HP Auto Port Aggregation (APA) User's Guide

HP Systems Networking

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1 Introduction to HP Auto Port Aggregation (APA) Concepts

Introduction

This document contains information on HP Auto Port Aggregation (HP APA) for use with HP products running on the HP-UX 10.20 , 11.0 and 11i operating systems. (11.0 must have the “9808 (or later) patch bundle” — an operating system patch released in August 1998).

This release includes LAN Monitor for HP-UX 10.20 and 11.x, an extension to APA that provides single-system high availability for Ethernet, FDDI, and Token Ring LAN cards, as well as support for the IEEE 802.3ad Link Aggregation Control Protocol (LACP). Four new configuration commands (*lanqueryconf*, *lancheckconf*, *landeleteconf*, and *lanapplyconf*) are used with LAN Monitor instead of *lanadmin*. See Appendix C , “Supported LAN Monitor Commands and Their Usage,” on page 103 for information.

The following terms are used in this document:

- **Port Aggregation** is the same as link aggregation. Within this document, we will use the term *link aggregate* to describe a logical grouping of one or more physical ports into a fat-pipe.

  This term is used to describe LACP, Manual, or PAgP (Cisco’s Fast EtherChannel) created ports.

- **Fail-over Group** is used to describe LAN Monitor created Link Aggregates. These fail-over groups are different from simple Link Aggregates because they can include either Link Aggregates or physical ports.

Part numbers for the HP APA product are as follows:

Software:

- J4240AA = HP APA Software Product for HP-UX 11.x
- J5080AA = LAN Monitor for HP-UX 10.20

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

What is HP Auto Port Aggregation?

Hewlett-Packard's Auto Port Aggregation (APA) increases a server's efficiency by grouping or "aggregating" multiple ports into a single link aggregate or fail-over group having a single IP address. Up to five aggregates per computer are permitted on HP-UX 10.20 and up to 50 on HP-UX 11.x.

The aggregated connections are IEEE 802.3-compliant and can be either HP-PB, HSC or PCI 10 or 100 Mbps Ethernet. The cable can be either unshielded twisted-pair (100BaseTX) or fiber-optic (100BaseFX) cable. Although the aggregate throughput can be several hundred Mbps over a single IP address, each port's connection is still 100 Mbps (200 Mbps if full duplex).

HP Auto Port Aggregation provides the following benefits:

- Bandwidth scalability: network managers can scale their networks in increments of 200 Mbps full-duplex to achieve maximum aggregate throughput of up to 400 Mbps (800 Mbps, full-duplex), and up to 2000 Mbps per server (five trunks per server, four ports per trunk). These are theoretical maximums. It all depends on the server.
- High Availability: it provides redundancy or link aggregation of computer ports. The ports can be either on the same computer or on separate computers. Port aggregating, or the bundling of two, three, or four ports together to function as a single link to another server, switch, or router introduces fault-tolerance into the link aggregate. A link aggregate will continue to operate as long as there is at least one port operating.
- Load balancing: HP APA supports true load balancing and failure recovery capabilities and distributes traffic — including unicast and multicast traffic — evenly across the aggregated links. Broadcast traffic is always sent out the first port in a link aggregate. In the event of a link failure, the HP APA automatically redistributes loads across the remaining links without user intervention. IP-based, CPU-based, and MAC-based distribution algorithms are supported at first release.
- Single MAC address: because ports aggregated with HP APA share a single, logical MAC address, there is no need to assign individual addresses to aggregated ports. Additionally, no client administration modifications are necessary.
- Flexibility: ports can be aggregated to achieve higher performance whenever network congestion occurs, providing network managers with the flexibility they need to meet demands of network growth.
- Investment protection: because the HP APA utilizes Ethernet technology, it provides a natural upgrade path for current Ethernet installations, leveraging existing end-stations, management tools and training.

HP APA can be configured in any of four ways:

- **Manual Mode** — This mode should be used to configure Link Aggregates on the HP 9000 when connected to a switch which only supports manual configuration. This mode requires the switch to support Link Aggregation. Use the following command:

lanadmin -X -a PortPPA MANUAL LinkAggPPA

See Appendix B, “Supported lanadmin Commands and Their Usage,” on page 89 for details. You can also use SAM to configure the Manual LinkAggs.

This mode only works with Ethernet Links.

- **Auto w/ PAgP** — this mode should be used when configuring Link Aggregates on the HP 9000 when connected to a switch which supports Cisco's Fast EtherChannel protocol (PAgP). This mode requires the switch to support Link aggregation. Use the following command to turn on the PAgP protocol:

  lanadmin -X -p PortPPA FEC_AUTO LinkAggPPA

  See Appendix C , “Supported LAN Monitor Commands and Their Usage,” on page 103 for details. You can also use SAM to turn on PAgP.

