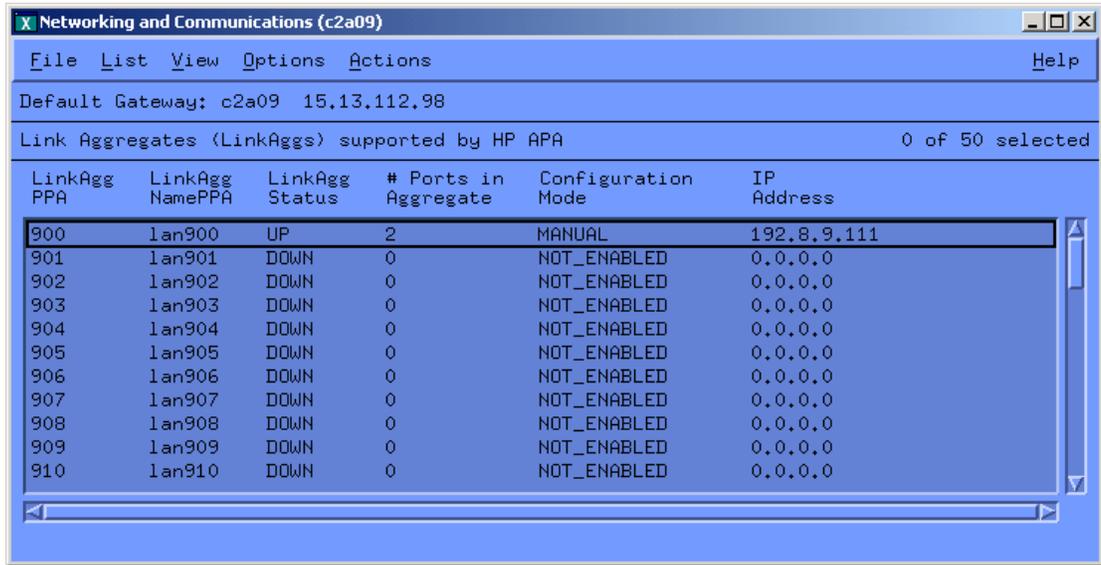
- Click **OK** to see the Configure Link Aggregates window (Figure 3-18) with all the link aggregate information filled in.

Figure 3-18 Configured Link Aggregates Display



- Clicking **OK** displays the original window (Figure 3-19). It now shows lan900 configured as a **MANUAL** mode link aggregate.

Figure 3-19 Link Aggregate Displays with Status UP



LinkAgg PPA	LinkAgg NamePPA	LinkAgg Status	# Ports in Aggregate	Configuration Mode	IP Address
900	lan900	UP	2	MANUAL	192.8.9.111
901	lan901	DOWN	0	NOT_ENABLED	0.0.0.0
902	lan902	DOWN	0	NOT_ENABLED	0.0.0.0
903	lan903	DOWN	0	NOT_ENABLED	0.0.0.0
904	lan904	DOWN	0	NOT_ENABLED	0.0.0.0
905	lan905	DOWN	0	NOT_ENABLED	0.0.0.0
906	lan906	DOWN	0	NOT_ENABLED	0.0.0.0
907	lan907	DOWN	0	NOT_ENABLED	0.0.0.0
908	lan908	DOWN	0	NOT_ENABLED	0.0.0.0
909	lan909	DOWN	0	NOT_ENABLED	0.0.0.0
910	lan910	DOWN	0	NOT_ENABLED	0.0.0.0

- The link aggregate is configured. Configure the next **MANUAL** mode link aggregate, or exit by choosing the **Exit** option from the **File** pull-down menu.

4 Configuring HP APA by Editing Files

Editing Configuration Files for All APA Modes

This chapter is for configuring the three modes associated with port aggregation. To configure LAN Monitor mode, see [Chapter 5](#).

Beginning with the December 2001 release, HP Auto Port Aggregation (HP APA) is shipped with the default port configuration mode set to MANUAL. The value in the `/etc/rc.config.d/hp_apaconf` file is `HP_APA_DEFAULT_PORT_MODE=MANUAL`. You can then specify any of the four port configuration modes before activating the product.

For release-specific information, refer to the release notes on your system in the `/opt/networkdocs` directory or on the Web at:

<http://www.docs.hp.com>



IMPORTANT The following information applies to each of the `hpapa start` / `hpapa stop` sequences listed on the following pages.

If you are configuring more than one of the four port-configuration modes described here and in the next chapter, minimize the number of times you have to enter `hpapa stop` (which can interrupt traffic on existing link aggregates) by editing all configuration files first. You then only need to enter one series of `hplm stop` (optional), `hpapa stop`, `hpapa start`, and `hplm start` (optional) commands to activate the link aggregates and failover groups.



NOTE HP APA also requires that you configure the trunking mode (AUTO or MANUAL) of your switches to match the mode being used on the server: Cisco Fast EtherChannel (FEC), IEEE 802.3ad Link Aggregation Control Protocol (LACP), or MANUAL mode.

Edit Files for MANUAL, FEC_AUTO, or LACP_AUTO Modes

1. Ensure that the switch ports and the HP LAN card ports are set to the same APA (or “trunking”) mode (MANUAL or AUTO), speed, and duplex mode.
2. Enter `lanadmin` interactively if you need to verify that all HP LAN card ports intended for aggregation are connected to the LAN.
3. When numbering the PPAs of your link aggregations, use the following numbers as the starting point:
 - 900 (for all versions of HP-UX 11i)
 - 100 (for HP-UX 11.0)



NOTE The following examples are for all versions of HP-UX 11i.

MANUAL Port Configuration Mode

Edit the following values in the `/etc/rc.config.d/hp_apaconf` file. Example: to put `lan1` and `lan2` into link aggregate 900 with MAC-based load balancing:

```
HP_APA_INTERFACE_NAME[0]=lan900
HP_APA_LOAD_BALANCE_MODE[0]=LB_MAC
HP_APA_MANUAL_LA[0]="1,2"
```

Edit the following values in the `/etc/rc.config.d/hp_apaportconf` file. If this is the first-time configuration, the `CONFIG_MODE` is already set to the default of MANUAL:

```
HP_APAPORT_INTERFACE_NAME[0]=lan1
HP_APAPORT_CONFIG_MODE[0]=MANUAL
HP_APAPORT_INTERFACE_NAME[1]=lan2
HP_APAPORT_CONFIG_MODE[1]=MANUAL
```

When you are done editing all configuration modes, activate the configuration by entering:

```
# /sbin/init.d/hplm stop 1
# /sbin/init.d/hpapa stop 2
# /sbin/init.d/hpapa start
# /sbin/init.d/hplm start 3
```

- 1 If failover groups are configured.
- 2 This can interrupt traffic on existing link aggregates.
- 3 For configuring failover groups.

FEC_AUTO Port Configuration Mode (Optional)

Set load balancing and group capability in the `/etc/rc.config.d/hp_apaconf` file. For example, to configure link aggregate 901 with MAC-based load balancing, enter:

```
HP_APA_INTERFACE_NAME[0]=lan901
HP_APA_LOAD_BALANCE_MODE[0]=LB_MAC
HP_APA_GROUP_CAPABILITY[0]=901
```

Edit the following values in the `/etc/rc.config.d/hp_apaportconf` file. For example, to put `lan1` and `lan2` into link aggregate 901:

```
HP_APAPORT_INTERFACE_NAME[0]=lan1
HP_APAPORT_GROUP_CAPABILITY[0]=901
HP_APAPORT_CONFIG_MODE[0]=FEC_AUTO
```

```
HP_APAPORT_INTERFACE_NAME[1]=lan2
HP_APAPORT_GROUP_CAPABILITY[1]=901
HP_APAPORT_CONFIG_MODE[1]=FEC_AUTO
```



NOTE Set the group capability in the previous examples to be the same as that of the link aggregate to which it belongs. Ports going to different link aggregates should have different group capabilities.

If you are done editing all configuration modes, activate the configuration by entering:

```
# /sbin/init.d/hplm stop 1
# /sbin/init.d/hpapa stop 2
# /sbin/init.d/hpapa start
# /sbin/init.d/hplm start 3
```

- 1 If failover groups are configured.
- 2 This can interrupt traffic on existing link aggregates.
- 3 For configuring failover groups.

LACP_AUTO Port Configuration Mode (Optional)

Set load balancing and APA port key in the `/etc/rc.config.d/hp_apaconf` file.

For example, to configure link aggregate 902 with MAC-based load balancing, enter:

```
HP_APA_INTERFACE_NAME[0]=lan902
HP_APA_LOAD_BALANCE_MODE[0]=LB_MAC
HP_APA_KEY[0]=902
```

Edit the link aggregate, the apaport key, and the configuration mode in the `/etc/rc.config.d/hp_apaportconf` file.

For example, to put `lan1` and `lan2` into link aggregate 902:

```
HP_APAPORT_INTERFACE_NAME[0]=lan1
HP_APAPORT_KEY[0]=902
HP_APAPORT_CONFIG_MODE[0]=LACP_AUTO
HP_APAPORT_INTERFACE_NAME[1]=lan2
HP_APAPORT_KEY[1]=902
HP_APAPORT_CONFIG_MODE[1]=LACP_AUTO
```



NOTE Set the LACP_AUTO key in the previous examples to be the same as that of the link aggregate to which it belongs. Ports going to different link aggregates should have different keys.

When you are done editing all configuration modes, activate the configuration by entering:

```
# /sbin/init.d/hplm stop 1
# /sbin/init.d/hpapa stop 2
# /sbin/init.d/hpapa start
# /sbin/init.d/hplm start 3
```

- 1** If failover groups are configured.
- 2** This can interrupt traffic on existing link aggregates.
- 3** For configuring failover groups.

Verifying Link Aggregate Status

This section describes the procedure for verifying the status of the link aggregates.

1. Configuration does not require a reboot to take effect. HP APA configuration is complete when you can verify which link aggregates have been formed. Depending on your configuration, there may be 0 or more link aggregates configured.

To verify which link aggregates have been configured, enter either of the following commands:

```
lanscan
```

```
lanscan -v (for a more detailed listing)
```

In the status information, the column titled Hardware Path contains the LinkAgg value for logical link aggregates. The column titled Hdw State shows the state of the link aggregates: UP or DOWN. UP indicates that the link aggregation is operational. DOWN indicates that the link aggregate has been initialized but not configured.

2. To verify that a link aggregate was formed correctly, find the link aggregate PPA (*linkaggPPA*) by entering `lanscan` with the value in the column titled `Crđ In#`, which corresponds to the desired link aggregate. Then, enter:

```
lanadmin -x -v linkaggPPA
```

The following example is for all versions of HP-UX 11i. To verify the physical ports associated with link aggregate PPA 901, enter:

```
lanadmin -x -v 901
```



NOTE When entering the `lanadmin` commands, be aware that the `-x` and `-X` are case sensitive. Options using the lowercase `-x` show status, while those using uppercase `-X` set configuration parameters or modes.

3. To verify all the physical ports in all configured link aggregates, enter:

```
lanscan -q
```

This command lists the Card Instance number for each physical port and for the link aggregates. Data similar to the following output will be displayed:

```
900          5 6 8 7
901
902
903
```

This output shows that link aggregate 900 contains four ports: lan5, lan6, lan8, and lan7.

If no link aggregates are formed, see [Chapter 8](#) for information on how to solve this problem.

Viewing Link Aggregate Characteristics Using lanscan

The `lanscan` command includes the ports in a link aggregate. Use `lanscan -q` to list the physical ports attached to all the link aggregates in the system.

lanscan Output

This section contains examples of output from the `lanscan` command.

Example 4-1 shows `lanscan` output on systems without HP APA installed; it remains the same.

Example 4-1 Sample lanscan Command Output Without HP APA Installed

```
# lanscan
Hardware Station      Crd Hdw   Net-Interface  NM  MAC      HP-DLPI  DLPI
Path      Address          In# State NamePPA        ID  Type     Support  Mjr#
10/4/8.1  0x080009B7C158  6   UP    lan6 snap6       1   ETHER    Yes      119
8/0/1/0   0x0060B0220001  0   UP    lan0 snap0       2   ETHER    Yes      119
8/0/2/0   0x0060B0220002  1   UP    lan1 snap1       3   ETHER    Yes      119
8/4/2/0   0x0060B04B2B43  3   UP    lan3 snap3       4   ETHER    Yes      119
8/8/2/0   0x0060B04BAB85  5   UP    lan5 snap5       5   ETHER    Yes      119
8/4/1/0   0x0060B04B2B42  2   UP    lan2 snap2       6   ETHER    Yes      119
8/8/1/0   0x0060B04BAB84  4   UP    lan4 snap4       7   ETHER    Yes      119
10/12/6   0x080009F0165D  7   UP    lan7 snap7       8   ETHER    Yes      119
```

Example 4-2 shows `lanscan` output on the same machine with link aggregation enabled. In this example, the link aggregate `lan900` is formed of ports `lan2`, `lan3`, `lan4`, and `lan5`. The output suppresses the information on `lan2`, `lan3`, `lan4`, and `lan5` because these ports cannot be used by themselves any longer. You can only see `lan900`.

Example 4-2 Sample lanscan Command Output with HP APA Installed

```
# lanscan
Hardware Station      Crd Hdw   Net-Interface  NM  MAC      HP-DLPI  DLPI
Path      Address          In# State NamePPA        ID  Type     Support  Mjr#
10/4/8.1  0x080009B7C158  6   UP    lan6 snap6       1   ETHER    Yes      119
8/0/1/0   0x0060B0220001  0   UP    lan0 snap0       2   ETHER    Yes      119
8/0/2/0   0x0060B0220002  1   UP    lan1 snap1       3   ETHER    Yes      119
10/12/6   0x080009F0165D  7   UP    lan7 snap7       8   ETHER    Yes      119
LinkAgg0  0x0060B04BAB84  900 UP    lan900 snap900 10   ETHER    Yes      119
LinkAgg1  0x000000000000  901 DOWN  lan901 snap901 11   ETHER    Yes      119
LinkAgg2  0x000000000000  902 DOWN  lan902 snap902 12   ETHER    Yes      119
LinkAgg3  0x000000000000  903 DOWN  lan903 snap903 13   ETHER    Yes      119
LinkAgg4  0x000000000000  904 DOWN  lan904 snap904 14   ETHER    Yes      119
```

Example 4-3 shows `lanscan` output with the verbose option. This displays some information specific to the port aggregate. Only a section of `lanscan` output is shown. In this example, `lanscan` prints out information for `lan900`. The information includes the list of ports belonging to the link aggregate (`lan2`, `lan3`, `lan4`, and `lan5`).

Example 4-3 Sample lanscan Verbose Output

```
# lanscan -v
-----
Hardware Station          Crd Hdw  Net-Interface  NM  MAC          HP-DLPI DLPI
Path      Address           In# State NamePPA        ID  Type         Support Mjr#
Link Agg  0x0060B04BAB84  900 UP   lan900 snap900  10  ETHER        Yes     119

Extended Station                               LLC Encapsulation
Address                                         Methods
0x0060B04BAB84                               IEEE HPEXTIEEE SNAP ETHER NOVELL

Driver Specific Information
hp_apa
.....
Hardware Crd Hdw  Net-Interface  NM  MAC  HP-DLPI DLPI  Driver
Path      In# State NamePPA        ID  Type  Support Mjr#  Name
8/8/1/0  4  UP   lan4 snap4      7  ETHER Yes    119  btlan4
8/4/1/0  2  UP   lan2 snap2      6  ETHER Yes    119  btlan4
8/8/2/0  5  UP   lan5 snap5      5  ETHER Yes    119  btlan4
8/4/2/0  3  UP   lan3 snap3      4  ETHER Yes    119  btlan4
```

The following example shows `lanscan` output with the option `-q` (extended print-ppa):

```
# lanscan -q
6
0
1
7
900    4 2 5 3
901
902
903
904
```

Verifying Physical Port Status

1. To verify the status of a specific physical port:
 - a. Find the `PortPPA` value for the desired physical port:
 - i. Enter the `lanscan` command:

```
# lanscan
Hardware Station          Crd Hdw  Net-Interface  NM  MAC          HP-DLPI DLPI
Path      Address           In# State NamePPA        ID  Type         Support Mjr#
0/0/0/0  0x0010837CD231  0  UP   lan0 snap0      1  ETHER        Yes     119
1/3/0/0  0x00306E0410B7  1  UP   lan1 snap1      2  ETHER        Yes     119
0/4/0/0  0x0060B0B3F193  2  UP   lan2 snap2      3  ETHER        Yes     119
0/5/0/0  0x0060B0B3C104  3  UP   lan3 snap3      4  ETHER        Yes     119
0/12/0/0 0x0060B0B3F112  4  UP   lan4 snap4      5  ETHER        Yes     119
```

- ii. Find the desired physical port in the column titled `Hardware Path` (0/4/0/0 in this example)
 - iii. The `PortPPA` for that physical port will be listed in the column titled `Crd In#` (2, in this example)
 - b. Find the link aggregate value (`linkaggPPA`) for the desired port. See step 3 in “Verifying Link Aggregate Status” (pg. 55).
 - c. Using the `portPPA` and `linkaggPPA` values found in the previous steps, enter the following command:

```
lanadmin -x -p portPPA linkaggPPA
```

For example, to verify that the port with PPA number 2 has successfully completed FEC negotiation, enter:

```
lanadmin -x -p 2 100
```

The output from this command should show a field called Port State. The value of the field should be UP. If not, then you might have a configuration problem. See [Chapter 8](#) for information on how to solve this problem.

2. To verify that a link aggregate was formed correctly, enter:

```
lanadmin -x -v linkaggPPA
```

For example, to verify that ports with PPA numbers 2, 3, 8, and 9 were successfully added to link aggregate with PPA number 101, enter:

```
lanadmin -x -v 101
```



CAUTION If you change some link aggregate variables using the `lanadmin` command, those changes are not preserved after reboots. If you use `lanadmin`, you also need to edit the two configuration files `/etc/rc.config.d/hp_apaconf` and `/etc/rc.config.d/hp_apaportconf`.

3. To obtain additional information on options for the `lanadmin` command, enter:

```
lanadmin -X -H linkaggPPA
```

where `linkaggPPA` can be any valid link aggregate number.

5 What Is LAN Monitor?

LAN Monitor Overview

The LAN Monitor mode of HP APA provides a failover capability with configuration tools similar to HP Serviceguard. LAN Monitor does not support HP Serviceguard. In the event of link failure, LAN Monitor automatically migrates the data flow from the primary link to one of the standby links in the failover group.

This chapter describes how to configure the LAN_MONITOR mode. For details on configuring the FEC_AUTO, MANUAL, and LACP modes, see Chapter 3 and Chapter 4.

LAN Monitor Features

- High availability and fast failover of network interfaces. For the AR0505 release of HP-UX 11i v1 (B.11.11.20) and PHNE_33116 (B.11.11.17) patch release, this also includes proactive failover.
- The ability to make link aggregates part of the failover group.
- Support for all LAN technologies: 100BT, Gigabit, 10 Gigabit Ethernet, FDDI, and Token Ring.
- Automatic failover group discovery and configuration commands (`lanqueryconf`, `lanapplyconf`, `lancheckconf`, `landeleteconf`).
- Support for SNMP (interface MIB only).
- Support for the following platforms:
 - HP-UX 11.0 and 11i: All except T-class
 - HP-UX 11i v2: All supported platforms
- For the AR0512 release of HP-UX 11i v2 (B.11.23.10), support for IPv6 configuration over failover groups.

Proactive Failover (HP-UX 11i v1 (B.11.11.20) Only)

By default, the port in a failover group with the highest priority is the primary active port. However, with proactive failover, the port that is the most efficient at carrying traffic is the active port. Efficiency is determined by assigning a cost to each port in a failover group. This cost is divided by the port's current link speed to yield a normalized port cost; link speed is the number of links in a link aggregate multiplied by the speed of the links, or in the case of a single link, only the link speed. The lower the normalized port cost, the higher the link's efficiency. If two links have the same normalized cost, the one with the higher priority is preferred.

For each failover group, if you assign a cost value to one link, you must assign a cost value to all other links in the group. If you do not specify a cost value for any of the failover group's links, then the failover group uses the default failover behavior based on priority.

During certain LAN Monitor events, the normalized port cost might change on the active or standby links. When these events occur, the normalized port cost of the active link and the standby links are compared. If a standby link has a lower normalized port cost than the active link, the standby link becomes the active port.

IPv6 Support (HP-UX 11i v2 (B.11.23.10) Only)

LAN monitor recognizes and supports IPv6 configuration over primary ports and failover groups. The following list summarizes this support:

- The `lanqueryconf` command recognizes a primary port that has an IPv6 address configured. The `/etc/lanmon/lanconfig.ascii` file generated by `lanqueryconf` will contain an IPv6 address in the `STATIONARY_IP` field.
If both an IPv4 address and an IPv6 address are configured on a primary port, the ASCII file generated by `lanqueryconf` will contain an IPv4 address in the `STATIONARY_IP` field.
- If you manually edit the ASCII file, you can specify either an IPv4 address or IPv6 address as the `STATIONARY_IP` address. See “Configuring LAN Monitor Failover Groups” (pg. 60) for a sample failover group entry with an IPv6 address.
- The `lanapplyconf` command does not require that the IP address specified in the ASCII file and the IP address configured on the primary port be identical.

Configuring LAN Monitor Failover Groups

If this is the first time you have configured a LAN Monitor failover group, or if you have changed the LAN Monitor configuration, do the following:

1. Connect the physical devices that are to be in the failover group to the same switch, or to different switches or hubs on the same subnet to achieve switch/hub redundancy.



NOTE Be sure that trunking is not enabled on the switch ports.

2. Check that a `linkloop` between the devices succeeds. If it fails, resolve the physical connection between the devices.
3. In the `/etc/rc.config.d/hp_apaportconf` file, assign the primary and standby physical ports to `LAN_MONITOR` mode.

For example, to put `lan1` and `lan2` into a failover group:

```
HP_APAPORT_INTERFACE_NAME[0]=lan1
HP_APAPORT_CONFIG_MODE[0]=LAN_MONITOR
```

```
HP_APAPORT_INTERFACE_NAME[1]=lan2
HP_APAPORT_CONFIG_MODE[1]=LAN_MONITOR
```

4. Activate the configuration by entering:

```
# /sbin/init.d/hplm stop 1
# /sbin/init.d/hpapa stop
# /sbin/init.d/hpapa start
# /sbin/init.d/hplm start
```

1 An error message similar to `ERROR: Unable to open /etc/lanmon/lanconfig for reading. might appear. Ignore the message.`

5. If the device to be the primary link does not have the desired IP address, add the IP address for the primary port or primary link aggregation to `/etc/rc.config.d/netconf`. Editing that file or using SAM will preserve the IP address permanently (across reboots).

Alternatively, you can also temporarily assign an IP address to the primary link and change the mode of the primary link and all standby links to `LAN_MONITOR`. For example, `ifconfig lan1 192.5.5.138`

6. Query the system for possible link failover groups by entering `lanqueryconf -s`.



CAUTION Running `lanqueryconf -s` will overwrite the original `/etc/lanmon/lanconfig.ascii` file.

This command queries the system and network for all possible failover groups. The results of the query are placed in the `/etc/lanmon/lanconfig.ascii` configuration file. This file should contain data similar to the following:

```
NODE_NAME                hpserver1
POLLING_INTERVAL        10000000
DEAD_COUNT              3
LM_RAPID_ARP            off
LM_RAPID_ARP_INTERVAL  1000000
LM_RAPID_ARP_COUNT      10
FAILOVER_GROUP          lan900
    STATIONARY_IP      192.1.1.1
    STANDBY            lan11    3
    PRIMARY            lan10    5
```

You can edit this file and change the number of ports in the failover groups, the dead count, poll interval, rapid ARP setting, rapid ARP interval, rapid ARP count, and stationary IP address. The following example shows a failover group entry that contains an IPv6 address (AR0512 release only):

```
FAILOVER_GROUP          lan901
    STATIONARY_IP      fe80::1
    STANDBY            lan11    3
    PRIMARY            lan4     5
    PRIMARY            lan1     3
    PRIMARY            lan2     3
    PRIMARY            lan3     3
```

7. Verify that the configuration in `/etc/lanmon/lanconfig.ascii` is still valid by using the `lancheckconf` command.
8. Create the failover groups specified in the configuration file by using the `lanapplyconf` command. This command creates the specified failover groups and the `/etc/lanmon/lanconfig` binary configuration file. Check the failover groups by using the `lanscan -q` and `netstat -in` commands.



NOTE If you later want to delete all the failover groups created, enter the `landeleteconf` command.