  This mode only works with Ethernet Links.

- **Auto w/ LACP** — this mode should be used when configuring Link Aggregates on the HP 9000 when connected to IEEE 802.3ad (LACP) supported switches. This mode requires the switch to support Link Aggregation. Use the following command to turn on LACP:

  lanadmin -X -p PortPPA LACP_AUTO linkAggPPA

  See Appendix B, “Supported lanadmin Commands and Their Usage,” on page 89 for details. You can also use SAM to configure the Manual LinkAggs.

  This mode only works with Ethernet Links.

- **LAN Monitor** — this mode should be used when configuring Fail-over groups on the HP 9000. The mode does not strictly require the switch to support Link Aggregation, although some configurations may require the switch to support Link Aggregation. See Appendix C , “Supported LAN Monitor Commands and Their Usage,” on page 103 for details.

  LAN Monitor mode supports four basic commands; *lanqueryconf*, *lanapplyconf*, *landeleteconf*, and *lancheckconf*. These commands are described in detail in Appendix C , “Supported LAN Monitor Commands and Their Usage.”

  This mode works with Ethernet, FDDI, and Token Ring links.

After you have installed HP APA, it automatically aggregates eligible ports (provided, of course, that you have configured your switch to enable Cisco's Fast EtherChannel (FEC) or IEEE 802.3 Link Aggregation Control Protocol (LACP). If your switch only supports manual configuration, you must turn FEC or LACP off on the ports (FEC_AUTO is the default configuration), which will be manually configured. Then do the manual, command line configuration explained in the *HP Auto Port Aggregation Quick Installation Guide* or Appendix B, “Supported lanadmin Commands and Their Usage.”

New Features

This release introduces a new Load Balancing Algorithm, 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 intended to be used in networking environments where direct Server-to-server Link Aggregation is needed. However, this algorithm may also be used inplace of the MAC, IP, or CPU based algorithms. See Appendix E , “Load Balancing and Data Flow Distribution Algorithms,” on page 131 for details.

This release also introduces support for HP-UX 11i and the new SuperDome platform.

NOTE The starting LinkAgg PPA number for HP-UX 11i is 900.

Table 1-1 LinkAgg PPA Numbers

OS	APA Starting LinkAgg PPA
10.20	90
11.x	100
11i	900 (1i = 11.11)

Summary of APA and LAN Monitor Features and Characteristics

LAN Monitor

The LAN Monitor (LM) feature of the HP Auto-Port Aggregation software provides a “Hot Standby” capability with MC/SG-like configuration tools even though LAN Monitor created Fail-over groups do not support MC/SG at first release. In the event of a link failure, the LAN Monitor software will automatically migrate the data flow from the primary link to one of the standby links in the “Link Aggregate.” The LAN Monitor feature is available on both HP-UX 10.20 and 11.x, beginning with the June 2000 release.

Features of LAN Monitor are:

- Supports all LAN technologies: Fast Ethernet, Gigabit, FDDI, and Token Ring
- Automatic Fail-Over Group Discovery and Configuration commands (*lanqueryconf*, *lanapplyconf*, *lancheckconf*, *landeleteconf*)
- MP Scalable
- High Availability via Multiple Links with Fail-over Capability
- All links keep their original MAC address
- Hot Standby Mode only (No Load Balancing)
- Link Level and IP Multicast Support
- Streams Transport for TCP/IP, ARPA, and NFS
- HP DLPI Interface Support
- LAN Commands and Tools
- SNMP (Interface MIB only) support
- Support for Platforms: A, D, K, and R
- Support with MIB Monitor (EMS)

Link Aggregation Control Protocol (LACP)

The Link Aggregation Control Protocol (LACP) software is fully compliant with the IEEE 802.3ad standard and is supported on all of the Fast Ethernet and Gigabit Ethernet network adapter cards. this feature provides automatic configuration of Link Aggregates. In addition, in the event of a link failure, LACP will automatically migrate the data flow(s) from the failed link to another link in the aggregation. LACP also supports all of the APA load balancing algorithms (that is; MAC, IP, and CPU).

Features of APA LACP are:

- Supports all Fast Ethernet and Gigabit Ethernet links
- Supports standard LAN commands (for example, *lanadmin*, *lanscan*

netstat, and so on).

- Support for Link Level and IP Multicast
- Streams Transport for TCP/IP, ARPA, and NFS
- HP DLPI Interface support
- Maximum of 32 ports per Link Aggregate
- Maximum of 50 Link Aggregates per server

Four Load Balancing Algorithms

- IP — Server-to-Router

NOTE APA supports configurations which include a router between the host and the server. However, routers are not typically attached directly to a server — there is usually a switch in between. Therefore, APA will work across configurations which include a router, or when directly connected to a router.