9. The failover group is now operational. A reboot will restart the failover group as long as the `/etc/lanmon/lanconfig.ascii` file is intact.

Example: Configuring a LAN Monitor Failover Group

Suppose you want to configure a simple, two-port LAN Monitor failover group on a K-class system. You enter the `netstat` and `ioscan` commands as follows:

```
# netstat -in
Name Mtu  Network      Address      Ipkts        Opkts
lan1 1500   192.1.1.0    192.1.1.153 9504123      12437048
lan0 1500   191.1.1.0    191.1.1.1   11202        257458
lo0  4136   127.0.0.0    127.0.0.1   417          417

# ioscan -fkC lan
Class      I  H/W Path  Driver      S/W State  H/W Type  Description
=====
lan        1  8/8/1/0  btlan4      CLAIMED    INTERFACE  HP HSC 100Base-TX
lan        2  8/8/2/0  btlan4      CLAIMED    INTERFACE  HP HSC 100Base-TX
lan        3  8/12/1/0 btlan4      CLAIMED    INTERFACE  HP HSC 100Base-TX
lan        4  8/12/2/0 btlan4      CLAIMED    INTERFACE  HP HSC 100Base-TX
```

```
lan      0 10/12/6 lan2      CLAIMED      INTERFACE      Built-in LAN
#
```

The netstat output shows that lan1 is currently configured with IP address 192.1.1.153. The ioscan output shows spare HSC 100BT devices lan2, lan3, and lan4.

You decide that lan2 will be the standby link for the failover group, with lan1 as the primary device.

To configure the failover group, do the following:

1. Connect lan1 and lan2 to the same switch or to different switches or hubs on the same subnet.



NOTE Be sure that trunking is not enabled on the switch ports.

2. Obtain the station address for lan2 by issuing the lanscan command, as follows:

```
# lanscan
Hardware Station      Crd Hdw      Net-Interface  NM  MAC      HP-DLPI  DLPI
Path      Address      In# State  NamePPA      ID  Type     Support  Mjr#
8/8/2/0   0x0060B04B7B83 2   UP    lan2 snap2     3   ETHER    Yes      119
8/12/2/0  0x001083953C1D 4   UP    lan4 snap4     4   ETHER    Yes      119
8/8/1/0   0x0060B04B7B82 1   UP    lan1 snap1     5   ETHER    Yes      119
10/12/6   0x080009D43696 0   UP    lan0 snap0     6   ETHER    Yes      119
8/12/1/0  0x001083953C1C 3   UP    lan3 snap3     7   ETHER    Yes      119
LinkAgg0  0x000000000000 900 DOWN  lan900 snap900  9   ETHER    Yes      119
LinkAgg1  0x000000000000 901 DOWN  lan901 snap901 10   ETHER    Yes      119
LinkAgg2  0x000000000000 902 DOWN  lan902 snap902 11   ETHER    Yes      119
LinkAgg3  0x000000000000 903 DOWN  lan903 snap903 12   ETHER    Yes      119
LinkAgg4  0x000000000000 904 DOWN  lan904 snap904 13   ETHER    Yes      119
```

The station address is 0x0060B04B7B83.

3. Verify that a linkloop command between lan1 and lan2 succeeds, as follows:

```
#
# linkloop -i 1 0x0060B04B7B83
Link connectivity to LAN station: 0x0060B04B7B83
-- OK
#
```

If the linkloop fails, resolve the connectivity issue between the devices.

4. Verify that an entry exists in the /etc/rc.config.d/hp_apaportconf file for the primary and standby interfaces that sets the interfaces' port configuration mode to LAN_MONITOR.

```
HP_APAPORT_INTERFACE_NAME[0]=lan1
HP_APAPORT_CONFIG_MODE[0]=LAN_MONITOR

HP_APAPORT_INTERFACE_NAME[1]=lan2
HP_APAPORT_CONFIG_MODE[1]=LAN_MONITOR
```

5. Activate the configuration by entering:

```
# /sbin/init.d/hplm stop !
# /sbin/init.d/hpapa stop
# /sbin/init.d/hpapa start
# /sbin/init.d/hplm start
```

! An error message similar to ERROR: Unable to open /etc/lanmon/lanconfig for reading. might appear. Ignore the message because no failover groups were created.

6. If the device to be the primary link does not have the desired IP address, enter ifconfig to assign the IP address. Also add an entry to the /etc/rc.config.d/netconf file to assign the IP address permanently (or use SAM to do it).

```
# ifconfig lan1 192.1.1.153
```

7. Enter the lanqueryconf -s command to query the system for possible failover groups.

```
# lanqueryconf -s
```

ASCII output is in the `/etc/lanmon/lanconfig.ascii` file.

- a. Verify that the content of the ASCII file is valid. Enter `lancheckconf`:

```
# lancheckconf
```

- b. View the contents of the `/etc/lanmon/lanconfig.ascii` file and verify that it contains the configuration information you want.

```
# cat /etc/lanmon/lanconfig.ascii
```

See the “Configuration Files” (pg. 65) section for an example of this file.

- c. Verify that `/etc/lanmon/lanconfig.ascii` has the failover group configured, as planned.

```
# cat /etc/lanmon/lanconfig.ascii
```

- d. Edit the file, if needed, and enter `lancheckconf` again.

8. Use the `lanapplyconf` command to build the failover group, and check it with the `lanscan -q` and `netstat -in` commands:

```
# lanapplyconf
```

```
Reading ASCII file /etc/lanmon/lanconfig.ascii
```

```
Creating Fail-Over Group lan900
```

```
Updated binary file /etc/lanmon/lanconfig
```

```
# lanscan -q
```

```
4
```

```
0
```

```
3
```

```
900          1 2
```

```
901
```

```
902
```

```
903
```

```
904
```

```
# netstat -in
```

Name	Mtu	Network	Address	Ipkts	Opkts
lan0	1500	191.1.1.0	191.1.1.1	1794	1173
lo0	4136	127.0.0.0	127.0.0.1	390	390
lan900	1500	192.1.1.0	192.1.1.153	0	0

9. The failover group is now operational. A reboot will restart the failover group as long as the `/etc/lanmon/lanconfig.ascii` file is intact and the primary port or primary link aggregation has an IP address in `/etc/rc.config.d/netconf` that matches the failover group's Stationary IP entry in `/etc/lanmon/lanconfig.ascii`.

If `lan1` fails, `lan2` becomes the active port. Similarly, if the failover group consists of two link aggregates, failover from the primary link aggregate to the standby link aggregate occurs only when all ports in the primary link aggregate failed. However, the examples in the next section show how proactive failover gives you greater control of the failover.

Proactive Failover Examples

Proactive failover relies on measuring and calculating efficiency. The efficiency of a link aggregate or individual port in a failover group is affected by the following:

- The number of ports in each member of the failover group
- The effective throughput of the switch or router to which the failover group members are connected

The following examples show how each affects the proactive failover operation.

Example 1

You want to configure a failover group (`lan902`) for proactive failover. You decide that failover group consists of two link aggregates: `lan900` and `lan901`. The `lan900` aggregate consists of ports 1, 2, and 3; the `lan901` aggregate consists of ports 4 and 5. Ports 1, 2, 3, 4, and 5 have speeds of 100 Mb/s. In addition, you want the link aggregate with the most operational ports at any point in time to be the active link in the failover group.



NOTE You can apply the methodology in this example to failover groups consisting of any number of link aggregates and ports.

To configure the failover group for proactive failover, do the following:

1. Determine network efficiency.

In this example, you assign both lan900 and lan901 a cost of 1.

2. Assign a priority to the aggregates.

If you prefer lan900 to be the active port when both link aggregates have the same number of operational ports, assign lan900 a higher priority. If you do not, the active port changes when one of the link aggregates becomes more efficient (has more operational ports or higher bandwidth). In this example, you assign lan900 a priority of 5 and lan901 a priority of 3.

3. Edit the lanconfig.ascii configuration file.

```

FAILOVER_GROUP      lan902

STATIONARY_IP      192.19.20.2
#   Primary/Standby      Interface      Priority : Cost
# -----+-----+-----
PRIMARY      lan900      5 : 1
STANDBY      lan901      3 : 1

```

Table 5-1 lists lan900 events for this example and how proactive failover determines the active port for lan902.

Table 5-1 lan900 Events and Proactive Failover (Equal Network Costs)

lan900 Event	lan900 Normalized Port Cost	lan901 Normalized Port Cost	Active Port
Failover group constructed ¹	1/300, or .003	1/200, or .005	lan900 ²
1 port fails	1/200, or .005	1/200, or .005	lan900 ³
1 port fails	1/100, or .01	1/200, or .005	lan901 ⁴
DOWN port becomes active	1/200, or .005	1/200, or .005	lan900 ⁵

¹ All ports in the link aggregates are operational.

² Normalized port cost is lower than lan901.

³ Normalized port cost is the same, but it has a higher priority than lan901.

⁴ Normalized port cost is lower than lan900.

⁵ Normalized port cost is the same, but it has a higher priority than lan901.

If the priorities were the same, lan901 would continue as the active port until the third port in lan900 became active.

Example 2

You want to configure a failover group (lan902) for proactive failover. You decide that the failover group consists of two link aggregates: lan900 and lan901. The lan900 aggregate consists of ports 2 and 3; the lan901 aggregate consists of ports 4 and 5. Ports 2, 3, 4, and 5 have speeds of 100 Mb/s. In addition, the link aggregates are connected to different routers using different speeds to connect to the network.

To configure the failover group for proactive failover, do the following:

1. Determine network efficiency.

In this example, you determine that the router connected to lan900 is 1.5 times more efficient at delivering traffic to the network than the router connected to lan901. You assign lan900 a cost of 1 and lan901 a cost of 1.5. However, you must express cost values in the lanconfig.ascii file

using whole numbers (no decimal points). The ratio of 1 to 1.5 is the same as the ratio of 2 to 3. Therefore, lan900 has a cost of 2 and lan901 has a cost of 3.

2. Assign a priority to the aggregates.

Because you prefer lan900 over lan901, you assign lan900 a priority of 8 and lan901 a priority of 7. That way, if both ports have the same normalized port cost, lan900 has precedence over lan901.

3. Edit the configuration file.

```

FAILOVER_GROUP      lan902

STATIONARY_IP      10.0.1.60
# Primary/Standby  Interface      Priority : Cost
# -----+-----+-----
PRIMARY           lan900      8 : 2
STANDBY           lan901      7 : 3

```

Table 5-2 lists lan900 events for this example and how proactive failover determines the active port for lan902.

Table 5-2 lan900 Events and Proactive Failover (Unequal Network Costs)

Event	lan900 Normalized Port Cost	lan901 Normalized Port Cost	Active Port
Failover group constructed ¹	2/200, or .010	3/200, or .015	lan900 ²
Port 2 on lan900 is DOWN	2/100, or .020	3/200, or .015	lan901 ³
Port 2 on lan900 is UP	2/200, or .010	3/200, or .015	lan900 ⁴
Port 4 on lan901 is DOWN	2/200, or .010	3/100, or .030	lan900 ⁵
Port 4 on lan901 is UP	2/200, or .010	3/200, or .015	lan900 ⁶
Ports 2 and 3 on lan900 are DOWN	0	3/200, or .015	lan901 ⁷

- 1 All ports in the link aggregates are operational.
- 2 Normalized port cost is lower than lan901.
- 3 Normalized port cost is lower than lan900.
- 4 Normalized port cost is lower than lan901.
- 5 Normalized port cost is lower than lan901.
- 6 Normalized port cost is lower than lan901.
- 7 This behavior is the same as if lan902 were a priority-based failover group.

Configuration Files

ASCII File

The ASCII configuration file is /etc/lanmon/lanconfig.ascii.

Example 5-1 Sample lanconfig.ascii Configuration File

```
*****
***** LAN MONITOR CONFIGURATION FILE
**** For complete details about the parameters and how
**** to set them, consult the lanqueryconf(1m) manpage
**** or your manual.
**** All timeout are microseconds, it will be round up
**** or down appropriately.
*****
NODE_NAME      hpserver
*****
# The valid range for POLLING_INTERVAL: 500,000-1,000,000 usec
# Default value for POLLING_INTERVAL: 10,000,000 usec
# Minimum value for DEAD_COUNT: 2
# Default value for DEAD_COUNT: 3
*****
POLLING_INTERVAL    10000000
DEAD_COUNT          3
*****
# By default, LM_RAPID_ARP is off.
# If LM_RAPID_ARP is on, the valid ranges are:
# LM_RAPID_ARP_INTERVAL: 1000000-4000000 (default:1000000 usec
# LM_RAPID_ARP_COUNT:      5 - 60          (default is 10)
# (LM_RAPID_ARP_INTERVAL * LM_RAPID_ARP_COUNT) <= 60s
*****
LM_RAPID_ARP        off
LM_RAPID_ARP_INTERVAL  1000000
LM_RAPID_ARP_COUNT    10

FAILOVER_GROUP      lan900

    STATIONARY_IP    193.33.33.33
    STANDBY          lan9      3
    PRIMARY          lan6      5

FAILOVER_GROUP      lan901
    STATIONARY_IP    195.55.55.55
    PRIMARY          lan4      5
    STANDBY          lan1      3
    STANDBY          lan2      3
    STANDBY          lan3      3

FAILOVER_GROUP      lan902
    STATIONARY_IP    fe80::2
    PRIMARY          lan11     5
    STANDBY          lan10     3
```

The ASCII configuration file contains the following fields:

NODE_NAME	The name of the system as obtained by gethostname. This must be the first line in the file.
FAILOVER_GROUP	The aggregate name for a single LAN Monitor link aggregate. You must specify an aggregate name for all LAN Monitor link aggregates on the system. If the group consists of multiple links (multiple PPAs), the aggregate name format is lan9XX, where XX is a decimal number starting with 00 (lan900). However, if the group is a single-link failover group, the aggregate name format is lanX, where X is the PPA of the link. Each FAILOVER_GROUP can have the following keywords:

STATIONARY_IP	The IPv4 address dedicated to the failover group. For the ARO512 release of HP-UX 11i v2 (B.11.23.10), you can also specify an IPv6 address. This is a required field; you must set it for each failover group before running <code>lanapplyconf</code> .
PRIMARY	Specifies the primary link for the <code>FAILOVER_GROUP</code> . A primary link is the active link that carries traffic in a failover group. It must also have an IP address configured on it. Specify this keyword only if the failover group has more than one link. A failover group can have only one primary port.
STANDBY	Specifies a standby link for the <code>FAILOVER_GROUP</code> . A standby link is a link that replaces the primary link when the primary is incapable of carrying traffic. Specify this keyword only if the failover group has more than one link. A failover group must have one or more standby links.

Both the `PRIMARY` and `STANDBY` keywords have the following fields:

- The LAN interface name (for example, `lan0` and `lan1`).
- The port priority that will be assigned to the port. The port with the highest priority is the primary port.
- A cost value for the LAN interface preceded by a colon (:). This is an optional field. See “Proactive Failover (HP-UX 11i v1 (B.11.11.20) Only)” (pg. 59) for more information.

POLLING_INTERVAL	The number of microseconds between polling messages. Polling messages are sent between links in the specified interval for monitoring the health of all the links in the link aggregate. Default is 10,000,000 (10 seconds). You can specify this keyword multiple times in the configuration file. A link aggregate’s polling interval is set to the last specified interval.
DEAD_COUNT	The number of polling packets that are missed before LAN Monitor sends a <code>nettl</code> log message to the user that indicates the link might have problems and the network should be checked. The default is 3.
LM_RAPID_ARP	Enables (on) or disables (off) the ability to transmit gratuitous ARP messages at intervals shorter than 5 seconds. This is an enhancement to LAN Monitor. By default, <code>LM_RAPID_ARP</code> is off. By default, when the MAC address of a failover group changes, a gratuitous ARP packet is transmitted. To ensure that other clients and servers receive the new IP-MAC mapping, <code>APA/LAN_MONITOR</code> transmits gratuitous ARP packets every 5 seconds for 1 minute. If a client fails to receive the first gratuitous ARP, it must wait for 5 seconds to receive the next one. In the meantime, if inbound and outbound traffic is present on the link, the traffic may be lost until the partner’s ARP cache is updated. If you enable this option, LAN Monitor transmits the gratuitous ARP at every <code>LM_RAPID_ARP_INTERVAL</code> interval, for a total of <code>LM_RAPID_ARP_COUNT</code> times immediately after the MAC address change. After completing the <code>LM_RAPID_ARP</code> process, the normal ARP process resumes and continues until 1 minute has elapsed since the first gratuitous ARP was transmitted.
LM_RAPID_ARP_INTERVAL	The number of microseconds between rapid gratuitous ARP messages. The range of valid values is 1000000–4000000, inclusive (1 second to 4 seconds). The default value is 1000000 (1 second). Specify a whole number of seconds because the value you specify is rounded up to the next whole number of seconds. The value must be a valid integer. If the value is out of the valid range and <code>LM_RAPID_ARP</code> is on, the interval value last processed with the <code>lanapplyconf</code> command is used. If

LM_RAPID_ARP is off, this value is ignored for the corresponding failover group.

LM_RAPID_ARP_COUNT The number of gratuitous ARP packets sent rapidly. The valid range is 5–60, inclusive. The default value is 10. The value must be a valid integer. If the value is not in the valid range and LM_RAPID_ARP is on, the count value last processed with the `lanapplyconf` is used. If LM_RAPID_ARP is off, this value is ignored for the corresponding failover group.

Binary File

The binary file `/etc/lanmon/lanconfig` stores the current snapshot of the aggregates. Because you cannot modify the aggregates using the `lanadmin` command, and this file is non-editable, it will correctly represent the current configuration.



CAUTION Do not edit the binary file because you can corrupt the data. Do not change the name or directory location. Doing so can make the product malfunction.

LAN Monitor Configuration Commands

lanqueryconf

The basic function of this command is to discover the set of LAN interfaces that can form a single link aggregate and then map that information to an ASCII configuration file (`/etc/lanmon/lanconfig.ascii`).

```
lanqueryconf [-s] [-b] [-v] [-c ascii_file]
```

You must specify either the `-s` or `-b` option.

The options are:

- `-b` Queries the binary file for the configuration.
- `-s` Queries the system for the configuration.
- `-v` Displays verbose output.
- `-c ascii_file` Specifies the name of the ASCII configuration file into which configuration information is written. By default, information is written to the `/etc/lanmon/lanconfig.ascii` file.

Query the system and create an ASCII configuration file

```
# lanqueryconf -s
```

This creates an ASCII file that represents the valid LAN Monitor aggregations that can be formed. You can edit this file and then use the `lanapplyconf` command to form the aggregations.

The output is similar to the sample file shown in “ASCII File” (pg. 65).

Query the system for the binary file

The `lanqueryconf -b` command reads the binary file `/etc/lanmon/lanconfig` and creates an ASCII output file that can show the LAN Monitor aggregations configured in the system.

```
# lanqueryconf -b
```

```
Reading binary file /etc/lanmon/lanconfig
```

```
ASCII output is in file /etc/lanmon/lanconfig.ascii
```

lanapplyconf

This command implements the configuration in the ASCII file `/etc/lanmon/lanconfig.ascii` and creates a binary file with the information.

```
lanapplyconf [-v] [-c ascii_file]
```

The options are:

- `-v` Specifies verbose output.
- `-c ascii_file` Specifies the ASCII file to be used for the configuration. The default is `/etc/lanmon/lanconfig.ascii`.

lancheckconf

This command validates the content of the ASCII configuration file.

```
lancheckconf [-v] [-c ascii_file]
```

The options are:

- v Specifies verbose output.
- c *ascii_file* Specifies the ASCII file to be checked. The default is `/etc/lanmon/lanconfig.ascii`.

landeleteconf

This command clears the aggregates that have been created in LAN Monitor mode.

```
landeleteconf [-v] [-g linkAggName]
```

The options are:

- v Specifies verbose output.
- g *linkAggName* Specifies the link aggregate interface name of the failover group to delete.

For example, to delete a failover group with a PPA of 904, enter:

```
# landeleteconf -g lan904
```

6 Using HP Serviceguard with HP APA

Following are the instructions for using HP Serviceguard with HP APA.

Requirements for Use

To use HP Serviceguard with HP APA, the following HP Serviceguard and HP APA requirements must be met:

- Required HP Serviceguard versions:
A.11.09, A.11.12, A.11.13 or later for HP-UX 11.0 and 11i v1
A.11.15 or later for HP-UX 11i v2
- HP Serviceguard supports only FEC_AUTO and MANUAL link aggregates. HP Serviceguard does not support LACP_AUTO mode link aggregates.



NOTE Configure HP APA before configuring HP Serviceguard. Use only link aggregates in the HP Serviceguard configuration.

- HP APA Configuration Requirement: Follow the general rules for configuring the HP APA FEC_AUTO link aggregates. If more than one FEC_AUTO aggregation is used on the system (including those that are not used with HP Serviceguard), each FEC_AUTO aggregation must have a different group capability.

See “Modifying Default Configuration Parameters” (pg. 36) for information on configuring link aggregates and for setting the FEC_AUTO group capability.



NOTE HP APA also requires that you configure your switches' trunking mode (AUTO or MANUAL) to match the mode being used on the server: Cisco Fast EtherChannel (FEC), IEEE 802.3ad Link Aggregation Control Protocol (LACP), or MANUAL mode.

7 Administering HP APA Using the lanadmin Command

This chapter describes the `lanadmin` command and the ways you can use it with HP APA.

Using lanadmin to Configure HP APA

You can use the `lanadmin -x|-X` command with options to view various settings and temporarily make configuration changes from the command line. You can also use `lanadmin` interactively.

Use the `lanadmin -x` command (lowercase x) with options to view various settings in HP APA, and the `lanadmin -X` command (uppercase X) with options to make temporary changes to HP APA.



CAUTION The `lanadmin` command does not preserve changes across reboots. Use SAM or edit the configuration files to permanently save the changes.



NOTE HP APA also requires that you configure your switches' trunking mode (AUTO or MANUAL) to match the mode being used on the server: Cisco's Fast EtherChannel (FEC), IEEE 802.3ad Link Aggregation Control Protocol (LACP), or MANUAL mode.

Summary of lanadmin -x & -X Options

Table 7-1 Summary of `lanadmin -x` & `-X` Options

lanadmin	-x (Set Options)	-x (View Options)
-a	Add ports to a link aggregate	N/A
-c	Clear link aggregate (remove all ports)	N/A
-d	Delete ports from link aggregate	N/A
-g	Set group capability	View group capability
-h	View help	View help
-H	View extended help	View extended help
-i	N/A	View given link aggregate port status
-k	Set LACP_AUTO Administrative Key	View LACP_AUTO Administrative Key
-l	Set load-balancing algorithm	View load-balancing algorithm
-m	N/A	View link aggregate status
-n	N/A	View status of all APA capable ports
-o	Clear data flows for link aggregates	N/A
-p	Set port mode	View port status
-q	N/A	View extended port status
-s	Set LACP_AUTO port system priority	View LACP_AUTO port system priority
-t	Set port priority	View port priority
-v	N/A	View given link aggregate status
-y	Turn Hot Standby on or off	View Hot Standby status
vmtu	N/A	View TSO status of link aggregate or failover group

Link- and Port-Specific lanadmin Commands

The following commands are specific to links and ports. The `lanadmin` options are in parentheses. See “lanadmin Syntax” (pg. 74) for the syntax details.

- Link-specific commands:
 - Manually configure a link aggregate:
 - Add physical ports to a link aggregate (-X -a)
 - Deconfigure (clear) a link aggregate (-X -c)
 - Delete physical ports from a link aggregate (-X -d)
 - Specify load-distribution algorithm (-X -l)
 - Specify Hot Standby mode (-X)
 - Clear data flows for a link aggregate (-X -o)
 - View status of a link aggregate (-x -v)
 - View status of a given link aggregate (-x -i)
 - View TSO status of a link aggregate (-x vmtu)
 - Automatically configure a link aggregate:
 - Enable LACP_AUTO or FEC_AUTO on physical ports (See port-specific commands)
 - Deconfigure a link aggregate (-X -c)
 - Specify load-distribution algorithm (-X -l)
 - Specify Hot Standby mode (-X -y)
 - View status of a link aggregate (-x -v)
 - View status of a given link aggregate (-x -i)
 - View TSO status of a link aggregate (x vmtu)
- Port-specific commands:
 - Delete ports from link aggregate (-X -d)
 - Specify group capability (-X -g)
 - Specify port key (-X -k)
 - View status of a port (-x -p)
 - Change configuration mode for a port (-X -p)
 - Specify port priority (-X -t)
 - View status of all APA capable ports (-x -n)

lanadmin Syntax

You use the `lanadmin` command to manage link aggregates and the addition of ports to a link aggregate. Use the following options with the `-X` (uppercase) option:

```
lanadmin [-X -a portPPA [portPPA]]
[-X -c linkAggregatePPA]
[-X -d portPPA [portPPA...] linkAggregatePPA]
[-X -g portPPA group_capability anyLinkAggregatePPA]
[-X [ -h -H ] anyLinkAggregatePPA]
[-X -k portPPA admin_key anyLinkAggregatePPA]
[-X -l load_balance_algorithm linkAggregatePPA ]
[-X -o linkAggregatePPA]
[-X -p portPPA config_mode anyLinkAggregatePPA]
[-X -s portPPA system_priority anyLinkAggregatePPA]
[-X -t portPPA port_priority anyLinkAggregatePPA]
```

[*-X -y on|off linkAggregatePPA*]

-a [-X -a portPPA] [portPPA...] linkAggregatePPA

Add ports with the specified *portPPAs* to the link aggregate with the specified *linkAggregatePPA* number.



CAUTION Be careful while using the *-a* suboption. This might lead to an invalid link aggregate. This command gives you full control over forming any link aggregate that you want.

-c [-X -c linkAggregatePPA]

Clear (remove all) ports from a link aggregate with the specified *linkAggregatePPA* number. This option fully deconfigures the link aggregate. After removal from a link aggregate, the port's mode is set to MANUAL. The Administrative Key (LACP) or *group_capability* (FEC_AUTO and MANUAL) will not be changed.

-d [-X -d portPPA [portPPA...] linkAggregatePPA]

Delete ports with the specified PPAs from the link aggregate with the specified *linkAggregatePPA* number.



CAUTION Failure to fully deconfigure a link aggregate (using the the *-c* suboption) may result in some properties being retained in the link aggregate. Subsequently, when new ports are added onto the link aggregate, they might not aggregate properly.

-g [-X -g portPPA group_capability anyLinkAggregatePPA]

Set group capability for a port with the specified *portPPA*. Ports going to different link aggregates should have different group capabilities. The valid values for *group_capability* are integral numbers starting at 0. This is applicable to MANUAL and FEC_AUTO ports.

-h [-X -h anyLinkAggregatePPA]

View the *-X|-x* options help screen.

-H [-X -H anyLinkAggregatePPA]

View the extended *-X|-x* options help screen, which includes a detailed description and syntax of the *-X|-x* options.

-k [-X -k portPPA admin_key anyLinkAggregatePPA]

Set Administrative Key for an LACP_AUTO port or LACP_AUTO link aggregate. Applies to LACP_AUTO only. An Administrative Key and Operational Key are associated with each port. The Operational Key is used for forming aggregations in autonegotiation. The Administrative Key can be set at anytime. At the port level, the Operational Key will only copy the Administrative Key value when the LACP protocol is not running. At the link aggregate level, the Operational Key will only copy the Administrative Key when the link aggregate is not configured (no ports have joined the link aggregate).

For example: An LACP_AUTO port is in an aggregation. The *admin_key* and *oper_key* are showing "1234". Use `lanadmin -X -k admin_key anyLinkAggregatePPA` to modify the *admin_key* to "5432". The *oper_key* will not be changed immediately. LACP_AUTO for the port must be stopped and then restarted for both keys to have the new value of "5432".

-l [-X -l load_balance_algorithm linkAggregatePPA]

Set the load-balancing algorithm for a link aggregate with the specified *linkAggregatePPA* number.

The following choices are valid for *load_balance_algorithm*:

LB_MAC Based on the MAC Address of the outgoing packet. Appropriate for server-to-switch configuration. This is the default setting.

LB_IP Based on the IP Address of the outgoing packet. Appropriate for server-to-router configuration.

LB_PORT Based on the TCP/UDP source and destination port numbers to distribute traffic across the ports in a link aggregate. Appropriate for server-to-server configuration.

- o [-X -o *linkAggregatePPA*]
Clear data flows for a link aggregate specified by *linkAggregatePPA*. This causes the link aggregate outbound traffic to be rebalanced across the ports in the link aggregate.
- p [-X -p *portPPA config_mode anyLinkAggregatePPA*]
Set mode for a port with the specified *portPPA* number. The following values are valid:

LACP_AUTO	Turn on IEEE 802.3ad (LACP).
FEC_AUTO	Turn on Fast EtherChannel (FEC) on the port for automatic port aggregation.
MANUAL	Turn off Fast EtherChannel (FEC) or IEEE 802.3ad (LACP) on the port.
LAN_MONITOR	Provides Hot Standby capability.
- s [-X -s *portPPA system_priority anyLinkAggregatePPA*]
Set system priority for an LACP_AUTO port. The default value is 0. This has no effect on a MANUAL or FEC_AUTO port.
- t [-X -t *portPPA port_priority anyLinkAggregatePPA*]
Set *port_priority* for the port with the specified PPA Number. For LACP_AUTO, this sets the priority value for the port. The `lanapplyconf` command assigns port priority according to settings in `lanconfig.ascii`. You can change the priority of primary and standby ports, but the primary port should have a higher priority. By default a primary port is 5; standby is 3. This option is not applicable to PAgP. If the port is not in a standalone state, attempting to set the port priority will fail. Check the port status using the `lanadmin -x -p` command.
The valid values for *port_priority* are integral numbers starting at 0.
For HOT_STANDBY: The bigger the number, the higher the priority.
For LACP ports: The smaller the number, the higher the priority.
- y [-X -y on|off *linkAggregatePPA*]
Turn on/off Hot Standby for the link aggregate with the specified *linkAggregatePPA* number. See the description of HP_APA_HOT_STANDBY in the "HP APA Parameters for Link Aggregates — hp_apaconf" (pg. 37) section for information.
Turn on sets link aggregate load-balancing mode to LB_HOT_STANDBY. Turn off sets link aggregate load-balancing mode to LB_MAC.

The following options can be passed along with the -x (lowercase) option:

- `lanadmin [-x -g portPPA anyLinkAggregatePPA]`
- `[-x [-h -H] anyLinkAggregatePPA]`
- `[-x -i linkAggregatePPA]`
- `[-x -k portPPA anyLinkAggregatePPA]`
- `[-x -l linkAggregatePPA]`
- `[-x -m anyLinkAggregatePPA]`
- `[-x -n anyLinkAggregatePPA]`
- `[-x -p portPPA anyLinkAggregatePPA]`
- `[-x -q portPPA anyLinkAggregatePPA]`
- `[-x -s portPPA anyLinkAggregatePPA]`
- `[-x -t portPPA anyLinkAggregatePPA]`
- `[-x -v linkAggregatePPA]`
- `[-x -y linkAggregatePPA]`
- `[-x vmtu linkAggregatePPA]`
- g [-x -g *portPPA anyLinkAggregatePPA*]
View the current group capability number of the specified port or link aggregate. This applies to MANUAL and FEC_AUTO ports.
- h [-x -h *anyLinkAggregatePPA*]
View the help screen.
- H [-x -H *anyLinkAggregatePPA*]
View the extended help screen, which includes a list of the -x|-X options and the syntax.

-i [-x -i *linkAggregatePPA*]

Display the port status associated with the link aggregation or failover group. Following is the information displayed for this option.

- Link aggregation or failover group PPA number.
- Link aggregation mode.
- Load-balancing mode used by the link aggregation.
- The port or ports of the link aggregation or failover group actively involved in sending and receiving data traffic.
- For LAN Monitor, the ports that are in state ready to takeover data traffic in case the current active port fails.
- The ports that are not ready to be used in a link aggregation or failover group. A port can be in this list due to:
 - The link state of the NIC is down.
 - The NIC is experiencing a hardware problem, which is causing unexpected failures.
 - The NIC has been configured to run an APA auto protocol and it has not reached a stable state.
- For LAN Monitor, a list of the ports in the "ready" list that have connectivity to the current active port. A port in the ready list might not be displayed in this field because connectivity might have been lost after forming the failover group.



NOTE This field may not be accurate after a link state change until `POLL_INTERVAL * DEAD_COUNT` seconds have expired.

Sample output for link aggregation:

```
Link Aggregate PPA #           : 900
Link Aggregation Mode         : MANUAL
Load Balance Mode             : IP Address based (LB_IP)
Active Ports PPA #           : 3 4
Port(s) not ready             : 5 6
```

Sample output for failover group (LAN Monitor):

In this example, 3, 4, 5 are in same subnet and 6, 7 are in different subnet, and port 5 is down.

```
Link Aggregate PPA #           : 901
Link Aggregation Mode         : LAN_MONITOR
Load Balance Mode             : Hot Standby (LB_HOT_STANDBY)
Active Ports PPA #           : 3
Port(s) ready                 : 4 6 7
Port(s) not ready             : 5
Port(s) connected to active port : 4
```

-k [-x -k *portPPA lnyLinkAggregatePPA*]

View Administrative and Operational Key for an LACP_AUTO port or link aggregate. Applies to LACP_AUTO only.

-l [-x -l *linkAggregatePPA*]

Display the current load-balancing algorithm for the link aggregate with the specified *linkAggregatePPA* number.

-m [-x -m *anyLinkAggregatePPA*]

View status for all link aggregates using any link aggregate in the command. Sample results:

```
Number of elements=50
[0] ppa           : 900
[0] index         : 0
[0] num_ports     : 1
```

```

[0] ports      : 4
-----
[1] ppa        : 901
[1] index      : 1
[1] num_ports  : 3
[1] ports      : 1 2 3
-----
[2] ppa        : 902
[2] index      : 2
[2] num_ports  : 0
[2] ports      :
-----
.
.
.
-n [-x -n anyLinkAggregatePPA]
View status for all APA capable ports using any link aggregate in the command. For example:
Number of elements=5
[0] ppa                : 1
[0] reserved2 value    : -1
[0] state               : 1
-p [-x -p portPPA anyLinkAggregatePPA]
View the present status of a port with the specified portPPA number. For example:
**** PORT NUMBER: 3 ****
Port FEC Mode          : FEC_AUTO
Port State             : UP
Port Group Capability  : 901
Port Priority          : 0
-q [-x -q portPPA anyLinkAggregatePPA]
View the present status of a port with the specified portPPA in the extended format. For example:
**** PORT NUMBER: 3 ****
pagpEnabled           : ENABLED
ppMyData.deviceId     : 00108318b907
ppMyData.distReq      : LEARNCAP_AGPORT
ppMyData.portPriority  : 0
ppMyData.sentPortIfIndex : 3
ppMyData.groupCapability : 901
ppMyData.groupIfIndex : 8
ppNoPagpTimerI       : 0
ppNoTransTimerQ      : 0
ppTHToTATimerS       : 0
ppSlowHelloTimerA    : 1
ppPartnerCount       : 1
+++++++ PARTNER DATA ++++++++
PARTNER 0
ppPartnerData.deviceId : 000883756600
ppPartnerData.distReq  : LEARNCAP_AGPORT
ppPartnerData.portPriority : 188
ppPartnerData.sentPortIfIndex : 188
ppPartnerData.groupCapability : 3
ppPartnerData.groupIfIndex : 211
ppTimerP              : 902
Port LACP Mode        : 1
+++++++ PARTNER DATA ++++++++
ppAutoMode.myAutoMode : 0
ppAutoMode.yourRequest : 0

```

```

ppMySlowHello          : 1
portState              : PAGP_STATE_UPPAGP
portNextState         : PAGP_STATE_UPPAGP
portNextEvent         : PAGP_EVENT_NULL
portXmitState         : PAGP_XMIT_STATE_SLOW_U6
portXmitNextState     : PAGP_XMIT_STATE_SLOW_U6
portXmitNextEvent     : PAGP_XMIT_EVENT_NULL

```

-s [*-s portPPA anyLinkAggregatePPA*]
View system priority for an LACP_AUTO port. This has no affect on a MANUAL or FEC_AUTO port.

-t [*-t portPPA anyLinkAggregatePPA*]
View the current port priority for the port with the specified *portPPA* number. For LACP_AUTO, this shows the priority value for the port. For HOT_STANDBY, this shows which port is used for traffic and which for standby. This option is not applicable to PAgP (FEC_AUTO).

-v [*-v linkAggregatePPA*]
View status for a given link aggregate with the specified *linkAggregatePPA* number. For example:

```

Link Aggregate PPA #      : 901
Number of Ports          : 3
Ports PPA                : 2 1 3
Link Aggregation State   : LINKAGG AUTO
Group Capability         : 901
Load Balance Mode       : MAC Address based (LB_MAC)

```

-y [*-y linkaggregatePPA*]
View Hot Standby status for the link aggregate with the specified *linkAggregatePPA* number.

vmtu [*-x vmtu linkaggregatePPA*]
View TSO status for a given link aggregate with the specified *linkAggregatePPA* number. For example:

```

# lanadmin -x vmtu 903
Driver/Hardware does not support TCP Segmentation Offload
#
# lanadmin -x vmtu 905
Driver/Hardware supports TCP Segmentation Offload, Current VMTU = 32160
#

```

The following existing option is supported, though with a different meaning:

-a Display current station address of link aggregate with the specified *linkAggregatePPA* number.

Using lanadmin from the Command Line



NOTE Remember that the starting PPA number for link aggregates varies with the operating system you have installed: for HP-UX 11.00, it is 100; and for 11i v1 and 11i v2, it is 900. The following example uses HP-UX 11i.

- To obtain additional information on options for the `lanadmin` command, enter:

```
lanadmin -X -H linkAggregatePPA
```

Where *linkAggregatePPA* can be any valid link aggregate PPA value.
- To form a link aggregate of ports automatically using the Cisco Fast EtherChannel protocol on that port, set the port's configuration mode to `FEC_AUTO`. Suppose port 2 needed to be trunked automatically:

```
lanadmin -X -p 2 FEC_AUTO 900
```

Where 900 is the PPA of the first link aggregate. When the protocol completes successfully, HP APA determines which link aggregate port 2 will best fit in to and adds the port to an aggregate based on the *group_capability* of ports and link aggregate. Ports in the same link aggregate must be connected to the same host and in the same trunk.

- To form a link aggregate of ports automatically using the LACP protocol, use `LACP_AUTO` in place of `FEC_AUTO` in the previous step. In `LACP_AUTO` mode, *key* is used in stead of *group_capability*.
- To manually configure ports with PPAs 6, 7, 8, and 9 into a link aggregate, `lan901`, enter the following command:

```
lanadmin -X -a 6 7 8 9 901
```



CAUTION Be careful while using the `-a` suboption. This might lead to an invalid link aggregate. This command gives you full control over forming any link aggregate that you want. This example will configure ports with PPAs 6, 7, 8, and 9 into a single link aggregate, even if they are connected to different switches, which is an invalid configuration, and could lead to problems.



NOTE If you are using `FEC_AUTO` or `LACP_AUTO` mode, ensure that the switch ports' configuration is set appropriately. Refer to the user's manual for your switch. HP APA also requires that you configure your switches' trunking mode (`AUTO` or `MANUAL`) to match the mode being used on the server: the Cisco Fast EtherChannel (`FEC`), IEEE 802.3ad Link Aggregation Control Protocol (`LACP`), or `MANUAL` mode.

- Before you can remove a port from an automatically formed link aggregate, you must turn off Cisco's Fast EtherChannel or LACP protocol on that port. If a port with a PPA number of 2 belongs to link aggregate `lan900` (which has a PPA number of 900), then enter one of the following two commands:

```
lanadmin -X -d 2 900
```

or

```
lanadmin -X -p 2 MANUAL 900
```

- To deconfigure `FEC_AUTO` (or `LACP_AUTO`) mode link aggregate 903, which has ports with PPAs 6, 7, 8, and 9, enter the following commands in succession:

```
# lanadmin -X -p 6 MANUAL 903
```

```
# lanadmin -X -p 7 MANUAL 903
```

```
# lanadmin -X -p 8 MANUAL 903
```

```
# lanadmin -X -p 9 MANUAL 903
```

Alternatively, the following single command will achieve the same result:

```
lanadmin -X -d 6 7 8 9 903
```

- To fully deconfigure a link aggregate, enter the following command:

```
lanadmin -X -c 903
```



IMPORTANT Failure to fully deconfigure a link aggregate can result in some properties being retained in the link aggregate. Subsequently, when you add new ports onto the link aggregate, they might not aggregate properly.

- To delete a single port (for example, 8) from link aggregate 901, enter the following command:

```
lanadmin -X -d 8 901
```

To delete ports 6 and 9, enter:

```
lanadmin -X -d 6 9 901
```

- To deconfigure the link aggregate 901 completely, enter:

```
lanadmin -X -c 901
```

This deletes the remaining port, 7, from link aggregate 901 and clears all the properties from the link aggregate; it becomes clean.



IMPORTANT After you delete all the ports from link aggregate 901, (after using, for example, `lanadmin -X -d 7 901`), use the `-c` suboption. Otherwise, some properties are retained in link

aggregate 901. Subsequently, when you add new ports to link aggregate 901, they will inherit old properties of the link aggregate and might not aggregate properly.

Example 7-1 Using lanadmin to Configure an FEC_AUTO Mode Link Aggregation

This example works for all versions of 11i (link aggregate begins at 900).

To add ports `lan1` and `lan2` (which are not aggregated) to link aggregate `lan901` (which is not enabled), with the group capability set to 901, do the following:

1. Configure the switch.

Configure your switches' trunking mode to match the mode being used on the server. The mode is Cisco Fast EtherChannel (FEC).

2. Configure the server:

a. Set the link aggregate's group capability to 901. Enter:

```
lanadmin -X -g 901 901 900
```

b. Change the port's group capability to be the same as the link aggregate's group capability (901).

```
# lanadmin -X -g 1 901 900
```

```
# lanadmin -X -g 2 901 900
```

c. Change ports `lan1` and `lan2` mode to `FEC_AUTO`.

```
# lanadmin -X -p 1 FEC_AUTO 900
```

```
# lanadmin -X -p 2 FEC_AUTO 900
```



NOTE By default, the `group_capability` of each physical link is set to 5.

Using lanadmin Interactively

When you enter the `lanadmin` command by itself, or with the `-t` option, the command becomes interactive. The following example illustrates the interactive use of `lanadmin`:

```
# lanadmin
```

```
LOCAL AREA NETWORK ONLINE ADMINISTRATION, Version 1.0
```

```
Tue , Oct 1,2002 14:05:56
```

```
Copyright 1994 Hewlett Packard Company.
```

```
All rights are reserved.
```

```
Test Selection mode.
```

```
lan      = LAN Interface Administration
menu     = Display this menu
quit     = Terminate the Administration
terse    = Do not display command menu
verbose  = Display command menu
```

```
Enter command: lan
```

```
LAN Interface test mode. LAN Interface PPA Number = 1
```

```
clear    = Clear statistics registers
display  = Display LAN Interface status and statistics registers
end      = End LAN Interface Administration, return to Test Selection
menu     = Display this menu
ppa      = PPA Number of the LAN Interface
quit     = Terminate the Administration, return to shell
```

reset = Reset LAN Interface to execute its selftest
specific = Go to Driver specific menu

Enter command: **ppa**

Enter PPA Number. Currently 1: **901**

LAN Interface test mode. LAN Interface PPA Number = 901

clear = Clear statistics registers
display = Display LAN Interface status and statistics registers
end = End LAN Interface Administration, return to Test Selection
menu = Display this menu
ppa = PPA Number of the LAN Interface
quit = Terminate the Administration, return to shell
reset = Reset LAN Interface to execute its selftest
specific = Go to Driver specific menu

Enter command: **display**

LAN INTERFACE STATUS DISPLAY
Tue , Oct 1,2002 14:07:10

PPA Number = 901
Description = lan901 Hewlett-Packard LinkAggregate Interface
Type (value) = ethernet-csmacd(6)
MTU Size = 1500
Speed = 300000000
Station Address = 0x108318b927
Administration Status (value) = up(1)
Operation Status (value) = up(1)
Last Change = 102502046

For link-aggregate MIB statistics, press <Return> to continue

Inbound Octets = 46821
Inbound Unicast Packets = 0
Inbound Non-Unicast Packets = 424
Inbound Discards = 1
Inbound Errors = 0
Inbound Unknown Protocols = 72
Outbound Octets = 41446
Outbound Unicast Packets = 346
Outbound Non-Unicast Packets = 346
Outbound Discards = 0
Outbound Errors = 0
Outbound Queue Length = 0
Specific = 0

LAN Interface test mode. LAN Interface PPA Number = 901

clear = Clear statistics registers
display = Display LAN Interface status and statistics registers
end = End LAN Interface Administration, return to Test Selection
menu = Display this menu
ppa = PPA Number of the LAN Interface
quit = Terminate the Administration, return to shell

reset = Reset LAN Interface to execute its selftest
specific = Go to Driver specific menu

Enter command: **specific**

Link Aggregation specific test mode. Valid LAN Interface PPAs: 2 1 3

linkagg = Link Aggregate status
port = Port's APA status
end = End Driver Specific Test Mode, return to Lan Interface
test mode.
menu = Display this menu
quit = Terminate the Administration, return to shell

Enter command: **linkagg**

Link Aggregate PPA # : 901
Number of Ports : 3
Ports PPA : 2 1 3
Link Aggregation State : LINKAGG AUTO
Group Capability : 901
Load Balance Mode : MAC Address based (LB_MAC)

Link Aggregation specific test mode. Valid LAN Interface PPAs: 2 1 3

linkagg = Link Aggregate status
port = Port's APA status
end = End Driver Specific Test Mode, return to Lan Interface
test mode.
menu = Display this menu
quit = Terminate the Administration, return to shell

Enter command: **port**

Enter Port PPA number: **1**

**** PORT NUMBER: 1 ****

pagpEnabled : ENABLED
ppMyData.deviceId : 00108318b907
ppMyData.distReq : LEARNCAP_AGPORT
ppMyData.portPriority : 0
ppMyData.sentPortIfIndex : 1
ppMyData.groupCapability : 901
ppMyData.groupIfIndex : 1
ppNoPagpTimerI : 0
ppNoTransTimerQ : 0
ppTHToTATimerS : 0
ppSlowHelloTimerA : 7
ppPartnerCount : 1

++++ PARTNER DATA +++++

PARTNER 0
ppPartnerData.deviceId : 000883756600
ppPartnerData.distReq : LEARNCAP_AGPORT
ppPartnerData.portPriority : 190
ppPartnerData.sentPortIfIndex : 190
ppPartnerData.groupCapability : 3

```
ppPartnerData.groupIfIndex      : 211
ppTimerP                         : 85
ppSlowHelloRequestP            : 1
+++++++ PARTNER DATA ++++++++
ppAutoMode.myAutoMode          : 0
ppAutoMode.yourRequest         : 0
ppMySlowHello                  : 1
portState                       : PAGP_STATE_UPPAGP
portNextState                   : PAGP_STATE_UPPAGP
portNextEvent                   : PAGP_EVENT_NULL
portXmitState                   : PAGP_XMIT_STATE_SLOW_U6
portXmitNextState               : PAGP_XMIT_STATE_SLOW_U6
portXmitNextEvent               : PAGP_XMIT_EVENT_NULL
Link Aggregation specific test mode. Valid LAN Interface PPAs: 2 1 3
```

```
linkagg = Link Aggregate status
port    = Port's APA status
end     = End Driver Specific Test Mode, return to Lan Interface
        test mode.
menu    = Display this menu
quit    = Terminate the Administration, return to shell
```

Enter command: **quit**

8 Troubleshooting HP Auto Port Aggregation (APA) Software

This chapter contains an overview on troubleshooting and detailed troubleshooting flowcharts and instructions.

Troubleshooting Overview

HP Auto-Port Aggregation problems can be caused by a variety of hardware and software components. The problem impacting your system may originate in a required hardware component (that is, networking adapter), the switch which the networking adapter connects to, or the HP Auto-Port Aggregation software.

As with any troubleshooting, a systematic approach is helpful. The following table and flowcharts provide a logical sequence of steps to follow when troubleshooting the HP Auto-Port Aggregation software.

Using the diagnostic flowcharts provided in this chapter, identify whether the problem is with the HP Auto-Port Aggregation software, configuration of the switch, physical connections to the switch, or whether it is in some other part of the network. Once the problem is isolated, perform the recommended corrective action.

If you cannot solve the problem on your own, contact your HP representative. Use the guidelines in “Contacting Your HP Representative” (pg. 120).



NOTE HP APA also requires that you configure your switches' trunking mode (AUTO or MANUAL) to match the mode being used on the server: Cisco's Fast EtherChannel (FEC), IEEE 802.3ad Link Aggregation Control Protocol (LACP), or MANUAL mode.

What Happens during Start Up?