- MAC — Server-to-Switch
- CPU — Server-to-Server
- Hot Standby

NOTE In HP-UX 11.x, hot standby and load balancing are both supported, but load balancing is supported on ethernet adapters only.

In HP-UX 10.20, hot standby is supported, but load balancing is not.

Summary

The following table summarizes the features and characteristics of APA and LAN Monitor.

Table 1-2 APA and LAN Monitor Features and Characteristics

	HP APA (HP-UX 11.x)		LAN Monitor (HP-UX 10.20)	Integration with MC/SG
Characteristics	FEC_AUTO, LACP_AUTO, Manual[1] Modes	LAN_MONITOR Mode	LAN_MONITOR Mode only	MANUAL[1] Mode only
Min# of Ports / LinkAgg	FEC_AUTO(2) LACP_AUTO(2) MANUAL(1)	2	2	2
Max# of Ports / LinkAgg	FEC_AUTO(4) MANUAL(4) LACP_AUTO(32)	32	32	4

Table 1-2 APA and LAN Monitor Features and Characteristics (Continued)

	HP APA (HP-UX 11.x)		LAN Monitor (HP-UX 10.20)	Integration with MC/SG
Primary Ports / LinkAgg	N/A	1	1	Min(2) Max(4)
Standby Ports / LinkAgg	N/A	31	31	Min(1) Max(3)
Max# of LinkAggs / System	50	50	5	Depends on number of ports in the aggregate[2]
Load Balancing (LB) or Hot Standby (HS)	FEC_AUTO (LB) LACP_AUTO(LB) MANUAL (Either)	LB[3] (Ethernet only) and HS	HS only (no LB)	LB[3] (Ethernet only) and HS
MIB Monitor Support	Yes	Yes	Yes	Yes
BUSES	PCI, HSC, HP-PB[4], core10/100BT	PCI, HSC[4], HP-PB, Core10/100BT PCI, HSC, HP-PB, Core10/100BT	PCI, HSC, HP-PB, Core10/100BT	
LINKS	100BT, Gigabit	100BT, Gigabit, FDDI, Token Ring	100BT, Gigabit, FDDI, Token Ring[5]	100Bt, Gigabit (also Token Ring & FDDI when MC/SG will coexist with LAN Monitor; Future Feature)
Platforms	All except T-Class	All Platforms	D, K, R, A180 only	All Platforms / No A-class on Gigabit
Workstation Support	Yes	Yes	No	Yes
Switches/Hubs	HP, Cisco, 3COM	All Types	All Types	HP, Cisco, 3COM (Hot Standby Mode works with all types of switches/hubs)
Start PPA#	100 (11.x), 900 (11i)	100 (11.x), 900 (11i)	90	100 (11.x), 900 (11i)
MC/SG Version	A.11.09	Future Feature	No support	A.11.09
SAM / CLI	SAM/lanadmin/ lanscan	lan**conf commands	lan**conf commands	N/A
OLAR	Future Feature	Future Feature	No support	Future Feature
EMS	Future Feature	Future Feature	Future Feature	Future Feature
Instant Ignition	Yes	Yes	No	N/A

1. MANUAL mode: can be Load Balancing or Non-Load Balancing
   - Load Balancing: MAC, IP, CPU algorithm, or LB_PORT.
   - Non-Load Balancing: Hot Standby mode.

2. When integrating with MC/SG, the max number of LinkAggs per system depends on the aggregate type of 2-ports or 4-ports (due to the constraint of 50 LinkAggs max per system):
   - 25 LinkAggs (2-ports)
   - 12 LinkAggs (4-ports) + 1-2 ports
3. Load Balancing is configurable on Ethernet links only. For FDDI and Token Ring, Hot Standby is the only choice.
4. HP-PB 100BT adapters can't be mixed with other non-HP-PB 100BT adapters.
5. No PCI Token Ring for 10.20

Patches in this Version

The HP 9000 can be running either HP-UX 10.20 or HP-UX 11.x.

NOTE There are no patches for HP-UX 11i.