Following is the sequence of actions that occur after you have installed the HP APA software. During the system boot-up, the following sequence of events occur:

1. Initialize HP APA software
All the internal housekeeping initialization (such as allocation of memory, etc.) for the software is done. During this step, the default values are assigned for all the properties on each port and link aggregate.
2. `hp_apaportconf` processing
Contains customization variables for each physical port. The features that can be set on each port are Group Capability, Port Priority, and Configuration Mode. If no value is specified for a given feature for a given port, the software assumes a default value for the same. The port's mode is set at this stage.
3. `hp_apaconf` processing
The `/etc/rc.config.d/hp_apaconf` file contains customization variables for each link aggregate. The features that can be set on each link aggregate are Load Balancing Mode, Hot Standby Mode, and ports in a Manual link aggregate. The last feature allows manual configuration of a link aggregate with the port(s) specified.
4. Start the HP APA software
Cisco's FEC or IEEE 802.3ad LACP protocol is started on the ports that have been marked as such. No action is taken for the ports that have Cisco's FEC or IEEE 802.3ad LACP turned off.
5. Process LAN Monitor ASCII file
Process `/etc/lanmon/lanconfig.ascii` to create failover groups. If this file has not been created then no action is taken.

Once the system is up and running, you can distinguish a link aggregate from a normal (unaggregated) port by running `lanscan(1M)` at the HP-UX prompt as follows:

Example 8-1 Sample lanscan Output

```
# lanscan
Hardware Station      Crd Hdw  Net-Interface  NM  MAC      HP-DLPI  DLPI
Path      Address          In# State NamePPA      ID  Type     Support  Mjr#
10/12/6   0x080009B19B60  12  UP   lan0 snap0      11  ETHER    Yes      119
LinkAgg0  0x0010830497D5  900 UP   lan900 snap900  14  ETHER    Yes      119
LinkAgg1  0x0060B0770028  901 UP   lan901 snap901  15  ETHER    Yes      119
LinkAgg2  0x000000000000  902 DOWN lan902 snap902  16  ETHER    Yes      119
LinkAgg3  0x000000000000  903 DOWN lan903 snap903  17  ETHER    Yes      119
LinkAgg4  0x000000000000  904 DOWN lan904 snap904  18  ETHER    Yes      119
```

The hardware path of a link aggregate has the form `LinkAggx`, where `x` indicates the link aggregate number. This is different from the typical hardware path, which is separated with a slash (/).

MAC Addresses for Link Aggregates

This section describes the process used to select unique MAC addresses for link aggregates.

The unique MAC address for a specific link aggregate is determined by using the permanent MAC address of the first physical port assigned to the link aggregate. If the first port is removed, the link aggregate's MAC address is updated with the permanent MAC address of the last port in the link aggregate.

When a physical port is removed from a link aggregate, its local MAC address is reset to the physical port's permanent MAC address.

Unsupported Way of Changing MAC Address

The HP-UX 11.0 version of APA does not support the following function:

- ▲ Changing the local MAC address on logical link aggregations via `DL_SET_PHYS_ADDR_REQ`.

Diagnostic Flowcharts

Below is a summary of the types of network tests in the diagnostic flowcharts. Follow the flowcharts in sequence beginning with Flowchart 1. Continue sequentially through flowcharts 2, 3, 4, 5, 6, 7, 8, 9, and 10 referring back to Flowchart 1 (ping), as indicated at the end of each flowchart, until you have corrected the problem.

The following flowcharts are described in general terms and can be executed on any network physical port supported by the HP Auto Port Aggregation software. See "Summary of HP APA and LAN Monitor Capabilities" (pg. 18) for a list of supported network physical ports (adapter cards).

Table 8-1 Flowchart Descriptions

Flowchart	Description
1	Network Level Loopback Test
2	Network Physical Port Connections/LED Test
3 and 4	Network Physical Port Configuration Test
5	Link Aggregation Configuration Test
5A	Manual Configuration Test
5B	PAgP Configuration Test
5C	LAN Monitor Configuration Test
5D	LACP Configuration Test
6	Network Configuration Test
7	ARP Verification
8	Link Level Loopback Test
9	Transport Level Loopback Test (using ARPA)
10	Bridge/Gateway Loopback Test

Network Level Loopback Test: Checks round-trip communication between Network Layers on the source and target host using the `ping` command.

Network Physical Port Connections/LED Test: Checks that all the hardware connections between your system and the network are connected and operational.

Network Physical Port Configuration Test: Verifies the configuration of the network physical port(s) on a host using the `lanscan(1M)`, `netfmt vf`, `lanadmin(1M)`, and `ifconfig(1M)` commands. In addition, the switch configuration should be verified using the appropriate switch commands.

Link Aggregation Configuration Test: Verifies the configuration of the link aggregate on the server. The switch configuration should be verified using the appropriate switch commands. The appropriate patches should also be verified.

ARP Verification: Checks `arp` entries using the `arp(1M)` command.

Link Level Loopback Test: Checks round-trip communication between Link Levels on the source and target host using the `linkloop(1M)` diagnostic.

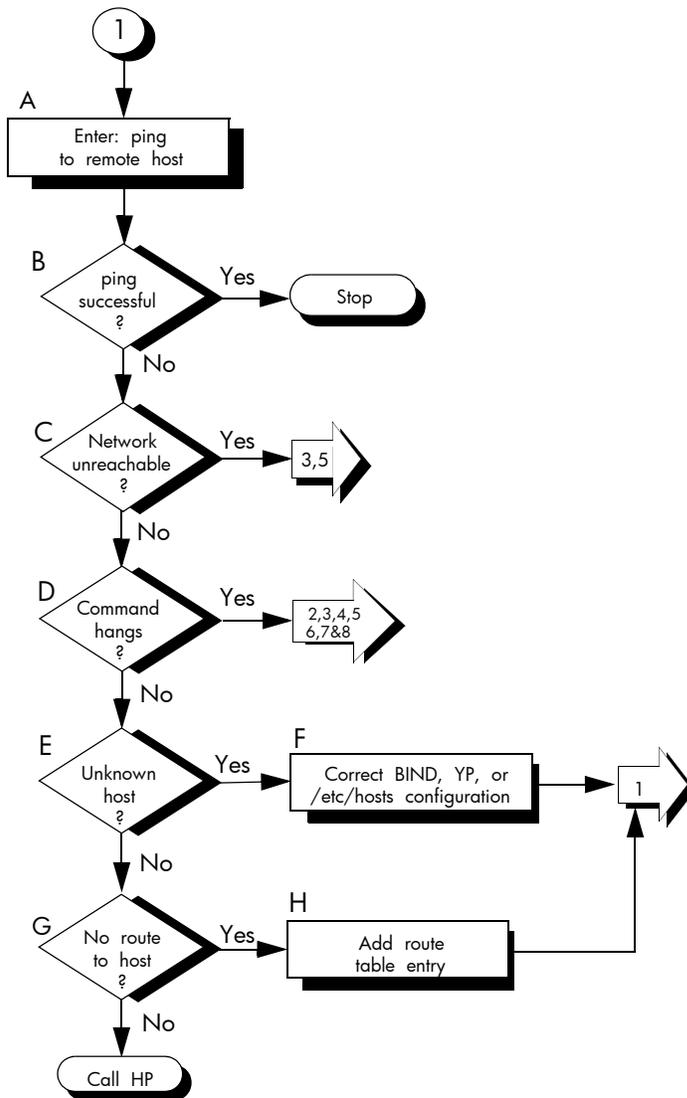
Transport Level Loopback Test: Checks round-trip communication between Transport Layers on the source and target host using ARPA services `telnet` and `ftp` commands.

Bridge/Gateway Loopback Test: Checks general network connections through a gateway.

Flowchart 1: Network Level Loopback Test

The following tests should be executed on the specific link aggregate which is experiencing problems.

Figure 8-1 Flowchart 1: Network Level Loopback Test



Flowchart 1 Procedures

- A. Enter: ping to remote host. Using ping, send a message to the remote host to which you are having problems connecting. For example:
ping spiff
- B. *ping successful?* A message is printed to stdout for each ping packet returned by the remote host. If packets are being returned, your system has network level connectivity to the remote host. Note what percentage of the total packets are lost, if any. Losing ten percent or more may indicate the network or remote host is extremely busy. You may also find it useful to note the round-trip transmission times. Periodically high transmission times may indicate that the network or remote host is extremely busy. Consistently high transmission times may indicate the local host is extremely busy. If a message is not returned after executing ping, ping is not successful. Enter **Ctrl+C** to stop the ping output.
- C. *Network unreachable?* If YES, go to Flowchart 3 to display connection status using the lanscan command. If this is OK, then proceed to Flowchart 5 and verify that the link aggregate is configured correctly.
- D. *Command hangs.* If a message is not returned after executing ping, go to Flowcharts 2 through 7, referring back to Flowchart 1 (ping) until you have corrected the problem.
- E. *Unknown host?* If you receive this message, go to Step F.
- F. *Correct BIND, YP or hosts configuration.* Add the missing host name and start again with Flowchart 1.
- G. *No route to host?* If Error= Sendto: No route to host, go to Step H. Otherwise, call your HP representative for help.

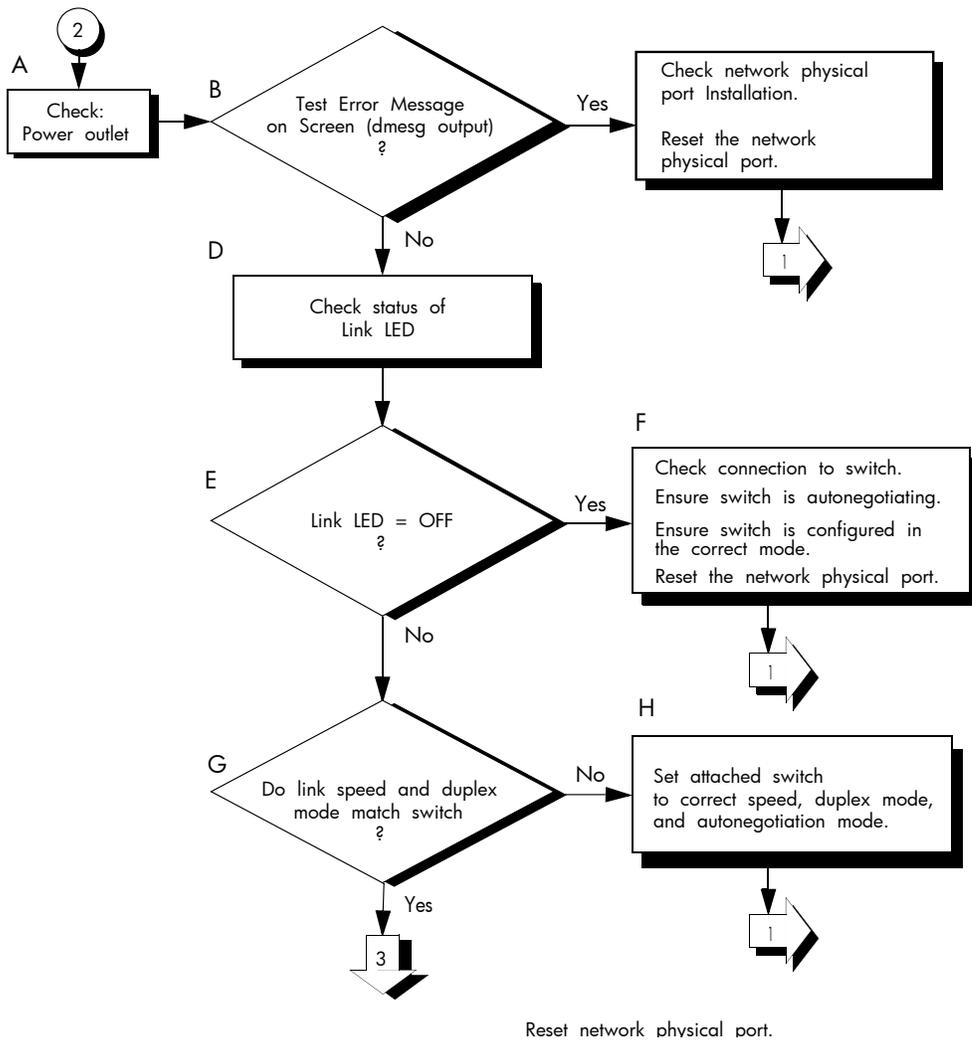
- H. *Add route table entry.* Using `route`, add a route table entry for that host. See `route(1M)` for information. Start again with Flowchart 1.

Flowchart 2: Network Physical Port Connections/LED Test

The following flowchart should be used for each of the network physical ports which have been configured in a specific link aggregate. These tests can be executed at any time to verify proper physical connection between the network physical port and the switch.

See “*Modifying Default Configuration Parameters*” (pg. 36) or Table 7-1 for a detailed description of how to determine which network physical ports are associated with a specific link aggregate.

Figure 8-2 Flowchart 2: Network Physical Port Connections/LED Test



Flowchart 2 Procedures

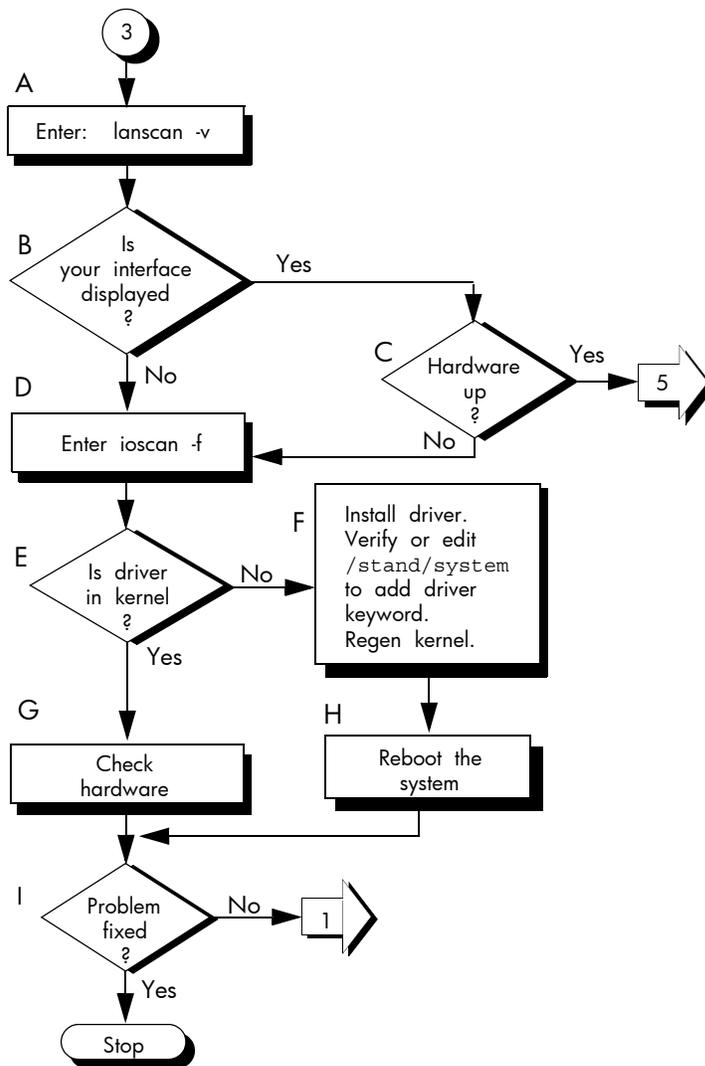
- A. *Check power outlet.* Ensure the power cord is plugged in to a live outlet.
- B. *Test error message on screen?* At the HP-UX prompt, enter the `dmesg` command, and look for an error message. Does the `dmesg` output show an error message from networking port(s) you are using? If not, go to Step D.
Note: even if the Test LED is OFF, a card problem is still possible.
- C. *Check card installation.* If `dmesg` reported an error message for the networking port(s), reset the port according to Steps D through G in Flowchart 4. If problem persists, call HP. Go back to Flowchart 1.
- D. Check status of Link LED.
- E. *Link LED = OFF?* Go to Step F.
Link LED = ON? Go to Step G.

- F. If Link LED = OFF, check connection to switch. Ensure switch is not autonegotiating. Ensure switch is configured in the correct mode. Reset card according to Steps D through G in Flowchart 4. Go back to Flowchart 1.
- G. *Do link speed and duplex mode match switch?* If they do, proceed to Flowchart 3.
- H. If Link speed and duplex mode do not match what you expect, set attached switch to the correct link speed and duplex mode, and if necessary enable autonegotiation. Reset the network physical port according to Steps D through G in Flowchart 4 and go back to Flowchart 1.

Flowchart 3: Network Physical Port Configuration Test

The following flowchart should be used for each of the network physical ports which are being configured in a specific link aggregate. These tests can be executed at any time to verify that the software for the network physical port is correctly installed on the server.

Figure 8-3 Flowchart 3: Network Physical Port Configuration Test



Flowchart 3 Procedures



NOTE Check that your network physical port connectors between the card and switch (or wall plug) are fully connected before beginning this flowchart.

- A. Enter: `lanscan`. Enter the `lanscan -v` command to display information about network physical ports and the link aggregates that are successfully installed on the system. Some network physical ports may

show up as part of a specific link aggregate and not as standalone ports. See Table 7-1 for a detailed description of how to determine which link aggregate a specific network physical port belongs to.

See the `lanscan` online manpage for more detailed information.

- B. Is your interface displayed? `lanscan` shows information about every LAN card in the system backplane. The Hardware Path of one of the entries should correspond to the network physical port slot multiplied times four. For example, a hardware path of 32 corresponds to a network physical port in slot 8.
- C. Hardware up? The hardware state is operational if up is displayed for the network physical port under the Hardware State heading. If it is, continue to Flowchart 5. If not, go to Step D.
- D. Enter `ioscan`. This will scan the system hardware and list the results. If you enter `ioscan -f`, output similar to the following will be displayed:

Example 8-2 Sample `ioscan -f` Output

Class	I	H/W Path	Driver	S/W State	H/W Type	Description
bc	0		root	CLAIMED	BUS_NEXUS	
bc	1	8	ccio	CLAIMED	BUS_NEXUS	I/O Adapter
ba	0	8/4	GSctoPCI	CLAIMED	BUS_NEXUS	PCI Bus Bridge - GSctoPCI
lan	4	8/4/1/0	btlan4	CLAIMED	INTERFACE	PCI(10110009) -- Built-in #1
lan	5	8/4/2/0	btlan4	CLAIMED	INTERFACE	PCI(10110009) -- Built-in #2
ba	1	8/8	GSctoPCI	CLAIMED	BUS_NEXUS	PCI Bus Bridge - GSctoPCI
lan	6	8/8/1/0	btlan4	CLAIMED	INTERFACE	PCI(10110009) -- Built-in #1
lan	7	8/8/2/0	btlan4	CLAIMED	INTERFACE	PCI(10110009) -- Built-in #2
ba	2	8/12	GSctoPCI	CLAIMED	BUS_NEXUS	PCI Bus Bridge - GSctoPCI
lan	8	8/12/1/0	btlan4	CLAIMED	INTERFACE	PCI(10110009) -- Built-in #1
lan	9	8/12/2/0	btlan4	CLAIMED	INTERFACE	PCI(10110009) -- Built-in #2
bc	2	10	ccio	CLAIMED	BUS_NEXUS	I/O Adapter
ext_bus	0	10/0	c720	CLAIMED	INTERFACE	GSC built-in Fast/Wide SCSI
target	0	10/0.6	tgt	CLAIMED	DEVICE	
disk	0	10/0.6.0	sdisk	CLAIMED	DEVICE	HP C2490WD
target	1	10/0.7	tgt	CLAIMED	DEVICE	
ctl	0	10/0.7.0	sctl	CLAIMED	DEVICE	Initiator
bc	3	10/4	bc	CLAIMED	BUS_NEXUS	Bus Converter
tty	0	10/4/0	mux2	CLAIMED	INTERFACE	MUX
lanmux	0	10/4/4	lanmux0	CLAIMED	INTERFACE	HP J2146A - 802.3 LAN
lan	1	10/4/4.1	lan3	CLAIMED	INTERFACE	
ba	3	10/8	GSctoPCI	CLAIMED	BUS_NEXUS	PCI Bus Bridge - GSctoPCI
lan	2	10/8/1/0	btlan4	CLAIMED	INTERFACE	PCI(10110009) -- Built-in #1
lan	3	10/8/2/0	btlan4	CLAIMED	INTERFACE	PCI(10110009) -- Built-in #2
ba	4	10/12	bus_adapter	CLAIMED	BUS_NEXUS	Core I/O Adapter
ext_bus	1	10/12/5	c720	CLAIMED	INTERFACE	Built-in SCSI
target	2	10/12/5.2	tgt	CLAIMED	DEVICE	
target	3	10/12/5.7	tgt	CLAIMED	DEVICE	
ctl	1	10/12/5.7.0	sctl	CLAIMED	DEVICE	Initiator
lan	0	10/12/6	lan2	CLAIMED	INTERFACE	Built-in LAN
ps2	0	10/12/7	ps2	CLAIMED	INTERFACE	Built-in Keyboard/Mouse
processor	0	32	processor	CLAIMED	PROCESSOR	Processor
processor	1	34	processor	CLAIMED	PROCESSOR	Processor
memory	0	49	memory	CLAIMED	MEMORY	Memory
ba	0	8/4	GSctoPCI	CLAIMED	BUS_NEXUS	PCI Bus Bridge - GSctoPCI
lan	4	8/4/1/0	btlan4	CLAIMED	INTERFACE	PCI(10110009) -- Built-in #1
lan	5	8/4/2/0	btlan4	CLAIMED	INTERFACE	PCI(10110009) -- Built-in #2

If there are multiple network physical ports installed in the system then the output above will be duplicated with only the H/W Path column changing to reflect the correct hardware path information. The example above shows multiple HSC 100BT cards installed.

- E. *Is driver in kernel?* If the driver has not been generated into the kernel, `ioscan` output will be similar to (but not necessarily the same as):

Example 8-3 Sample ioscanner -f Output

```
# ioscanner -f
Class      I  H/W Path  Driver   S/W State  H/W Type  Description
=====
unknown   -1  10/4/4   UNKNOWN  UNCLAIMED INTERFACE
```

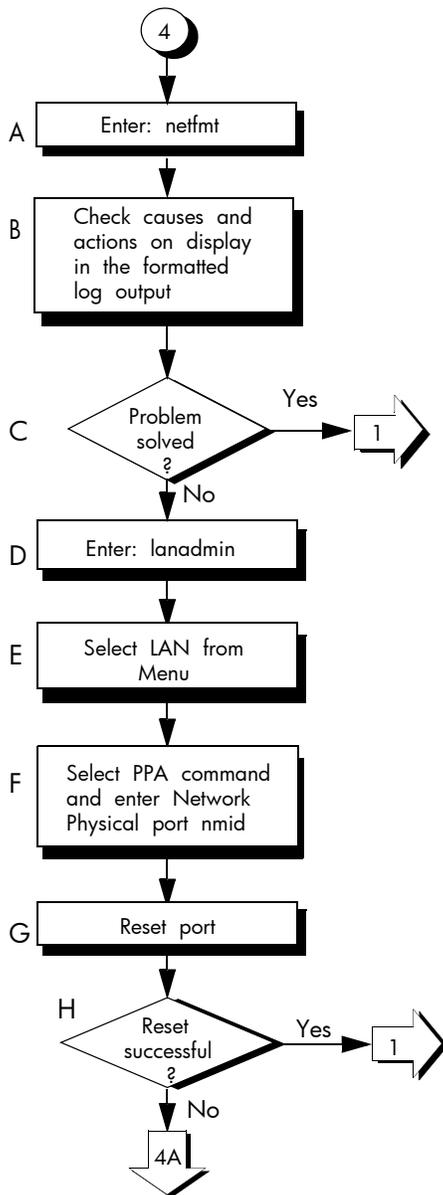
The `class` and `driver` fields alone will indicate "unknown" status if the kernel has not been generated. If the driver has not been generated, continue to Step F. If the driver is in the kernel, go to Step G.

- F. *Verify or edit /stand/system and regen kernel.* Verify/edit that `/stand/system` contains the appropriate keyword for the networking adapter you are using. For example, if you are using the HSC 100BT network adapter, the keyword `btlan4` should appear. Or, if using a V-class PCI 100BT network adapter, the keyword `btlan6` should appear. If not, see "Creating a New Kernel" in Chapter 3 of the *Installing and Administering LAN/9000 Software* manual for instructions on how to edit `/stand/system` to create a new kernel.
Verify that the required patch is installed for the network physical port which is being used. "Required Software" (pg. 19) for a list of required patches.
- G. *Check Hardware.* Verify that the network card is seated correctly and that it is operational.
- H. *Reboot the system.*
- I. *Problem fixed?* If you have found the appropriate network physical port problem, stop. If not, start again with Flowchart 1.

Flowchart 4: Network Physical Port Configuration Test

The following flowchart should be used for each of the network physical ports which are being configured in a specific link aggregate. These tests can be executed at any time to verify if there are any `nettl` log messages associated with the network physical ports that are being configured in a link aggregate.

Figure 8-4 Flowchart 4: Network Physical Port Configuration Test



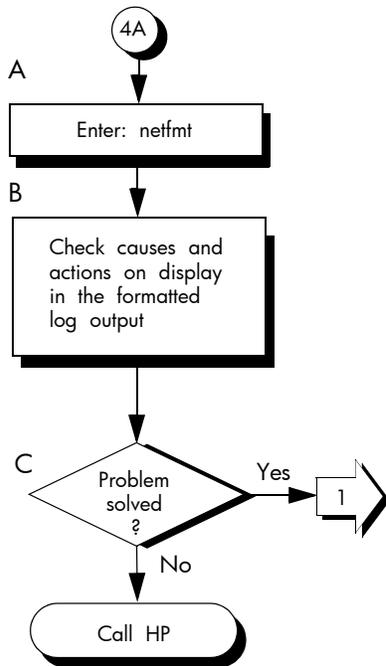
Flowchart 4 Procedures

- A. Enter: `netfmt`. Use the `netfmt` command to view log data (error and disaster messages). For example:

```
# netfmt -v -f /var/adm/nett1.LOG00 | more
```
- B. Check causes and actions on display in the formatted log output. Use the time stamp to find the proper logs. Ensure that you are looking at the appropriate network physical port information.
- C. Problem solved? If YES, go to Flowchart 1. If not, continue with Step D.
- D. Enter `lanadmin`. For a complete description of this command, see `lanadmin(1M)`.
- E. Select LAN from Menu. Select `lan` to enter the LAN Interface diagnostic.
- F. Select the `PPA` command and enter the Network Physical Port PPA. You can use the `lanscan` command to find the current PPA for the network physical port. The PPA you enter becomes the current device to be tested.
- G. Reset the network physical port according to Steps D through G in Flowchart 4. The `reset` command in `lanadmin` re-executes the LAN network physical port self-test.
- H. Reset successful? The reset is successful if no errors are displayed as a result of the reset command. If the self-test was successful, the problem may be that you are not connected to the network properly. Correct the problem and verify the resolution by continuing with Flowchart 1. Otherwise, go to Flowchart 4A.

Flowchart 4A: Network Physical Port Configuration Test

Figure 8-5 Flowchart 4A: Network Physical Port Configuration Test



Flowchart 4A Procedures

- A. Enter: `netfmt`. Use the `netfmt` command to view log data (error and disaster messages). For example:

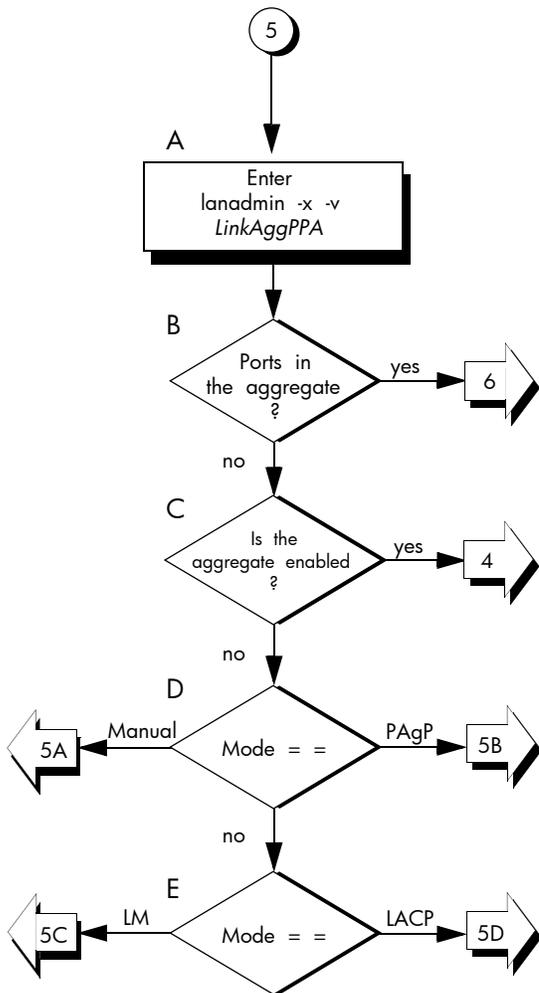
```
# netfmt -v -f /var/adm/nett1.LOG00 | more
```

Extend the search to LOG01 as information may have rolled (overflowed) into this file from LOG00.
- B. *Check causes and actions on display in the formatted log output.* Use the time stamp to find the proper logs. Ensure that you are looking at the appropriate network physical port information.
- C. *Problem solved?* If YES, go to Flowchart 1. If not, contact your HP representative.

Flowchart 5: Link Aggregate Configuration Test

The following tests should be executed on the specific link aggregate which is not working correctly.

Figure 8-6 Flowchart 5: Link Aggregate Configuration Test



Flowchart 5 Procedures

Note that 11.0 instance numbers start at 100, and all versions of 11i start at 900.

HP-UX 11i (all versions)

- A. Enter `lanadmin -x -v LinkAggPPA`. Sample output for three scenarios using link aggregate 900 follows. Case 1 shows that a link aggregate is enabled and there are ports in the aggregate. Case 2 shows that there were ports in the aggregate, but they are currently down. In case 3, the link aggregate is not enabled and either you need to add ports to enable it (LAN Monitor or Manual mode) or turn on LACP/PAGP aggregation protocols, so ports could be added to the aggregate automatically.

Case 1:

```
# lanadmin -x -v 900
Linkaggregate PPA #       : 900
Number of Ports           : 2
Ports PPA                 : 5 6
Link Aggregation State    : LINKAGG MANUAL
Group Capability           : 0
Load Balance Mode         : MAC Address Based (LB_MAC)
```

Case 2:

```
# lanadmin -x -v 900
Linkaggregate PPA #       : 900
Number of Ports           : 0
Ports PPA                 : NONE
```

```
Link Aggregation State : LINKAGG HAS NO PORTS
Group Capability       : 0
Load Balance Mode     : MAC Address Based (LB_MAC)
```

Case 3:

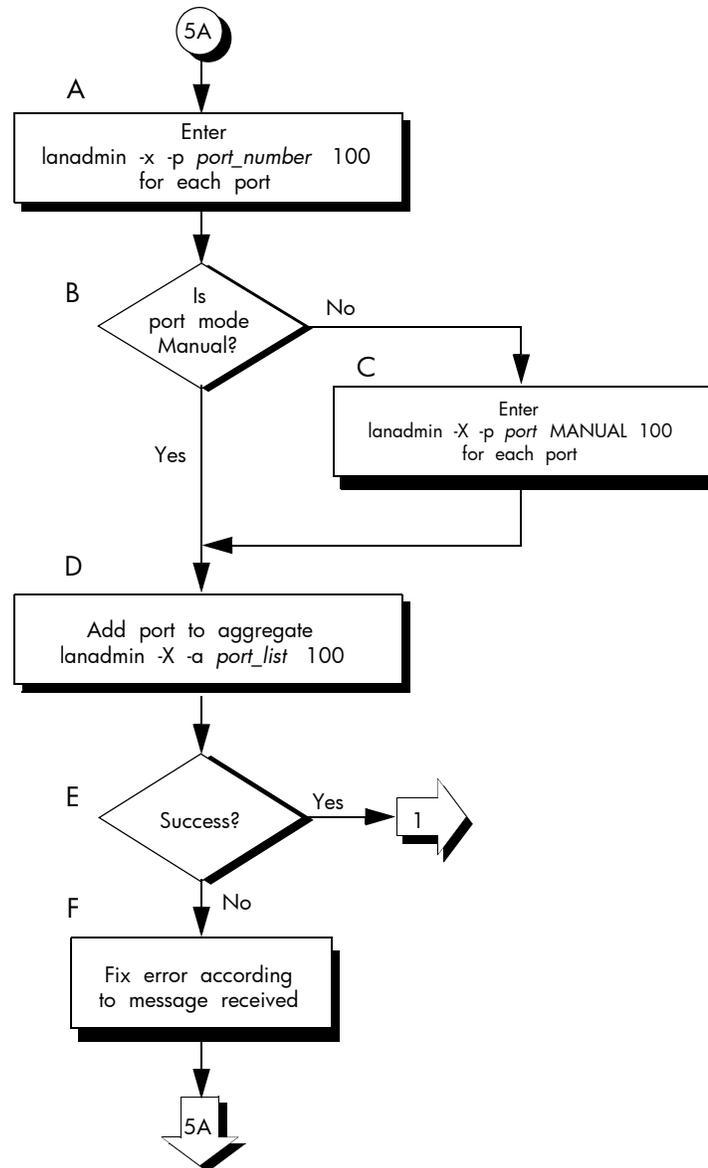
```
# lanadmin -x -v 900
Linkaggregate PPA #   : 901
Number of Ports      : 0
Ports PPA            : NONE
Link Aggregation State : LINKAGG IS NOT ENABLED
Group Capability     : 0
Load Balance Mode    : MAC Address Based (LB_MAC)
```

See [Table 7-1](#) for a detailed list of supported commands and their usage.

- B. If there are ports in the aggregate, as shown by the Ports PPA line above, go to Flowchart 6. Otherwise continue to the Step C.
- C. If the aggregate is enabled, go to Flowchart 4. Otherwise continue to Step D.
- D & E. Depending on the mode (MANUAL, FEC_AUTO, LAN_MONITOR, or LACP_AUTO) in which you want to enable the aggregate, follow Flowchart 5A, 5B, 5C, OR 5D as appropriate. FEC_AUTO is the same as PAgP and LAN_MONITOR is also being referred to as LM.

Flowchart 5A: Manual Configuration Test

Figure 8-7 Flowchart 5A: Manual Configuration Test



Flowchart 5A Procedures

- A. Enter `lanadmin -x -p portppa 900` to determine the mode for each of the ports that you want to be a part of the aggregate in MANUAL mode. For example, to determine the status of port PPA 4, enter:

```
lanadmin -x -p 4 900
```

For more examples of the `lanadmin` command, see [Table 7-1](#).

- B. Examine the output and look at the mode. If the port mode is not MANUAL go to Step C. Otherwise go to Step D.
- C. Enter `lanadmin -X -p portppa MANUAL 900` to change the state to MANUAL for all the ports which were not in MANUAL mode.
- D. Add the ports to the aggregate using the following command syntax:

```
lanadmin -X -a PortPPA LinkAggPPA
```

This command will add the network physical ports with *PortPPA* numbers to the link aggregate with *LinkAggPPA*. For example, to add network physical ports with PortPPAs 1,2,3, and 4 to aggregate 900, enter:

```
lanadmin -X -a 1 2 3 4 900
```

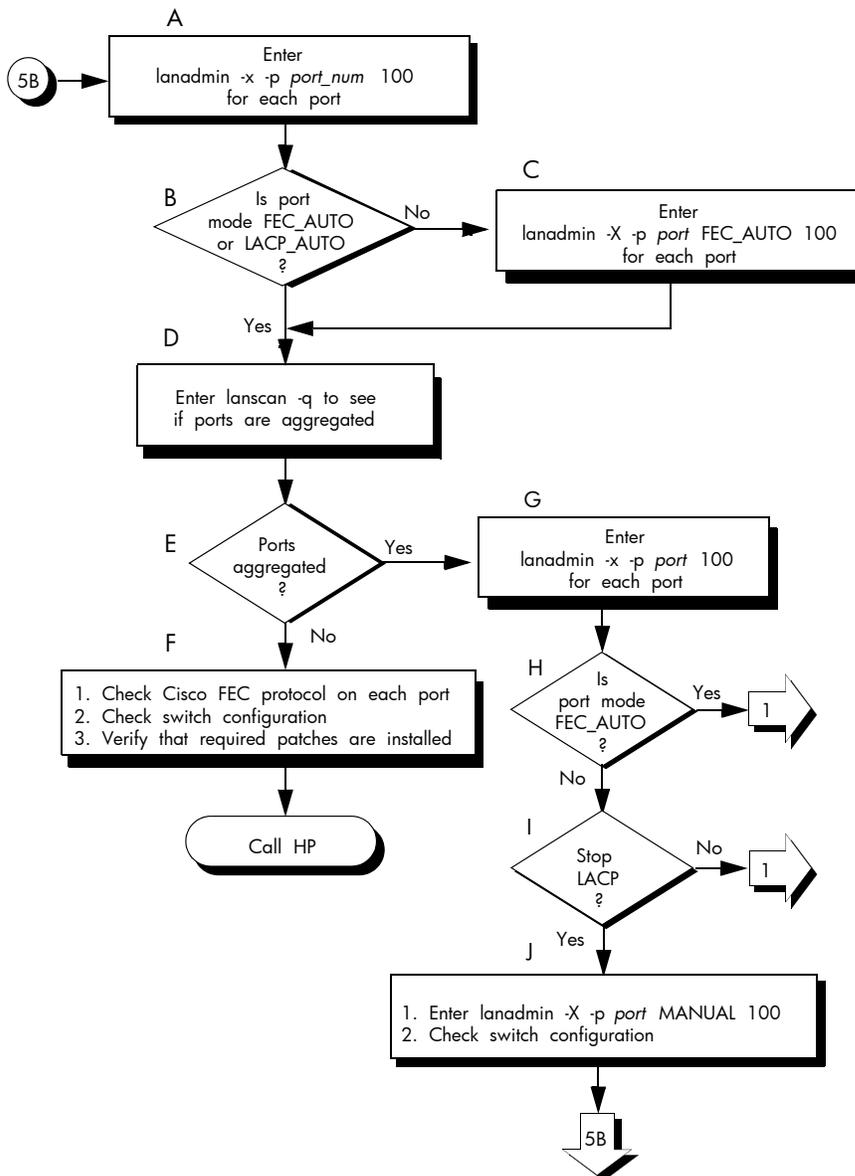
- E. Did the above command complete successfully? If YES go to Flowchart 1. If NO fix the error according to the error message and go back to the beginning of this flowchart.



NOTE The link aggregate can be configured, but there can still be misconfiguration problems on the switch. Its imperative that both the switch and the server links aggregates are consistent in order for successful network communication to occur.

Flowchart 5B: PAgP Configurations Test

Figure 8-8 Flowchart 5B: PAgP Configuration Test



Flowchart 5B Procedures

- A. Enter `lanadmin -x -p portppa 900` to determine the mode for each of the ports that you want to be a part of the aggregate in PAgP mode. For example, to determine the status of portppa 4, enter:

```
lanadmin -x -p 4 900
```

For more examples of the `lanadmin` command, see Table 7-1.

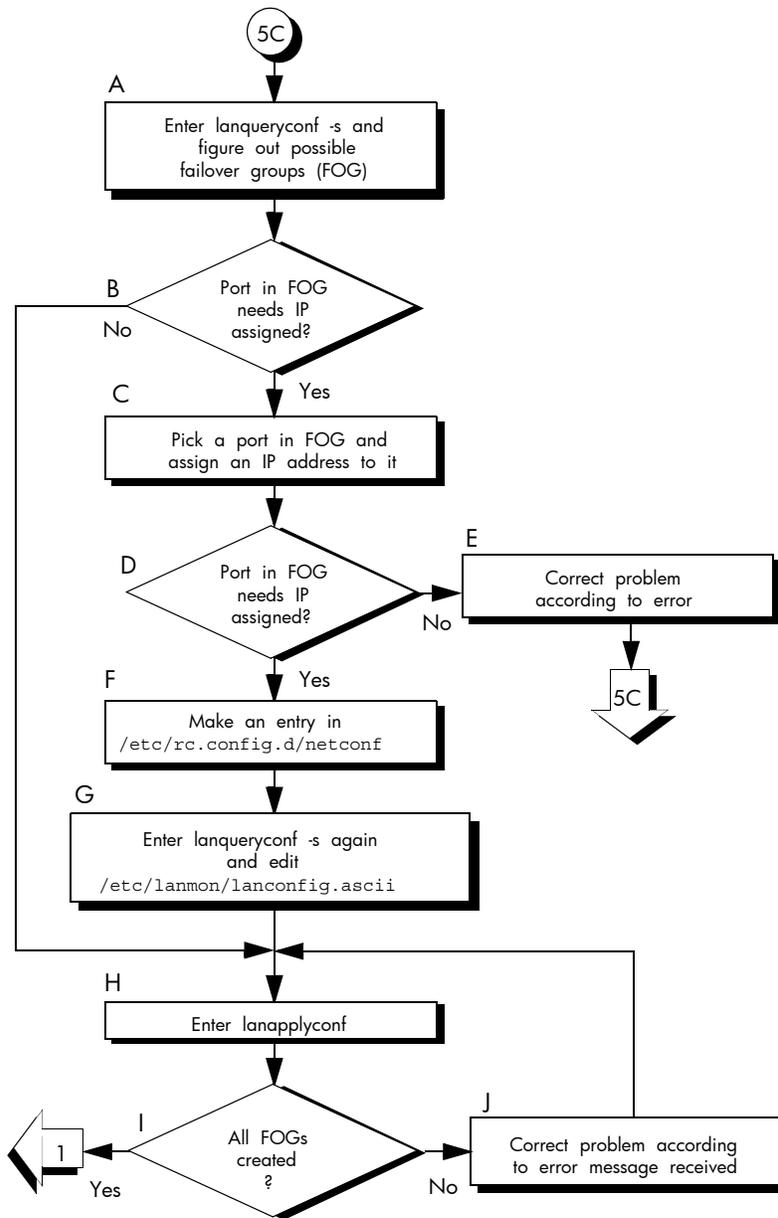
- B. Examine the output and look at the mode. If the port mode is neither FEC_AUTO nor LACP_AUTO go to Step C. Otherwise go to Step D.
- C. Enter: `lanadmin -X -p portppa FEC_AUTO 900` to change the state to FEC_AUTO for all the ports which were in MANUAL mode. Wait 30 seconds for the aggregation protocol to establish the connection.
- D & E. Enter `lanscan q` to see if ports are aggregated. If YES go to Step G. If NO go to Step F.
- F. *Ports aggregated?* If the are not aggregated, then the following should be verified for correctness.
1. Auto Add:
If you are attempting to enable a link aggregate via the Cisco Fast EtherChannel protocol check the network physical port status with the following command:
`lanadmin -x -p PortPPA LinkAggPPA`
This command displays output similar to the following:

```
Port FEC Mode
Port State
Port Group Capability
Port Priority
```

The Port State field should show UP if the Cisco FastEtherChannel Protocol has negotiated successfully. If the Port State is not UP then go to Step 3, below.
 2. Switch Configuration:
Verify that the switch is configured correctly. Refer to the appropriate switch documentation to determine if the switch ports connected to the server are configured correctly for link aggregation.
 3. Required Patches:
Verify that required patches are properly installed on your server. See "Required Software" to determine which patches are required for the HP Auto-Port Aggregation Product.
If all of the checks above are OK then call your HP Representative. If any step is not OK, then correct the problem and go back to Step A.
- G. Enter the following command again:
`lanadmin -x -p portppa LinkAggPPA`
- H. Is port mode FEC_AUTO? If YES go to Flowchart 1. If NO, go to Step I.
- I. Stop LACP? The port mode must be LACP_AUTO. If you DO NOT want to stop LACP on the ports, go to Flowchart 1. If you DO want to use the ports for PAgP go to Step J.
- J.
 1. Enter `lanadmin -X -p port MANUAL 900` to stop the LACP protocol.
 2. Check switch configuration. Check the configuration to ensure the port should not run IEEE 802.3ad LACP protocol, but Cisco Fast EtherChannel protocol.
Wait 30 seconds for the port to settle down and then start this flowchart's procedure again.

Flowchart 5C: LAN Monitor Configuration Test

Figure 8-9 Flowchart 5C: LAN Monitor Configuration Test



Flowchart 5C Procedures

- A. `lanqueryconf -s` determines which set of ports are on the same subnet, and which one of them is configured with an IP address and writes valid configurations to the default file `/etc/lanmon/lanconfig.ascii`. It also prints a warning message if none of the ports on a subnet have an IP address assigned. For more information, see `lanqueryconf(1M)`.

Enter `lanqueryconf -s` to do a system-wide search for ports/links that can form failover groups.

Example 1:

`lanqueryconf -s` fails to find ports that can form a failover group.

```
# lanqueryconf -s
```

```
WARNING: None of the ports in subnet ( lan2 ) have an IP address assigned
WARNING: None of the ports in subnet ( lan4 ) have an IP address assigned
WARNING: None of the ports in subnet ( lan12 ) have an IP address assigned
WARNING: None of the ports in subnet ( lan6 lan7 ) have an IP address assigned
No Fail-Over groups found. ASCII file not created.
```

Example 2:

lanquery -s successfully finds ports that can form a failover group.

```
# lanqueryconf -s
```

ASCII output is in file /etc/lanmon/lanconfig.ascii

The /etc/lanmon/lanconfig.ascii file looks like:

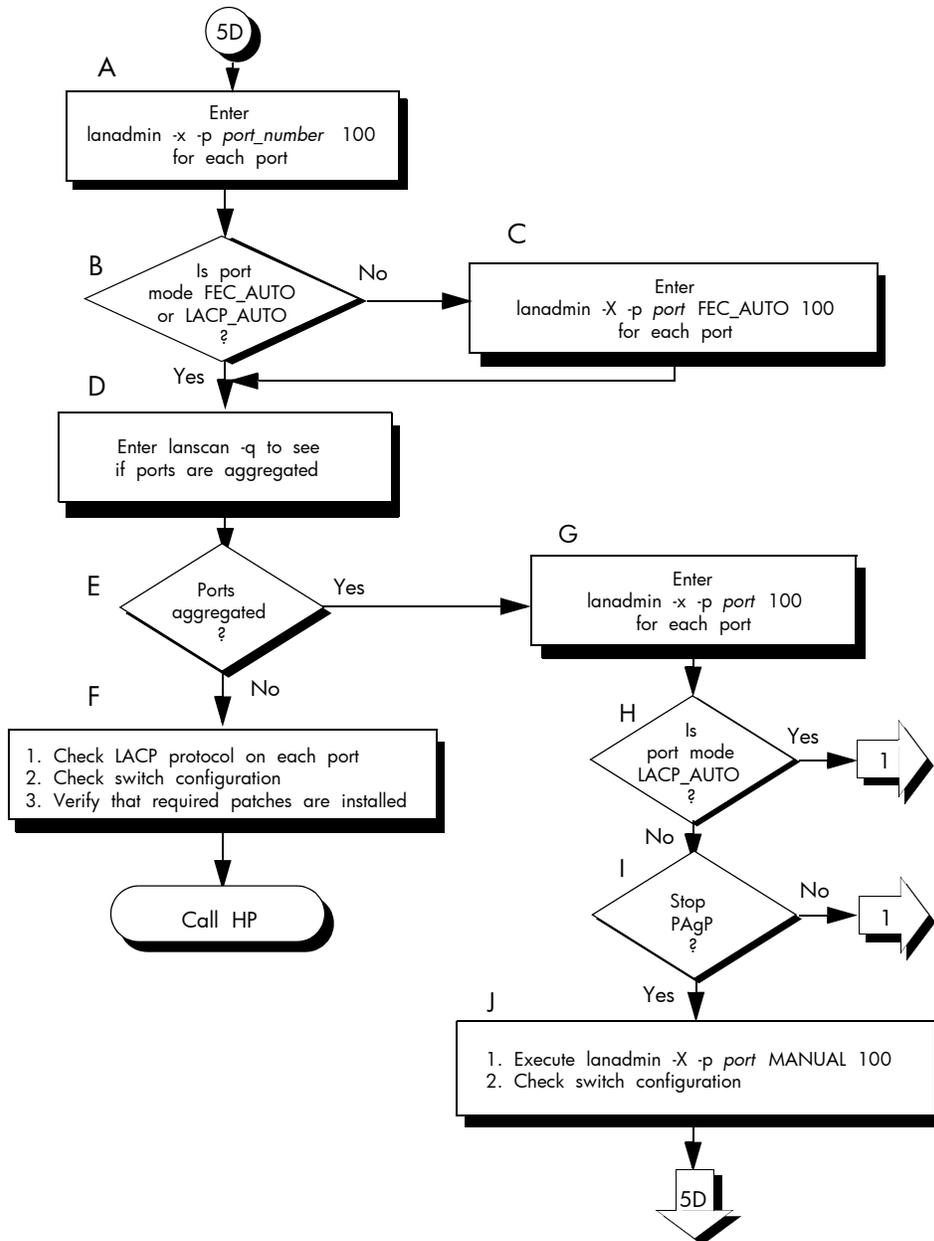
```
NODE_NAME          hpntc6s
POLLING_INTERVAL   1000000
DEAD_COUNT          3

FAILOVER_GROUP      lan901
  STATIONARY_IP      194.12.14.56
  PRIMARY             lan0     5
  STANDBY             lan2     3
```

- B. If none of the ports in a failover group has an IP address assigned, lanqueryconf prints a warning message.
- C. The port that you choose to assign an IP address carries all the traffic to and from the failover group. This port is called the primary port, and in the event of failure of this port, the next highest priority port among the standby ports takes over. Use the following syntax for the ifconfig command:
ifconfig interface ip_address up
Example: ifconfig lan3 192.12.14.56 up
For more details, see ifconfig(1M).
- D. Enter ifconfig interface to check if the command in Step C was successful. For example:
ifconfig lan3
lan3: flags=843<UP, BROADCAST RUNNING MUTICAST>
 inet 192.12.14.56 netmask ffffffff broadcast 192.12.14.255
- E. Correct any problem with the ifconfig flags or other error indications and repeat from Step A. Use ifconfig(1M) to understand the errors.
- F. An entry in /etc/rc.config.d/netconf helps in configuring IP addresses automatically by using the rc scripts on boot up.
- G. Enter lanqueryconf -s again so it can determine which ports can form failover groups.
- H. Enter lanapplyconf. This reads the information in a configuration file, forms failover groups with it as described in the configuration file, and switches the IP address from the primary port to the failover group. The default configuration file is /etc/lanmon/lanconfig.ascii.
- I. If at least one failover group was created, the command succeeds. If lanapplyconf printed warning or error messages, then some or all of the failover groups may not be created. Check if all configured FOGs are created, if so go to Flowchart 1. Otherwise go to Step J.
- J. Check error and warning messages printed by the lanapplyconf command in step I. Rectify any errors and warnings and go to Step H to enter lanapplyconf again. If previous lanapplyconf commands created only some failover groups from the configuration file, then those failover groups will be reported as "already in use" when lanapplyconf is entered a second time. This can be safely ignored.

Flowchart 5D: LACP Configuration Test

Figure 8-10 Flowchart 5D: LACP Configuration Test



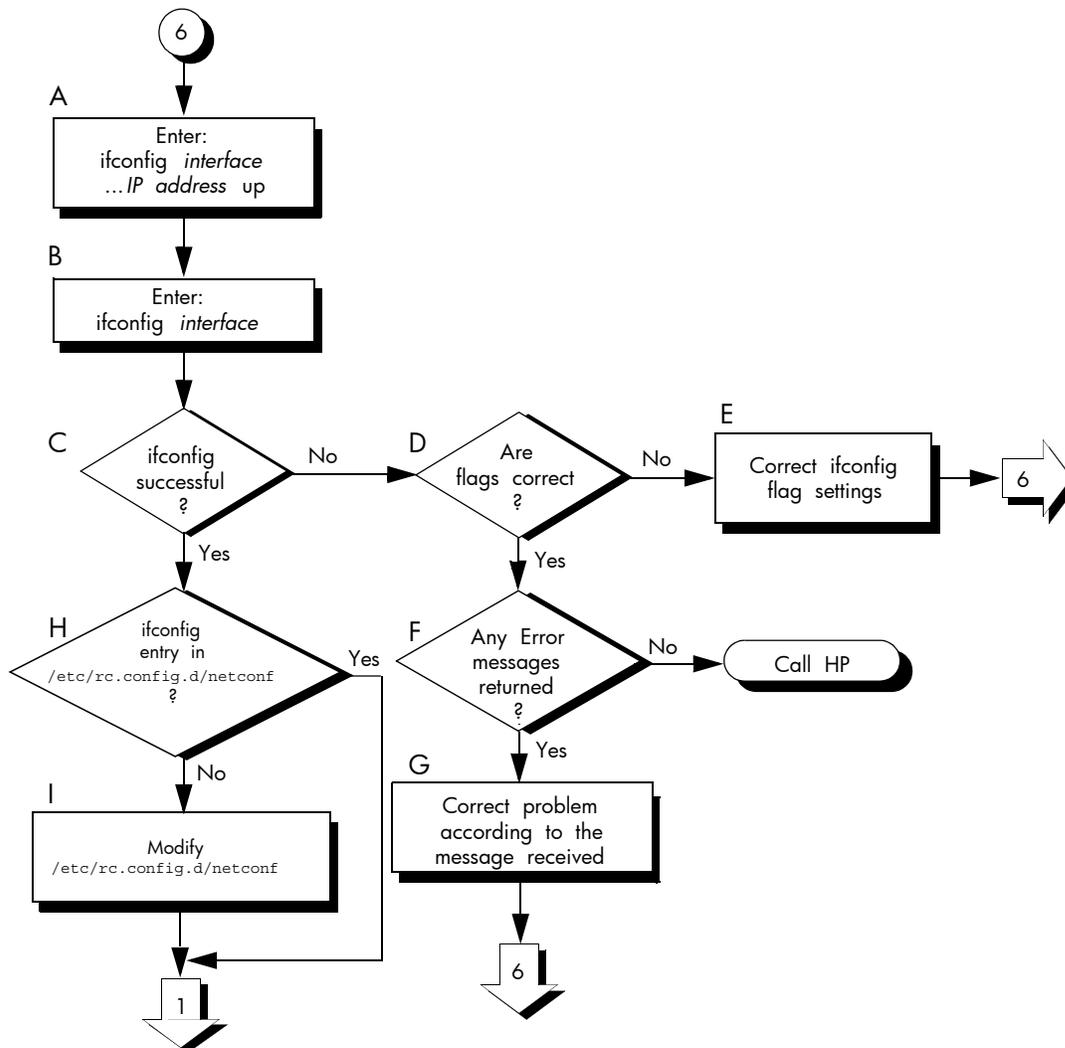
Flowchart 5D Procedures

- A. Enter `lanadmin -x -p portppa 900` to determine the mode for each of the ports that you want to be a part of the aggregate in PAgP mode. For example, to determine the status of portppa 4, enter:
lanadmin -x -p 4 900
For more examples of the `lanadmin` command, see [Table 7-1](#).
- B. Examine the output and look at the mode. If the port mode is not `FEC_AUTO` or `LACP_AUTO` go to Step C. Otherwise go to Step D.
- C. Enter `lanadmin -X -p portppa LACP_AUTO 900` to change the state to `LACP_AUTO` for all the ports which were in `MANUAL` mode. Wait 30 seconds for the aggregation protocol to establish the connection.
- D & E. Enter `lanscan -q` to see if ports are aggregated. If YES go to Step G. If NO go to Step F.

- F. Ports aggregated? If the ports are not aggregated, then the following should be verified for correctness.
1. Auto Add:
If you are attempting to enable a link aggregate via the IEEE 802.3ad LACP Protocol. Check the network physical port status with the following command:
`lanadmin -x -p PortPPA LinkAggPPA`
This command displays output similar to the following:
Port LACP Mode
Port State
Port Group Capability
Port Priority
The Port State field should be UP if the IEEE 802.3ad LACP Protocol has negotiated successfully. If the Port State is not UP then go to Step 3, below.
 2. Switch Configuration:
Verify that the switch is configured correctly. Refer to the appropriate switch documentation to determine if the switch ports connected to the server are configured correctly for link aggregation.
 3. Required Patches:
Verify that required patches are properly installed on your server. See "Required Software" (pg. 19) to determine which patches are required for the HP Auto-Port Aggregation Product.
- If all of the checks above are OK, call your HP Representative. If any step is not OK, correct the problem and go back to Step A.
- G. Enter the following command again:
`lanadmin -x -p portppa LinkAggPPA`
- H. Is port mode LACP_AUTO? If YES go to Flowchart 1. If NO, go to Step I.
- I. Stop PAgP? The port mode must be FEC_AUTO. If you DO NOT want to stop FEC_AUTO (PAgP) on the ports, go to Flowchart 1. If you DO want to stop PAgP and use the ports for LACP go to Step J.
- J.
 1. Enter `lanadmin -x -p port MANUAL 900` to stop the FEC_AUTO (PAgP) protocol.
 2. Check switch configuration. Check the configuration to ensure the port should not run Cisco's FEC_AUTO protocol, but IEEE 802.3ad LACP protocol.
Wait 30 seconds, then start this flowchart's procedure again.

Flowchart 6: Network Configuration Test

Figure 8-11 Flowchart 6: Network Configuration Test



Flowchart 6 Procedures

- A. Enter `ifconfig interface IP address up` on the link aggregate you want to configure in order to ensure that the link aggregate is enabled. For example, to configure an IP address for the link aggregate lan900, enter:

```
ifconfig lan900 192.6.1.17 up
```

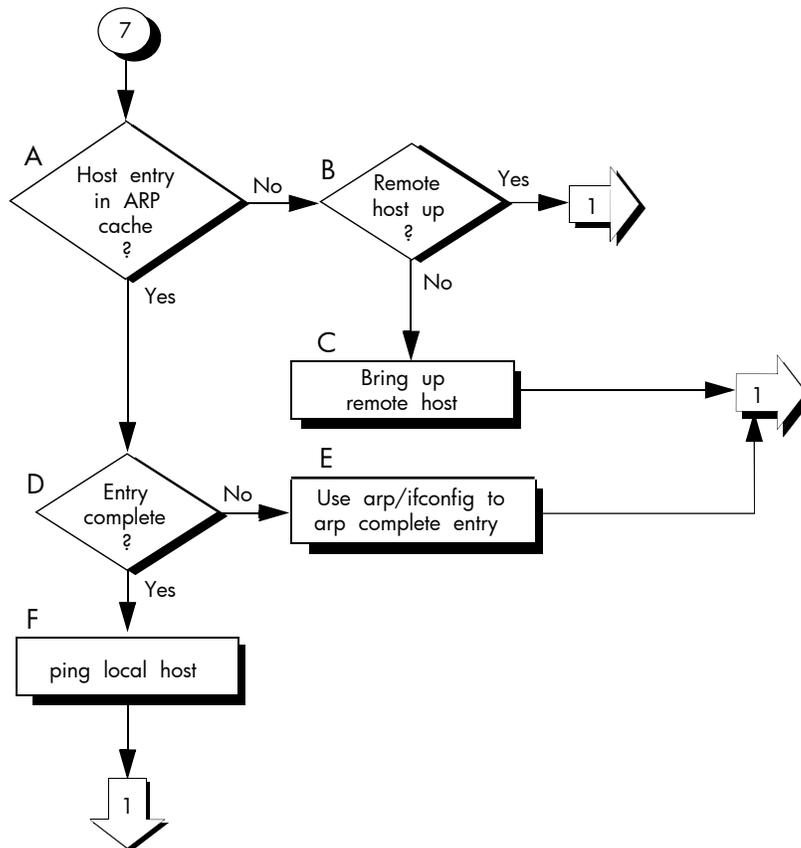
 For more examples of the `ifconfig` command, see `ifconfig(1M)`.
- B. Enter `ifconfig interface` without the `up` parameter again, to check the flag setting on the link aggregate you want to test for the UP parameter. For example, to check the link aggregate lan900, enter:

```
ifconfig lan900
```
- C. `ifconfig successful?` `ifconfig` was successful if the output shows the correct Internet address and the flags: `<UP, BROADCAST, NOTRAILERS, RUNNING>`.
 Note: Make sure the UP flag is displayed.
- D. `Are flags correct?` If `flags` are not correct, use the `ifconfig` command to correct them. If they are correct, go to Step F.
- E. Correct the `ifconfig flag` settings. If `ifconfig` returns an incorrect `flag` setting, re-enter the command with the proper setting. For more information, see `ifconfig(1M)`. Start again with Flowchart 5, as necessary.

- F. Any error message returned? If `ifconfig` is not successful, and an error message appears, go to Step G. If no error messages appear, contact your HP representative.
- G. Correct the problem according to the message received. If you received an error message, make the appropriate corrections stated in the message and then begin this procedure again.
- H. `ifconfig` entry in `/etc/rc.config.d/netconf`?
Check that there is an entry in the `/etc/rc.config.d/netconf` file for your 10/100Base-TX card.
- I. Modify the `/etc/rc.config.d/netconf` file according to the IP address you want assigned to the link aggregate. Then enter the following command:
`/sbin/init.d/net start`
For more information, refer to `ifconfig(1M)`. Go back to Flowchart 1 to verify that the problem has been solved.

Flowchart 7: ARP Verification

Figure 8-12 Flowchart 7: ARP Verification



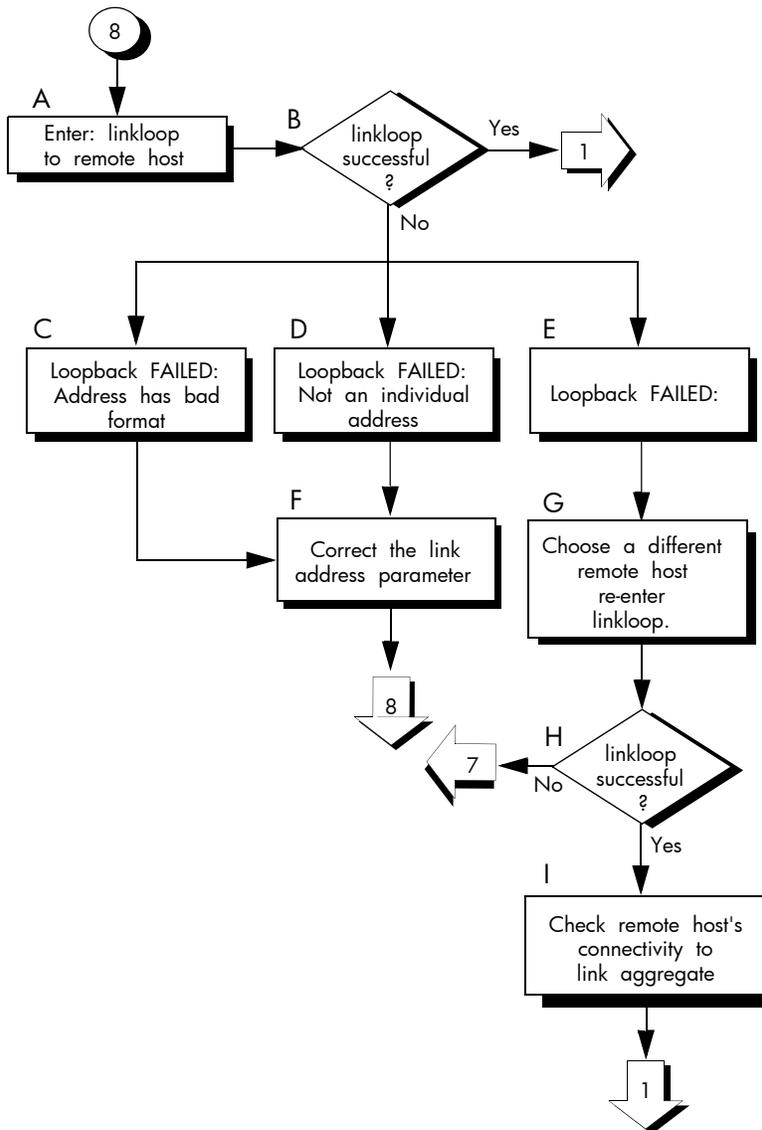
Flowchart 7: Procedures

- A. Host entry in ARP cache? Using `arp`, check that an entry exists for the remote host in your system's ARP cache. For example, enter:
`arp spiff`
- B. Remote host up? If there is no ARP cache entry for the remote host, first check that the remote host is up. If not, the remote host has not broadcast an ARP message, and that probably is why there is no entry in the ARP cache
- C. Bring up the remote host. Have the node manager of the remote host bring that system up and start again with Flowchart 1.
- D. Entry complete? Check to see if there is an ARP cache entry, but it is wrong or not complete. If the entry is complete, go to Step F.

- E. Use `arp` to complete entry. Using `arp`, enter the correct Station Address. For more information, refer to `arp(1M)`. Also, try running the following commands on the link aggregate which is not working properly. For example, if link aggregate 900 is not working properly enter the following commands:
- ```
ifconfig lan900 down
ifconfig lan900 up
```
- Start again with Flowchart 1.
- F. ping local host. Using `ping`, do an internal loopback on your own system. In other words, ping your own system.
- If the internal loopback is successful, your system is operating properly to the Network Layer (OSI Layer 3). In addition, you know an ARP cache entry for the remote host exists on your system. Start again with Flowchart 1.

## Flowchart 8: Link Level Loopback Test

**Figure 8-13** Flowchart 8: Link Level Loopback Test



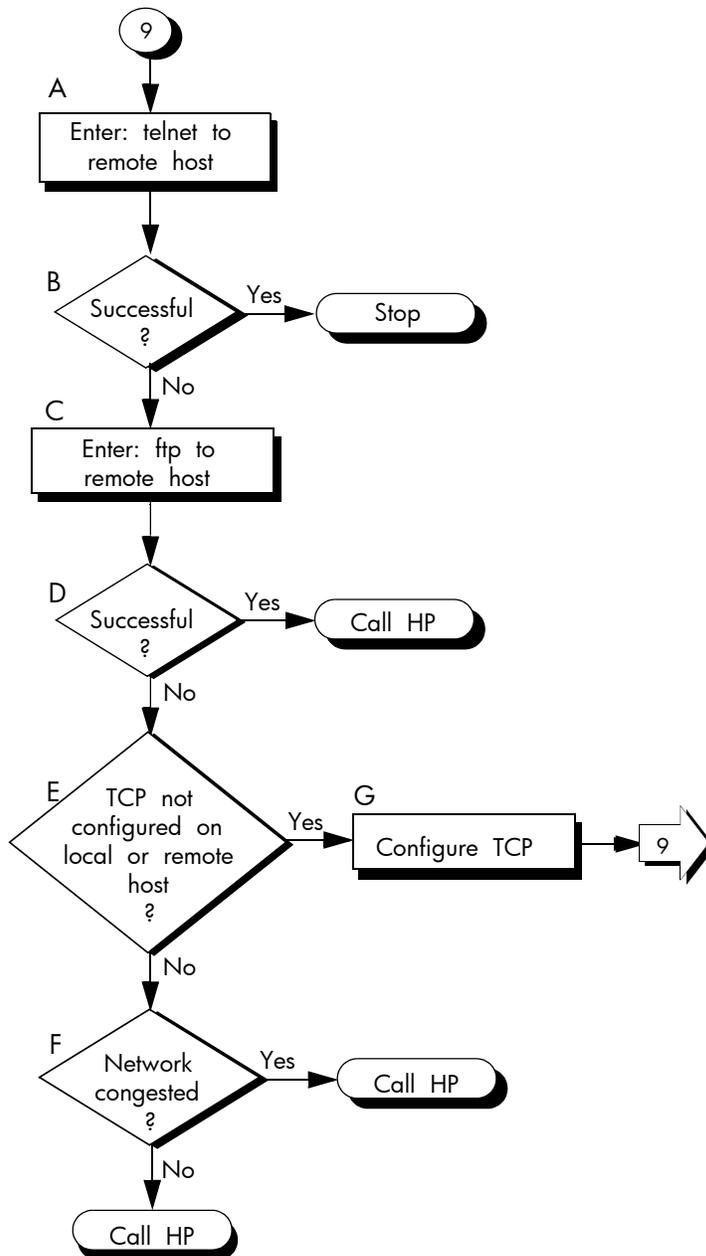
### Flowchart 8 Procedures

- A. Enter: `linkloop` to the remote host. Enter the PPA of your link aggregate and link level address (station address) of the remote host in hexadecimal form (preceded by "0x"). Enter `lanscan` on the local system to find the PPA and obtain the link level address (station address) of the remote host. For more information on the `linkloop` command, see `linkloop(1M)`.

- B. linkloop successful? If the test was successful, go to Flowchart 1 to verify that the problem is solved. Network connectivity is OK through the Link Layer (OSI Layer 2). If not successful, note which error was returned and continue with this flowchart.
- C. Loopback failed: Address has bad format. The link level address is not correct. Go to Step F.
- D. Loopback failed: Not an individual address. The link level address is not correct. The first hexadecimal digit has its high order bit set (if the value is equal to or greater than 8, it is set). This means it is a multicast or broadcast address, which is not allowed. The address must be unique to one remote host. Go to Step F.
- E. Loopback failed. The remote host did not respond. Go to Step G.
- F. Correct the link address parameter. Change the link level address to an allowed value and start again with Flowchart 8.
- G. Choose a different remote host; re-enter linkloop. Restart Flowchart 7 using a different remote host. If this does not work, then check the switch configuration to verify the link aggregate on the switch is configured correctly.
- H. linkloop successful? If the test was successful, go to Step I. Network connectivity is OK through the Link Layer (OSI Layer 2). If not successful, the problem may be with the remote system. Go to Flowchart 7.
- I. Check remote host's connectivity to link aggregate. Contact the node manager of the remote host. Check that the host is configured correctly and that its network interface is up. If necessary, use Flowchart 1 to verify configuration of the remote host.

## Flowchart 9: Transport Level Loopback Test (using ARPA)

**Figure 8-14** Flowchart 9: Transport Level Loopback Test (using ARPA)



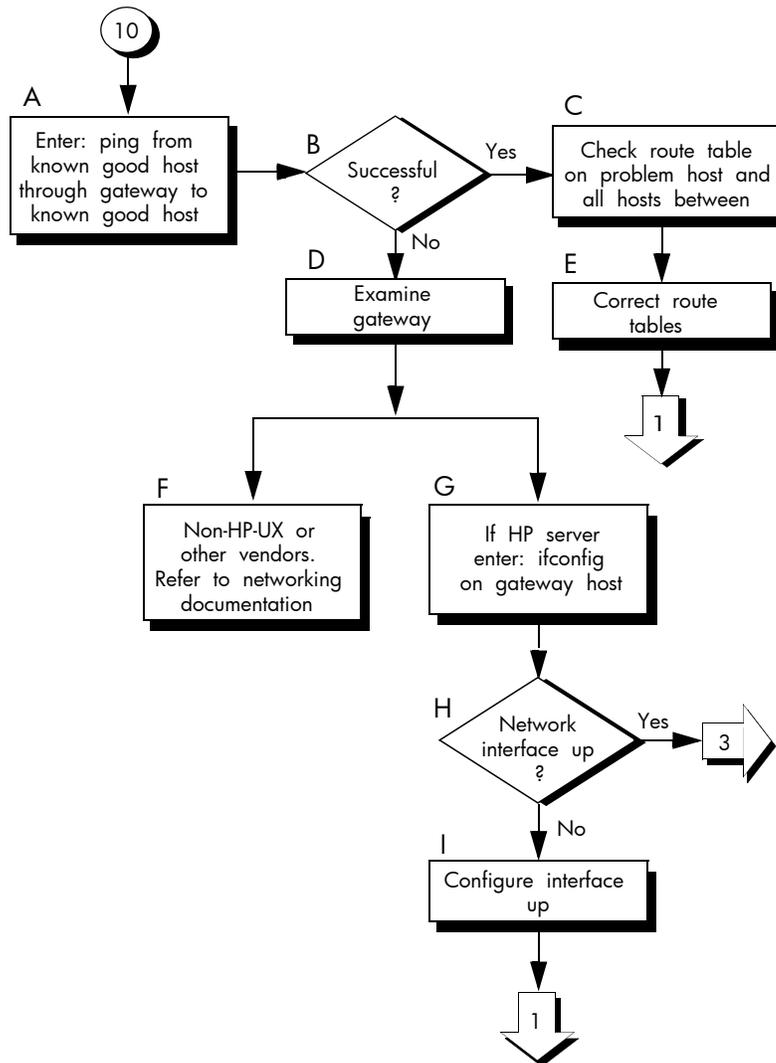
### Flowchart 9 Procedures

- A. Enter: `telnet` to the remote host. Try to establish a `telnet` connection to the remote host.
- B. Successful? If your `telnet` attempt was successful, stop. The connection is OK through the Transport Layer (OSI Layer 4).
- C. Enter: `ftp` to remote host. Unlike `telnet`, `ftp` does not go through a pseudoterminal driver (`pty`) on your system. This step tests to see if the `pty` is why `telnet` failed.
- D. Successful? If `ftp` is successful, you probably have a problem with a `pty` on your system. Contact your HP representative.
- E. TCP not configured on local or remote host? Neither `telnet` nor `ftp` will work if TCP is not configured on either side of the connection. Check the `/etc/protocols` file on both hosts to be sure TCP is installed and configured.

- F. Network congested? If TCP is installed on both hosts, do a file transfer to another remote host on the network. Use `netstat(1)` to check for lost packets.  
If network congestion is not the cause, more detailed diagnostics are required. Again, contact your HP representative.
- G. Configure TCP. If necessary, install TCP on either or both hosts. Start again with this flowchart.

## Flowchart 10: Bridge/Gateway Loopback Test

**Figure 8-15** Flowchart 10: Bridge and Gateway Loopback Test



### Flowchart 10 Procedures

- A. Enter: ping from known good host through gateway to known good remote host. This will test gateway connectivity to the remote network.
- B. Successful? If the executing `ping` returned successfully, the problem may exist in the routing table for the problem host. Go to Step C.
- C. Check route table on problem host and all hosts in between. Enter `netstat -r` to examine a route table.
- D. Examine gateway. If the gateway is an HP server, go to Step G. If it is not, go to Step F.
- E. Correct route tables. Ensure that the proper IP/Internet addresses are assigned in the Destination and Gateway fields. If you are using subnetting, make sure that the destination is what you expect: a network or a host. Go back to Flowchart 1 to verify that the problem is solved.
- F. Non-HP-UX servers or other vendors. Refer to networking documentation. Refer to the documentation that came with the gateway for additional diagnostics.

- G. If an HP-UX server, enter `ifconfig` on gateway host. Enter `ifconfig` for all network interfaces on the gateway.
- H. Network interface up? If the output from `ifconfig` does not include the UP parameter, the network interface is down. Enter `netstat -i` to check the status of the network interfaces. An asterisk (\*) indicates that the interface is DOWN. If the network interface is DOWN, go to Step I.  
If the network interfaces are UP, start again with Flowchart 3. Using Flowchart 3, test all network interfaces on the gateway.
- I. Configure interface up. Enter `ifconfig` on each interface to bring it up. Start again with Flowchart 1. Use Flowchart 1 to test all network interfaces on the gateway.

## Known Problems and Workarounds

### HP 9000 T-600 (T-class server)

HP APA is not supported on the HP 9000 T-600 server.

### Known Installation Problems

Installing APA without the latest core LAN patch may cause installation failures, and HP APA may not function correctly.

### Known Problems with Switches

- **HP ProCurve Switches**

When disabling Cisco's Fast EtherChannel protocol on an HP server, the HP ProCurve switches will block that particular port from further usage.

**Corrective Action:** In order to use the network physical port on the HP server after disabling Cisco's Fast EtherChannel, you must physically move the connection from the server to the switch to another non-Cisco Fast EtherChannel port on the switch.

- **Cisco Catalyst 5000 Switches**

- Turning off Cisco's Fast EtherChannel on one network physical port on the HP server may cause the entire link aggregate (the port it is associated with) to be deconfigured.

**Corrective Action:** This problem can only be corrected by reconfiguring the switch to not include the port in the link aggregate being configured. Refer to the appropriate switch documentation for details on how to reconfigure link aggregates.

The Catalyst 5000 switch only allows two- or four-port link aggregates. Refer to the *Cisco Catalyst 5000 Configuration Guide* for more details on these limitations.

A known problem has been fixed for HSC 100Base-TX, and PCI 4-port 100Base-TX when interfacing to a Cisco Catalyst 5000 switch [with firmware version 4.5(4)] with ports in Desirable Mode connected to an HP server with ports running HP APA. Sometimes the link aggregations went up and down repeatedly.

**Corrective Action:** For HP-UX 11.0, the HSC 100Base-TX fix requires patch PHNE\_20420, and the PCI 4-port fix is in patch PHNE\_20423. You also need the core LAN patch PHNE\_20657 (or later).

For HP-UX 11i, the 100Base-T fix is in patch PHNE\_23465.

For 11i v2, the HSC 100BT is not supported.

- **3Com SuperStack II Switches**

To interoperate with the switch, disable the Trunk Control Message Protocol (TCMP) on all of the ports that are being used with HP servers.

## 9 HP APA Statistics

This chapter describes how link aggregate level statistics are collected and reported, along with sample outputs.

### HP Auto Port Aggregation Statistics

The link aggregate software keeps a counter for each statistic defined in RFC 1213 MIB II or RFC 2863 for 64-bit statistics. Each counter is set to the negative of the sum of all the physical ports in the link aggregate when it is created. When reporting the value of a statistic, the sum of all the physical ports corresponding statistic counter is added to the link aggregates counter.

For a detailed description of the statistics fields themselves refer to RFC 1213 for 32-bit statistics, and RFC 2863 for 64-bit statistics.

When a physical port is removed from a link aggregate, each of its statistics is added to the corresponding link aggregate statistic. When a physical port is added to a link aggregate, its current statistics are subtracted from the link aggregates statistics.



**NOTE** Cisco's Fast EtherChannel (FEC) packets are not counted in the link aggregate statistics. This is required because the FEC packets never traverse the link aggregate, they only traverse the port. Therefore, they should not be included in the link aggregation level statistics.

The September 2004 release (B.11.23.05) of HP APA for HP-UX 11i v2 and the May 2005 release (B.11.11.20) of HP APA for HP-UX 11i v1 support 64-bit statistics if all ports in the aggregate also support 64-bit statistics. The statistics are gathered and reported similar to what is explained for RFC 1213. For 64-bit statistics, APA uses the statistics defined in RFC 2863.

Link aggregate behavior regarding support of 64-bit statistics:

- Aggregates will support 64-bit MIB (Management Information Base) if all the member links are capable of 64-bit statistics, during the creation of aggregate.
- The 64-bit statistics capability will be downgraded to 32 bits if, the aggregate membership changes to include one or more links that are not 64-bit MIB capable. Once the aggregate's 64-bit MIB capability is downgraded, it will never be upgraded again for the life of the aggregate.
- To check if a link supports 64-bit statistics, use command `lanadmin -g mibstats_ext linkagg ppa`

See `lanadmin(1M)` for command information.

32-bit MIB statistics can be retrieved anytime but, the 64-bit statistics can only be retrieved if the aggregate is capable of 64-bit statistics.

### Link Aggregate Interface Statistics Display

This section displays the statistics fields for LAN interface cards which are displayed onscreen with the `lanadmin display` command. The `lanadmin` command is also used to examine RFC 1213 MIB II and RFC 2863 statistics for logical link aggregate interfaces.

Link aggregate characteristics can be displayed using the `lanscan` command, see "Viewing Link Aggregate Characteristics Using `lanscan`" (pg. 55) for sample output.

### LAN Interface Status Display, 32-Bit Statistics

To display 32-bit statistics, use the `lanadmin -g linkagg ppa` command.

```
lanadmin -g 900
```

```
LAN INTERFACE STATUS DISPLAY
Fri, Jul 30, 2004 12:20:23
```

```
PPA Number = 900
Description = lan900 Hewlett-Packard LinkAggregate Interface
```

```

Type (value) = other(1)
MTU Size = 1500
Speed = 0
Station Address = 0x000000000000
Administration Status (value) = up(1)
Operation Status (value) = down(2)
Last Change = 0
Inbound Octets = 0
Inbound Unicast Packets = 0
Inbound Non-Unicast Packets = 0
Inbound Discards = 0
Inbound Errors = 0
Inbound Unknown Protocols = 0
Outbound Octets = 0
Outbound Unicast Packets = 0
Outbound Non-Unicast Packets = 0
Outbound Discards = 0
Outbound Errors = 0
Outbound Queue Length = 0
Specific = 0

```

## LAN Interface Status Display, 64-Bit Statistics

To display 64-bit statistics, use the `lanadmin -g mibstats_ext linkagg ppa` command  
**# lanadmin -g mibstats\_ext 900**

### LAN INTERFACE EXTENDED MIB STATISTICS DISPLAY Fri, Jul 30, 2004 12:23:11

```

Interface Name = lan900
PPA Number = 900
Description = lan900 Hewlett-Packard LinkAggregate Interface
Interface Type(value) = other(1)
MTU Size = 1500
Speed = 0 Mbits/Sec
Station Address = 0x00306e4a927b
Administration Status = up
Operation Status = down
Last Change = Tue Jul 27 17:49:32 2004
Inbound Octets = 0
Inbound Unicast Packets = 0
Inbound Multicast Packets = 0
Inbound Broadcast Packets = 0
Inbound Discards = 0
Inbound Errors = 0
Inbound Unknown Protocols = 0
Outbound Octets = 0
Outbound Unicast Packets = 0
Outbound Multicast Packets = 0
Outbound Broadcast Packets = 0
Outbound Discards = 0
Outbound Errors = 0
Counter Discontinuity Time = Tue Jul 27 17:49:32 2004
Physical Promiscuous Mode = invalid
Physical Connector Present = false
Interface Alias =
Link Up/Down Trap Enable = enabled

```

---

# 10 TSO Support for Link Aggregations and Failover Groups

This chapter describes how the TCP Segmentation Offload (Large Send) feature is supported on link aggregates and failover groups.

TCP Segmentation Offload (TSO) is a mechanism by which the host stack offloads certain portions of outbound TCP packet processing to the Network Interface Card (NIC) thereby reducing host CPU utilization. This functionality can significantly reduce the load on the server for certain applications which primarily transmit large amounts of data from the system. For more information on TSO support for physical drivers please refer to igelan or iether driver Release Notes corresponding to the 11i v2 September 2004 release, available on <http://www.docs.hp.com>.

TSO is disabled by default. To enable TSO on each specific interface, consult the Ethernet Support Guide, available in <http://www.docs.hp.com>, in the Networking and Communication section.

The following command will list the TSO capability of a link, where *anylinkaggPPA* could also be the PPA of a card.

```
lanadmin -x vmtu anylinkaggPPA
Driver/Hardware supports TCP Segmentation Offload. Current VMTU = 32160.
```

It is recommended that the TSO status of a port be checked prior to adding it to a link aggregate.

## Summary of TSO behavior for Link Aggregation

- If TSO is enabled on all of the physical ports in a link aggregate, TSO will be enabled. If any of the ports within that link aggregate go DOWN or UP, the TSO status of the link aggregate will not change. Once the physical ports are added to the aggregate, the TSO capability of the physical ports cannot be changed.
- If a port is removed from a link aggregate:
  - If TSO was supported on the link aggregate before removing the port, TSO will remain enabled on the link aggregate.
  - If TSO was disabled on the link aggregate before removing the port, TSO of link aggregate will be based on remaining ports in the link aggregate. If all remaining ports support TSO, TSO will be enabled on the link aggregate, otherwise TSO will remain disabled.

## TSO Example for Link Aggregation

The following example demonstrates TSO behavior on link aggregates. In this example, TSO is enabled on lan3 and lan4, and not enabled on lan5.

Add ports lan3 & lan4 to link aggregate 903, and view TSO status:

```
lanadmin -X -a 3 4 903
Added ports:3 4 to lan903
lanadmin -x vmtu 903
Driver/Hardware supports TCP Segmentation Offload, Current VMTU = 32160
```

Add port lan5 to link aggregate 903, and then view TSO status:

```
lanadmin -X -a 5 903
Added ports:5 to lan903
lanadmin -x vmtu 903
Driver/Hardware does not support TCP Segmentation Offload
```

TSO will be disabled on link aggregate 903, since TSO is not enabled on lan5. If any of the ports in a link aggregation do not support TSO (lan5 in this example), TSO will be disabled on the link aggregate.

Remove port lan4 from link aggregate 903, and then view TSO status:

```
lanadmin -X -d 4 903
lanadmin -x vmtu 903
Driver/Hardware does not support TCP Segmentation Offload
```

TSO will remain disabled in this case since lan5 is still part of 903.

Remove lan5 from 903, and then view TSO status:

```
lanadmin -X -d 5 903
lanadmin -x vmtu 903
```

Driver/Hardware supports TCP Segmentation Offload, Current VMTU = 32160  
TSO is now enabled on lan903 since remaining ports support TSO.

## Summary of TSO behavior for Failover Groups

The TSO status of a failover group depends on the TSO status of the current active port. When the active port is changed, the TSO status of the failover group may change.

## TSO Example for Failover Groups

The following example demonstrates the TSO behavior on a failover group link aggregate.

TSO is enabled on lan4 and disabled on lan5, and failover group link aggregate 905 is created with lan4 as primary and lan5 as standby. Obtaining status on failover group lan5 and TSO status yields:

```
lanadmin -x -i 905
Link Aggregate PPA # : 905
Link Aggregation Mode : LAN_MONITOR
Load Balance Mode : Hot Standby (LB_HOT_STANDBY)
Active Port PPA # : 4
Port(s) ready : 5
Port(s) not ready : NONE
Port(s) connected to active port : 5
#
lanadmin -x vmtu 905
Driver/Hardware supports TCP Segmentation Offload, Current VMTU = 32160
```

If lan4 goes down and lan5 becomes the current active port, the status changes to:

```
lanadmin -x -i 905
Link Aggregate PPA # : 905
Link Aggregation Mode : LAN_MONITOR
Load Balance Mode : Hot Standby (LB_HOT_STANDBY)
Active Port PPA # : 5
Port(s) ready : NONE
Port(s) not ready : 4
Port(s) connected to active port : NONE
#
lanadmin -x vmtu 905
Driver/Hardware does not support TCP Segmentation Offload
```

TSO is now disabled on failover group link aggregate lan905 since the current active port, lan5, does not support TSO.

## Nettl logs for TSO

Whenever the TSO status of a link aggregate or failover group changes, a warning message will be logged in the nettl.

Example of nettl messages:

- When the TSO capability is disabled on an aggregate, a WARNING message is logged.

```
-----Auto-Port Aggregation/9000 Networking-----@#%
Timestamp : Wed Aug 18 PDT 2004 09:37:56.600031
Process ID : [ICS]
User ID (UID) : -1
Device ID : 903
Connection ID : 0
Subsystem : HP_APA
Log Class : WARNING
Path ID : 0
Log Instance : 0

```

<3014> HP Auto-Port Aggregation product disabled TCP Segmentation Offload capability for link aggregation 903.

- When the TSO capability is enabled on an aggregate, an INFORMATIVE message is logged.

-----Auto-Port Aggregation/9000 Networking-----@#%

```
Timestamp : Wed Aug 18 PDT 2004 09:37:53.020072
Process ID : [ICS] Subsystem : HP_APA
User ID (UID) : -1 Log Class : INFORMATIVE
Device ID : 903 Path ID : 0
Connection ID : 0 Log Instance : 0
```

~~~~~  
<4015> HP Auto-Port Aggregation product enabled TCP Segmentation Offload capability for link aggregation 903. VMTU = 32160.



---

# Appendix A Load Balancing and Data Flow Algorithms

## Supported Load Balancing and Data Flow Algorithms

The algorithms described in this section only apply to outbound data transfer. Inbound Load Balancing and Data Flow Distribution are strictly determined by the link partner and have no effect on the outbound algorithms. In addition, although each of these algorithms can be used in all supported configurations, they may not all provide the same load on each of the physical ports in the link aggregate. Therefore, HP prefers you use the algorithm that is recommended for each supported configuration.

## Packet Ordering

Each of the algorithms guarantees that it will not introduce any severe ordering problems within a specific data flow. This is required to ensure that the performance is not degraded significantly as a result of turning on one of the algorithms.

Further, all packets for a specific data flow always flow out through the same physical port (the only exception is CPU based distribution) until the data flow is aged out of the distribution table. This means that in order to generate simultaneous load on each of the physical ports in a link aggregate, multiple data flows must be started over the link aggregate.

## Load Balancing Algorithm

The Load Balancing algorithm is a three-step process.

1. **Data Flow Lookup** — The Data Flow Distribution algorithm (next section) determines an index into a hash table which includes the physical port the data flow should be forwarded out of.
2. **Data Flow Physical Port Assignment** — If the hash index for the data flow has not been assigned a physical port (the entry is NULL), then a physical port in the link aggregate is assigned to that specific hash index. The physical port is selected on a Round Robin basis.
3. **Aging Data Flows** — Over time each data flow is checked to determine if it is still active. If the data flow has not been active in the last 30 seconds, its specific hash index is cleared (aged out). If the data flow restarts after being cleared from the hash table it will be re-assigned a new physical port on a Round Robin basis.

## Data Flow Distribution Algorithms

Listed below are the three supported Data Flow Distribution algorithms, plus the Hot Standby mode. Each algorithm is briefly explained and the recommended configuration for the specific algorithm is also listed.

For examples on configuring the algorithms, please refer to the earlier chapters on configuration in this guide.



**NOTE** Each of the supported Data Flow Distribution algorithms must be set on the specific link aggregate prior to adding any physical ports.

---

- **Destination MAC address**

The Destination MAC address based algorithm uses the least significant byte of the link level destination MAC address, of the data flow, as an index into a table of 256 possible entries. If the entry is NULL, then a physical port is selected from the link aggregate on a Round Robin basis and assigned to the index. The physical port selected will be used to send packets for the duration of the specific data flow.

This is the default algorithm for all link aggregates.

Recommended Configuration: Server-to-Switch

- **IP address**

The IP address based algorithm uses the least significant bytes of the source and destination IP address, of the data flow, as an index into a table of 256 possible entries. The same processing that occurs for destination MAC distribution is used if the entry is NULL.

Recommended Configuration: Server-to-Router

- **LB\_PORT** — TCP/UDP Port-based Algorithm

The TCP/UDP Port-based algorithm uses the TCP/UDP source and destination port numbers to distribute traffic across the ports in a link aggregate. This algorithm is recommended for use when connecting two HP servers in a back-to-back configuration.

Recommended configuration: Server-to-Server

- **Hot Standby**

Hot Standby ON mode uses one primary link in the link aggregate to send all outbound traffic on. Therefore, when this mode is enabled there is no load balancing across the network physical ports in the link aggregate. If the primary link goes down (for example, cable disconnect) then all the traffic on the primary link is automatically switched to a secondary link in the same link aggregate.

The primary and secondary links are determined by the Port Priority of the network physical ports in the link aggregate. The network physical port with the highest Port Priority is used as the primary link. If there are multiple network physical ports with equal Port Priorities then the APA software will pick one of the ports.

If Hot Standby is configured on an aggregation, the ports must be cabled to a switch and the switch ports must not be configured for an aggregation.

Recommended configuration: Servers that need highly available network interfaces.

- **CPU** — **No longer recommended when using Server-to-Server. See LB\_PORT**

The CPU-based algorithm uses the processor index that the data flow is being serviced on, as an index into a table of 256 possible entries. Therefore, this algorithm relies on the CPU scheduler to determine how data flows will be distributed across different physical ports.

Do not use this configuration on uniprocessor systems as only one physical port in the link aggregate will be used.



**NOTE** Since this algorithm relies on the CPU scheduler to determine where the packets for a specific data flow will be sent, it is possible for a specific data flow to move from one physical port to another during the lifetime of the data flow. This is possible because if one CPU becomes loaded, one or more processes may need to be migrated to another CPU. This can lead to a specific data flow sending data out one interface and then switching to another due to an overloaded CPU. This may cause a temporary ordering problem, but should not result in any significant or prolonged performance problems.

---

---

# Appendix B HP APA Resources

In addition to this manual, use the following resources to maintain and administer HP APA.

## HP-UX Manual Reference Pages (manpages)

While installing, configuring, or troubleshooting HP APA, you may need to refer to any of the following online manual reference pages (manpages) for useful HP-UX operating system or HP APA commands. To display a manpage, enter the following at the system prompt: `man command name`. For example, `man arp`.

- `arp(1M)` displays and modifies the Internet-to-station address mapping tables used by the Address Resolution Protocol.
- `hosts(4M)` is a database that contains a single line entry for each host name entry.
- `ifconfig(1M)` assigns an address to a network interface, and configures and displays network parameters.
- `ioscan(1M)` scans system hardware, usable I/O system devices, or kernel I/O system data structures as appropriate, and lists the results.
- `lanadmin(1M)` resets or reports the status of the LAN card.
- `lanscan(1M)` displays information about LAN cards that are successfully bound to the system.
- `linkloop(1M)` verifies network connectivity through the Data Link Layer (OSI Layer 2).
- `neffmt(1M)` formats common tracing and logging binary files.
- `netstat(1M)` provides network statistics and information about network connections.
- `nettl(1M)` logs network events and traces packets as they enter and exit the 10/100Base-TX driver.
- `ping(1M)` verifies network connectivity through the Network Layer (OSI Layer 3) and reports the round-trip time of communications between the local and remote hosts.
- `route(1M)` adds and deletes entries to the network routing table.
- `sam(1M)` configures networking software.
- `swinstall(1M)` loads software filesets onto 10.x and later systems.
- `swverify(1M)` verifies software installation.

## Error Messages

HP APA comes with an online message catalog that is used to report networking problems. You must use the `nettl` logging and tracing utility to display the probable cause and action for a message.

For HP-UX 11i v1 (B.11.11.20), APA also supports the logging of status messages to the `syslog.log` file. See "HP APA Parameters for Link Aggregates — `hp_apaconf`" (pg. 37) for information on enabling this feature.

## Logging Messages

The HP network physical port and the HP APA software use the `nettl(1M)` logging and tracing facility supplied with HP-UX. You may access the logging and tracing utility using either the graphical user interface (GUI) version or the command line interface.

Features of the GUI version, which are now a part of your HP system, include:

- An interface which guides you through logging and tracing tasks.
- An interface which allows you to create and format reports.
- The capability to collect logging and tracing subsystem-specific information.
- Report screens which are updated instantaneously with current logging and tracing information by the subsystem.
- Context-sensitive on-line help.

To access the GUI version of the logging and tracing utility, enter the command:

```
nettladm
```

See `netladm(1M)` for information on using the GUI version or `nettl(1M)` for information on using the command line interface.

There are three levels of logging:

- At link aggregate level.
- At Cisco's FEC level.
- At IEEE 802.3ad LACP level

Listed below are some examples using the command line interface.

- To turn on all logging at link aggregate level, enter:  
`nettl -log 0xf -e HP_APA`
- To turn on all logging at Cisco's FEC level, enter:  
`nettl -log 0xf -e HP_APAPORT`
- To turn on all logging at IEEE 802.3ad level, enter:  
`nettl -log 0xf -e HP_APALACP`
- To examine the log file with cause and action descriptions, enter:  
`netfmt -v -f /var/adm/nettl.LOG00 | more`
- To examine just the log messages in the log file, enter:  
`netfmt -f var/adm/nettl.LOG00`
- To check network logging and tracing status, enter:  
`nettl -status`
- To start Cisco's FEC tracing to the file `/tmp/tracefile.TRC0`, enter:  
`nettl -tracoon all -entity HP_APAPORT -file /tmp/tracefile`
- To stop Cisco's FEC tracing, enter:  
`nettl -traceoff all -entity HP_APAPORT`
- To start LACP tracing to the file `/tmp/tracefile.TRC0`, enter:  
`nettl -tracoon all -entity HP_APALACP -file /tmp/tracefile`
- To stop LACP tracing, enter:  
`nettl -traceoff all -entity HP_APALACP`
- To format the tracefile into the file `/tmp/traceout`, enter:  
`nettl -f /tmp/tracefile.TRC0 > /tmp/traceout`

See `netfmt(1M)` for further information about this card and how to create a filter for trace formatting.

For HP-UX 11i v1 (B.11.11.20), APA also supports the logging of status messages to the `syslog.log` file. See "HP APA Parameters for Link Aggregates — `hp_apaconf`" (pg. 37) for information on enabling this feature.

## Contacting Your HP Representative

If you have no service contract with HP, you may follow the procedure described below, but you will be billed accordingly for time and materials.

If you have a service contract with HP, document the problem as a Service Request (SR) and forward it to your HP representative. Include the following information where applicable:

- A description of the problem. Describe the events leading up to and including the problem. Attempt to describe the source and symptoms of the problem.  
Your description should include: HP-UX commands; communication subsystem commands; job streams; result codes and messages; and data that can reproduce the problem. You should also provide a network map with the host name, IP/Internet address, and station address of each system connected with the HP system.

Illustrate as clearly as possible the context of any message(s). Prepare copies of information displayed at the system console and user terminal.

- Obtain the version, update, and fix information for all software. To check the HP APA version number, enter `what vmunix` and look for the keyword, `hp_apa`.  
To check the version of your kernel, enter `uname -r`.  
This allows HP to determine if the problem is already known and if the correct software is installed at your site.
- Prepare copies of all the following files:
  - `/etc/rc.config.d/netconf`
  - `/etc/rc.config.d/hp_apaconf`
  - `/etc/rc.config.d/hp_apaportconf`
  - `/etc/lanmon/lanconfig.ascii`
- Enter the `dmesg` command and record messages about the status of the HP APA card.
- Enter the `lanscan -v` command and record the output.
- Enter the `display` command of the `lanadmin` diagnostic on the HP APA interface and record the output.
- Record the troubleshooting flowchart number and step number where you are unable to resolve the problem.
- Record all error messages and numbers that appear at the user terminal and the system console.
- Save all network log files. Make sure that ERROR and DISASTER log classes are enabled when log files are collected.  
Prepare the formatted output and a copy of the log file for your HP representative to further analyze.
- Prepare a listing of the HP-UX I/O configuration you are using for your HP representative to further analyze. Use the `ioscan` command to help collect this information.
- Prepare a list of your switch trunking configuration related to this problem.
- Try to determine the general area within the software where you think the problem exists. Refer to the appropriate reference manual and follow the guidelines on gathering information for that product.
- Document your interim, or "workaround," solution. The cause of the problem can sometimes be found by comparing the circumstances in which it occurs with the circumstances in which it does not occur.
- Create copies of any Internet or HP APA link trace files that were active when the problem occurred for your HP representative to further analyze.
- In the event of a system failure, a full memory dump must be taken. Use the HP-UX `savecore` utility to save a core dump. Send the output to your HP representative.

## Available Manuals

The following documents are available:

### ▲ *HP Auto Port Aggregation Release Notes*

This document provides summarized information about the HP Auto Port Aggregation product, and late-breaking information that is not in either the *Installation Guide* or the *Support Guide*. It is an online only file located on your system in `/opt/networkdocs` or on the Worldwide Web at:

<http://www.docs.hp.com>

## Software Product Numbers and Filesets

Part numbers for the HP APA product are as follows:

Software:

### ▲ J4240AA = HP APA Software Product for HP-UX 11.0 and all versions of 11i

The HP Auto Port Aggregation software includes the following products and filesets:

Product Filesets:

APA-KRN

APA-RUN  
APA-INIT  
APA-FORMAT  
SAM-APA  
APA-LM

# Appendix C Logging Messages to syslog.log

Beginning with the AR0512 release of HP-UX 11i v2 (B.11.23.10), the AR0505 release of HP-UX 11i v1 (B.11.11.20), and PHNE\_33116 (B.11.11.17) patch release, you can choose to log APA and LAN Monitor status messages to the `syslog.log` file. The status messages are a subset of the messages APA logs to the `nettl` log file, but are reworded for readability and understandability.



**NOTE** APA LAN Monitor messages will continue to be logged to the `nettl` log even if logging to `syslog` is enabled.

See the `HP_APA_USE_SYSLOG` parameter description in the “HP APA Parameters for Link Aggregates — `hp_apaconf`” (pg. 37) section for information on how to configure APA to log status messages to the `/var/adm/syslog/syslog.log` file.

## Examples

The following section contains sample status messages that might appear in the `syslog.log` file. In these examples, a link is considered UP:

- If its `ifOper` status is UP (the link can carry network traffic) and
- If the link is part of an automatic link aggregate and it has successfully negotiated via the protocol with the link partner to become a member of the link aggregate.

A link is considered DOWN:

- Anytime its `ifOper` status is DOWN (the link cannot carry network traffic) or
- If the link is part of an automatic link aggregate and the protocol has failed to maintain the membership of the port in the link aggregate.

```
Mar 3 08:49:54 hpserver1 vmunix: APA/LM: Product is now running. 1
Mar 3 08:49:54 hpserver1 vmunix: APA/LM: Product is now stopped. 2
Mar 3 08:50:20 hpserver1 vmunix: APA/LM: LA:lan900 - lan7 is up 3
Mar 3 08:50:20 hpserver1 vmunix: APA/LM: LA:lan900 is up
Mar 3 08:50:20 hpserver1 vmunix: APA/LM: LA:lan900 - lan8 is up
Mar 3 08:50:20 hpserver1 vmunix: APA/LM: LA:lan900 - lan9 is up
Mar 3 08:51:34 hpserver1 vmunix: APA/LM: LA:lan900 - lan8 is down 4
Mar 3 08:50:26 hpserver1 vmunix: APA/LM: LA:lan900 - lan9 is removed 5
Mar 3 08:52:05 hpserver1 vmunix: APA/LM: LA:lan900 - lan7 is down 6
Mar 3 08:52:05 hpserver1 vmunix: APA/LM: LA:lan900 is down
.
.
.
Mar 3 08:50:26 hpserver1 vmunix: APA/LM: LA:lan900 - lan8 is removed 7
Mar 3 08:50:26 hpserver1 vmunix: APA/LM: LA:lan900 - lan7 is removed
Mar 3 08:50:26 hpserver1 vmunix: APA/LM: LA:lan900 is cleared
```

**1** The `/sbin/init.d/hpapa start` command was issued, for example, at system boot time.

**2** The `/sbin/init.d/hpapa stop` command was issued.

**3** Link aggregate (LA) 900 was created with three links 7, 8, and 9.

**4** Link 8 is not operational.

**5** Link 9 was removed from `lan900`; for example, by issuing the `lanadmin -X -d portPPA linkAggregatePPA` command.

**6** Link 7 and link aggregate 900 are not operational.

**7** Link aggregate 900 was cleared; for example, by issuing the `lanadmin -X -c linkAggregatePPA` command.

If link aggregate 900 is a failover group, `lan900` has a `FOG:` prefix instead of `LA:` as shown in the previous example.

For failover groups and Hot-standby mode link aggregates, the current active link is also displayed as in the following example:

```
Mar 3 08:58:03 hpserver1 vmunix: APA/LM: FOG:lan900 - lan1 is up (lan1 is active)
Mar 3 08:58:03 hpserver1 vmunix: APA/LM: FOG:lan900 is up (lan1 is active)
Mar 3 08:58:03 hpserver1 vmunix: APA/LM: FOG:lan900 - lan2 is up (lan1 is active)
.
```

```
.
.
Mar 3 08:58:03 hpserver1 vmunix: APA/LM: FOG:lan900 - lan2 isn't receiving poll 1
Mar 3 08:58:03 hpserver1 vmunix: APA/LM: FOG:lan900 - lan2 now receiving poll \
 packets (lan1 is active) 2
Mar 3 08:58:03 hpserver1 vmunix: APA/LM: FOG:lan900 - Proactive Failover Occurred \
 (lan901 is active) 3
```

- 1** Connectivity among links in the failover group was lost.
- 2** The link in the failover group started receiving poll packets; it has recovered connectivity.
- 3** Proactive failover occurred in the failover group.

For detailed log messages, use NetTL subsystem. See `nettl(1M)` for more information.

---

# Glossary

## A

|                              |                                                                                                                                                                                                                                                                                                |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>aggregate</b>             | A group. For APA, a group of up to eight ports makes one link aggregate. There can be 50 link aggregates per computer.                                                                                                                                                                         |
| <b>aggregation</b>           | See aggregate.                                                                                                                                                                                                                                                                                 |
| <b>APA</b>                   | Auto Port Aggregation                                                                                                                                                                                                                                                                          |
| <b>ARP</b>                   | Address Resolution Protocol. A TCP/IP protocol used to obtain a node's physical address.                                                                                                                                                                                                       |
| <b>Auto Port Aggregation</b> | APA. HP's software product that allows grouping up to eight ports into an aggregate to boost performance and provide port fail over. The eight port limit applies only for the AR0512 release (B.11.23.10) in FEC_AUTO and MANUAL mode; other releases have a four port limit for these modes. |

## F

|                                |                                                                                                                                                 |
|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>failover group</b>          | A logical grouping of one or more physical ports formed by LAN Monitor. The failover group is used as an alternative if the primary link fails. |
| <b>Fast EtherChannel (FEC)</b> | The proprietary name of Cisco's port aggregation product. When referring to FEC mode, it indicates use of PAgP on a link.                       |
| <b>FEC</b>                     | See Fast EtherChannel.                                                                                                                          |
| <b>FEC_AUTO</b>                | The automatic configuration mode of FEC.                                                                                                        |
| <b>flow</b>                    | A sequence of MAC frames between a pair of hosts where all of the MAC frames form part of the same conversation between that pair of hosts.     |

## G

|                         |                                                                                                                 |
|-------------------------|-----------------------------------------------------------------------------------------------------------------|
| <b>group capability</b> | An integer value used to determine which network physical ports can be aggregated into a common link aggregate. |
|-------------------------|-----------------------------------------------------------------------------------------------------------------|

## H

|                    |                                         |
|--------------------|-----------------------------------------|
| <b>Hot Standby</b> | A method of providing high availability |
| <b>HSC</b>         | High Speed Connect                      |

## L

|                         |                                                                                                                                                                                                                                                                                      |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>LACP_AUTO</b>        | Link Aggregation Control Protocol                                                                                                                                                                                                                                                    |
| <b>LAN</b>              | Local Area Network                                                                                                                                                                                                                                                                   |
| <b>LB_IP</b>            | Internet Protocol-based algorithm for <a href="#">server-to-router</a> configurations.                                                                                                                                                                                               |
| <b>LB_MAC</b>           | MAC-based algorithm for <a href="#">server-to-switch</a> configurations (this is the default algorithm). See Also for information..                                                                                                                                                  |
| <b>LB_PORT</b>          | TCP/UDP port-based algorithm for <a href="#">server-to-server</a> (back-to-back) configurations                                                                                                                                                                                      |
| <b>link aggregate</b>   | A logical grouping of one or more physical ports into a single "fat-pipe". This term is used to describe LACP_AUTO, Manual, or PAgP (Cisco Fast EtherChannel) created logical ports.                                                                                                 |
| <b>link aggregation</b> | See link aggregate.                                                                                                                                                                                                                                                                  |
| <b>linkaggPPA</b>       | The PPA or logical card instance number of a specific link aggregate.                                                                                                                                                                                                                |
| <b>load balancing</b>   | A method of distributing traffic across the network physical ports in a link aggregate. Unicast and multicast traffic is distributed across the network physical ports in a link aggregate. Broadcast traffic is always sent out the first network physical port in a link aggregate |

## M

|            |                      |
|------------|----------------------|
| <b>MAC</b> | Media Access Control |
|------------|----------------------|

|                                         |                                                                                                                                                                           |
|-----------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>MANUAL</b>                           | The default mode of port configuration. Can be performed by editing two configuration files or by using SAM.                                                              |
| <b>MIB</b>                              | Management Information Base                                                                                                                                               |
| N                                       |                                                                                                                                                                           |
| <b>network adapter</b>                  | A network device which has one or more network physical ports.                                                                                                            |
| <b>network physical port</b>            | The communications channel formed when you attach a network cable between a specific network port (adapter card) and a LAN device.                                        |
| P                                       |                                                                                                                                                                           |
| <b>PAgP</b>                             | See Port Aggregation Protocol.                                                                                                                                            |
| <b>PCI</b>                              | Peripheral Component Interconnect                                                                                                                                         |
| <b>physical point of attachment</b>     | See PPA.                                                                                                                                                                  |
| <b>port</b>                             | The communications channel formed when you attach a network cable between a network physical port and a LAN device.                                                       |
| <b>port aggregate</b>                   | See link aggregate.                                                                                                                                                       |
| <b>port aggregation</b>                 | See link aggregate.                                                                                                                                                       |
| <b>Port Aggregation Protocol (PAgP)</b> | The proprietary port aggregation protocol, developed by Cisco Systems Inc., which automatically determines a bidirectional connection between two network physical ports. |
| <b>port priority</b>                    | An integer value used to determine which network physical port will be used as the primary port in a link aggregate in hot standby mode.                                  |
| <b>PPA</b>                              | A unique integer identifier for each network physical port installed on a server.                                                                                         |
| S                                       |                                                                                                                                                                           |
| <b>SAM</b>                              | System Administration Management                                                                                                                                          |
| <b>server-to-router</b>                 | See LB_IP.                                                                                                                                                                |
| <b>server-to-server</b>                 | See LB_PORT.                                                                                                                                                              |
| <b>server-to-switch</b>                 | See LB_MAC.                                                                                                                                                               |
| T                                       |                                                                                                                                                                           |
| <b>TCP</b>                              | Transmission Control Protocol                                                                                                                                             |
| <b>trunk</b>                            | See link aggregate.                                                                                                                                                       |
| <b>TSO</b>                              | TCP Segmentation Offload                                                                                                                                                  |

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# Index

## Symbols

3Com SuperStack II switch, 110

## A

algorithm

data flow, 117

load balancing, 117

APA (see HP APA)

Hot Standby mode, 26

ARP command

manpage description, 119

ARP verification, 105

Auto Port Aggregation (see HP APA)

## B

binary file

caution, 68

creating, 68

reading, 68

bridge loopback test, 109

## C

Catalyst 5000 switch, 110

caution

binary file, 68

HP\_APA\_HOT\_STANDBY, 38

lanadmin -a option, 80

lanadmin command, 73

lanqueryconf command, 61

characteristics

viewing for link aggregates, 55

Cisco Catalyst 5000 switch, 110

command

ioscan, 91

LAN Monitor configuration, 68–69

lanadmin, 73

lanapplyconf, 68

lancheckconf, 69

landeleteconf, 69

lanqueryconf, 68

commands

hp\_apaconf, 85

hp\_apaportconf, 85

configuration

(see also sample configuration)

FEC\_AUTO mode example, 54

LACP\_AUTO mode example, 54

LAN Monitor commands, 68–69

MANUAL mode example, 53

planning for, 33

using SAM, 35, 41

configuration file

(see also file)

lanconfig.ascii, 65

lanconfig.ascii fields, 66, 68

configuration parameter

modifying, 36

configuration test

LACP, 102

LAN Monitor, 100

link aggregate, 94

manual, 97

network, 104

PAGP, 98

physical port, 90, 92, 94

connection

testing for physical port, 89

CPU algorithm, 118

## D

data flow algorithm, 117

DEAD\_COUNT, 67

destination MAC address

algorithm, 117

diagnostic flowchart

descriptions, 86

overview, 85

DL\_SET\_PHYS\_ADDR\_REQ

changing MAC address, 86

## E

error message, 119

event

startup, 85

example

lanscan output, 56

## F

failover group

(see also proactive failover)

configuration example, 61

configuring, 60

deleting, 69

LAN Monitor, 29

name format, 66

switch restrictions, 30

syslog status messages, 123

TSO, 113

with link aggregations, 29

FAILOVER\_GROUP, 66

fat pipe, 17

FDDI

LAN Monitor support, 30

FEC\_AUTO mode

configuration example, 54

configuring by editing files, 53

configuring with lanadmin, 81

configuring with SAM, 41, 46

file

editing for APA configuration, 53

hp\_apaconf, 37, 39

- hp\_apoportconf, 39–40
- lanconfig.ascii, 36
- netconf, 36
- files
  - editing for APA configuration, 55
- fileset
  - HP APA, 121

## G

- gateway loopback test, 109
- group (see failover group)
- group capability, 37

## H

- hosts file
  - manpage description, 119
- Hot Standby mode
  - algorithm, 118
  - sample configuration, 26
- HP 9000 T-600 T-class server, 110
- HP APA
  - and HP Serviceguard, 71
  - capabilities, 18
  - configuration planning, 33
  - configuring by editing files, 53
  - configuring FEC\_AUTO mode with lanadmin, 81
  - configuring using SAM, 41, 51
  - failover group environment, 29
  - features, 17
  - filesets, 121
  - LAN Monitor environment, 29
  - part numbers, 121
  - sample configurations, 21, 28
  - statistics, 111
  - troubleshooting, 85
- HP ProCurve switch, 110
- HP representative, 120
- HP Serviceguard
  - and HP APA, 71
- HP\_APA\_DEFAULT\_PORT\_MODE, 37
- HP\_APA\_GROUP\_CAPABILITY, 37
- HP\_APA\_HOT\_STANDBY, 38
  - caution, 38
- HP\_APA\_INIT\_ARGS, 38
- HP\_APA\_INTERFACE\_NAME, 38
- HP\_APA\_KEY, 38
- HP\_APA\_LACP\_SYSTEM\_ID\_MODE, 38
- HP\_APA\_LOAD\_BALANCE\_MODE, 38
- HP\_APA\_MANUAL\_LA, 38
- HP\_APA\_MAX\_LINKAGGS, 39
- HP\_APA\_USE\_SYSLOG, 39
- hp\_apaconf file
  - parameters, 37, 39
  - startup processing, 85
- HP\_APAPORT\_CONFIG\_MODE, 39
- HP\_APAPORT\_GROUP\_CAPABILITY, 39
- HP\_APAPORT\_INIT\_ARGS, 39
- HP\_APAPORT\_INTERFACE\_NAME, 40
- HP\_APAPORT\_KEY, 40

- HP\_APAPORT\_PRIORITY, 40
- HP\_APAPORT\_SYSTEM\_PRIORITY, 40
- hp\_apoportconf file
  - parameters, 39–40
  - startup processing, 85

## I

- ifconfig command
  - manpage description, 119
- installation (see software installation)
- ioscan command
  - example, 91
  - manpage description, 119
- IP address
  - algorithm, 117
- IPv6 address, 60

## K

- known problems, 110

## L

- LACP configuration test, 102
- LACP\_AUTO mode
  - configuration example, 54
  - configuring by editing files, 53, 55
- LAN card (see NIC)
- LAN Monitor
  - and SAM, 41
  - capabilities, 18
  - configuration commands, 68–69
  - configuration examples, 28, 31
  - configuration files, 36
  - configuration test, 100
  - configuring failover groups, 60
  - failover group, 29
  - failover group example, 61
  - failover group with link aggregations, 29
  - FDDI support, 30
  - features, 59
  - proactive failover example, 63
  - switch restrictions, 30
  - Token Ring support, 30
- lanadmin command
  - a option caution, 80
  - X options, 75–76
  - x options, 76
  - caution, 73
  - command line use, 79
  - displaying 32-bit statistics, 111
  - displaying 64-bit statistics, 112
  - interactive use, 81
  - manpage description, 119
  - syntax, 74
  - tasks, 73
  - test selection, 81
  - verifying ports, 55
- lanapplyconf
  - and IPv6, 60
- lanapplyconf command

- syntax, 68
- lancheckconf command
  - syntax, 69
- lanconfig file, 68
  - creating, 68
  - reading, 68
- lanconfig.ascii file
  - building from binary file, 68
  - creating, 68
  - creating the binary file, 68
  - fields, 66, 68
  - sample, 65
  - validating content, 69
- landeleteconf command
  - syntax, 69
- lanqueryconf
  - and IPv6, 60
  - caution, 61
- lanqueryconf command, 68
  - syntax, 68
- lanscan command
  - manpage description, 119
  - sample output, 56
  - verifying link aggregate status, 55
- LB\_IP
  - recommendation, 33
  - specifying in hp\_apaconf file, 38
- LB\_MAC
  - recommendation, 33
  - specifying in hp\_apaconf file, 38
- LB\_PORT
  - algorithm, 118
  - recommendation, 34
  - specifying in hp\_apaconf file, 38
- LED
  - testing for physical port, 89
- link aggregate
  - adding ports using SAM, 50
  - clearing, 69
  - configuration test, 94
  - configuring FEC\_AUTO mode by editing files, 53
  - configuring FEC\_AUTO mode using SAM, 41, 46
  - configuring LACP\_AUTO mode by editing files, 53
  - configuring MANUAL mode by editing files, 53
  - configuring MANUAL mode using SAM, 46
  - configuring using SAM, 42, 45, 49
  - definition, 17
  - deleting ports using SAM, 50
  - displaying advanced options using SAM, 43, 49
  - displaying interface statistics, 111
  - displaying status using SAM, 45
  - displaying using SAM, 42, 47–48, 50
  - MAC addresses for, 86
  - parameters for, 37
  - switch restrictions in failover group, 30
  - syslog status messages, 123
  - TSO, 113
  - verifying status, 55
  - viewing characteristics, 55
- link level loopback test, 106
- linkloop command
  - manpage description, 119
- LM\_RAPID\_ARP, 67
- LM\_RAPID\_ARP\_COUNT, 68
- LM\_RAPID\_ARP\_INTERVAL, 67
- load balancing
  - algorithm, 117
  - description, 17
- log
  - syslog, 123
  - viewing data, 94
- log message, 119
  - viewing nettl, 92
- loopback test
  - bridge, 109
  - gateway, 109
  - link level, 106
  - network level, 87
  - transport level, 108

## M

- MAC address
  - changing with DL\_SET\_PHYS\_ADDR\_REQ, 86
  - destination, 117
  - link aggregates, 86
- manpages, 119
- manual configuration test, 97
- MANUAL mode
  - configuration example, 53
  - configuring by editing files, 53, 55
  - configuring with SAM, 46
- message
  - error, 119
  - logging, 119
  - logging to syslog, 123

## N

- netfmt command
  - manpage description, 119
- netstat command
  - manpage description, 119
- nettl command
  - manpage description, 119
  - viewing log messages, 92
  - viewing logs, 114
- nettl facility
  - logging, 119
- network adapter (see NIC)
- network configuration test, 104
- Network Interface Card (see NIC)
- network level loopback test, 87
- network physical port (see physical port)
- network test, 86
- NIC
  - supported on 11.00, 20
  - supported on 11i v1, 20
  - supported on 11i v2, 21
- NODE\_NAME, 66

**P**  
 packet ordering, 117  
 PAgP configuration test, 98  
 patch  
     requirements, 19  
 physical port, 90  
     configuration test, 92, 94  
     displaying using SAM, 43  
     modifying attributes using SAM, 44  
     modifying with SAM, 48  
     testing connections, 89  
     testing LED, 89  
     verifying status, 57  
 ping command  
     manpage description, 119  
 POLLING\_INTERVAL, 67  
 port aggregation  
     setting mode using SAM, 35  
     setting modes using SAM, 41  
     statistics, 111  
     supported modes, 35  
 port status (see status)  
 PRIMARY, 67  
 proactive failover, 59  
     configuration example, 63  
     description, 59  
 problems, 110  
 ProCurve switch, 110  
     no switch between router and server, 24  
     server-to-server, 26  
     server-to-server with switch, 28  
     switch between router and server, 25  
 server-to-server  
     back-to-back environment, 26  
     configuration with switch, 27  
 software installation, 34–35  
     requirements, 19  
 STANDBY, 67  
 startup event, 85  
 STATIONARY\_IP, 67  
 statistics, 111  
     displaying 32-bit, 111  
     displaying 64-bit, 112  
 status  
     verifying for link aggregates, 55  
     verifying for physical port, 57  
 status message, 123  
 swinstall command  
     manpage description, 119  
 switch  
     3Com SuperStack II, 110  
     Cisco Catalyst 5000, 110  
     HP ProCurve, 110  
     limitations in router and server configuration, 25  
     potential limitations, 22  
     potential limitations server to server, 27  
     supported, 20  
 swverify command  
     manpage description, 119  
 syslog  
     logging status messages, 123

**R**  
 route command  
     manpage description, 119

**S**  
**SAM**  
     adding ports, 50  
     and LAN Monitor, 41  
     configuration method, 36  
     configuring FEC\_AUTO mode, 41, 46  
     configuring link aggregates, 42, 49  
     configuring MANUAL mode, 46  
     deleting ports, 50  
     displaying advanced options, 49  
     displaying link aggregate advanced options, 43  
     displaying link aggregate status, 45  
     displaying link aggregates, 42, 47–48, 50  
     displaying physical ports, 43  
     modifying physical port attributes, 44  
     setting port aggregation mode, 35, 41  
 sam command  
     manpage description, 119  
 sample configuration  
     enterprise intranet client/server, 23  
     high availability, 26  
     hot standby, 26  
     LAN Monitor and FDDI, 31  
     LAN Monitor and Token Ring, 31  
     LAN Monitor failover group, 29  
     LAN Monitor failover group with link aggregations, 30

**T**  
 T-class server, 110  
 test  
     ARP, 105  
     LACP configuration, 102  
     LAN monitor configuration, 100  
     lanadmin command, 81  
     link aggregate configuration, 94  
     link level loopback, 106  
     manual configuration, 97  
     network, 86  
     network configuration, 104  
     network level loopback, 87  
     PAgP configuration, 98  
     physical port configuration, 90, 92, 94  
     physical port connections, 89  
     physical port LED, 89  
     transport level loopback, 108  
 Token Ring  
     LAN Monitor support, 30  
 transport level loopback test, 108  
 troubleshooting, 85  
     ARP verification, 105  
     bridge loopback, 109  
     diagnostic flowchart descriptions, 86

- gateway loopback, 109
- LACP Configuration, 102
- LAN Monitor configuration, 100
- link aggregate configuration, 94
- link level loopback, 106
- manual configuration, 97
- network configuration, 104
- network level loopback, 87
- overview, 85
- PAgP configurations, 98
- physical port configuration, 90, 94
- physical port connections, 89
- transport level loopback, 108

trunk, 17

TSO

- failover group, 113
- failover group example, 114
- failover group summary, 114
- link aggregate, 113
- link aggregation example, 113
- link aggregation summary, 113
- nettl log messages, 114

W

workarounds, 110