Required Patches *

Driver	10.20	11.0
10/100BT		
PCI 1-port 100BT (RJ45) - (btlan5)	PHNE_20892	PHNE_20442
PCI 1-port 100BT (AUI,BND,RJ45) - (btlan6)	N/A	PHNE_19094
PCI 4-port 100BT (btlan)	PHNE_20422	PHNE_20423
PCI 100BT/SCSI Combo Card (btlan3)	PHNE_19019 (800) PHNE_20962 (700)	HP-UX 11.0 Additional Core Enhancement rel of January 2000
Core PCI 10/100BT (btlan3)	PHNE_19019 (800) PHNE_20962 (700)	HP-UX 11.0 Additional Core Enhancement rel of January 2000
EHSC/HSC 1-port, 2-port 100BT (btlan4)	PHNE_22216	*PHNE_22461
HP-PB 10/100BT (btlan1)	PHNE_18172	PHNE_18639
HP-PB 10BT (lan3)	*PHNE_21216 (800) *PHNE_21215 (700)	*PHNE_21217
Gigabit		
PCI 1000SX (gelan)	March 2000 release	March 2000 release
PCI 1000BT (gelan)	N/A	N/A
EHSC/HSC 1000SX (gelan)	March 2000 release	March 2000 release
FDDI		
PCI FDDI (fddi4)	June 2000 release	June 2000 release
EHSC/HSC FDDI (fddi3)	PHNE_20010	March 2000 release
HP-PB FDDI (fddi)	PHNE_20726	March 2000 release
Token Ring		
PCI Token Ring	June 2000 release	June 2000 release
HP-PB Token Ring	June 2000 release	June 2000 release
DLPI/LANC		
DLPI/LANC (lan_dlpi.c, lanc*)	*PHNE_21216 (800) *PHNE_21215 (700)	*PHNE_21217

* These or later

IMPORTANT

The patches must be in place before installing the HP APA software.

Absence of the latest core LAN patch can cause the following behavior:

- Release of April 1999:

  Installation of the product will fail.

- Release of June 1999:

  Installation of the product will succeed, but it will not initialize. When the patch is installed, it will cause the system to reboot. Only then will the product initialize and become usable.

Unsupported Functions and Configurations

This section describes all of the functions and configurations that are currently unsupported.

There is one unsupported function:

- *DL_SET_PHYS_ADDR_REQ*

  The HP APA product does not support changing the local MAC address on logical link aggregates.

There is one unsupported configuration:

- *Server-to-hub (router)*

  The HP APA product does not support configurations which have the server link aggregate directly connected to a hub (or router). This is not supported because the device is a shared environment and therefore it does not make sense to aggregate multiple links.

Known Problems and Workarounds

HP 9000 T-600 (T-class server)

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

- There are scaling issues for the one-port HSC 100BT cards which prevent support for more than two cards.
- Systems that support HP APA usually have four interfaces per aggregate, so having only two interfaces would severely limit the use of APA.

Exception Notices

- Only use lowercase when specifying *on/off* for *HP_APA_HOT_STANDBY* in **/etc/rc.config.d/hp_apaconf**. Uppercase will cause errors.
- In **/etc/rc.config.d/hp_apaconf**, specify *LB_CPU, LB_MAC,* or *LB_IP*. Specifying *HP_APA_LB_CPU*, *HP_APA_LB_MAC*, and *HP_APA_LB_IP* will cause script errors.

Known Installation Problems

Installing APA on HP-UX 11.0 without the latest core LAN patch. See the note (Important) after the section “Patches in this Version” on page 16 for details.

Known Problems with Switches

- **HP ProCurve Switches**

  When disabling Cisco's Fast EtherChannel protocol on the HP 9000 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 9000 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 9000 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 100Base-SX, HSC 100Base-TX, and PCI 4-port 100Base-TX where a Cisco Catalyst 5000 switch [firmware version 4.5(4)] with ports in “Desirable Mode” connected to an HP server with ports running the HP APA software sometimes caused link aggregations to go up and down repeatedly.

Corrective Action: 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) as listed in the “Patches in this Version” section.

- **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 9000 servers.

Software Availability in Native Languages

The commands used with this product are the ones supported by the Native Language Support Catalog of HP-UX.

What Manuals are Available

The following documents are available:

- *HP Auto Port Aggregation Quick Installation Guide*

  This document summarizes the installation, configuration, verification, and troubleshooting of the HP Auto Port Aggregation product.

- *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 *Quick Installation* or *User’s* guides.

2 Modifying Default HP Auto Port Aggregation (APA) Configuration

What Happens during Start Up?

Refer to the *HP Auto Port Aggregation Quick Installation Guide* for installation instructions. Following is the sequence of actions that occur after you have installed the HP APA software.

Once J4240AA has been selected for installation, the product is installed and is followed by a system reboot. 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 Config Mode. If no value is specified for a given feature for a given port, the software assumes a default value for the same. The config mode for a port initially sets (in step 1 above) Cisco's FEC mode to ON. If a port has been marked to set the mode to OFF, then the same will be done at this stage.

3. **hp_apaconf** processing

   /etc/rc.config.d/hp_apaconf contains a bunch of 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 fail-over 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:

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 100 UP    lan100 snap100 14  ETHER     Yes     119
LinkAgg1 0x0060B0770028 101 UP    lan101 snap101 15  ETHER     Yes     119
LinkAgg2 0x000000000000 102 DOWN  lan102 snap102 16  ETHER     Yes     119
LinkAgg3 0x000000000000 103 DOWN  lan103 snap103 17  ETHER     Yes     119
LinkAgg4 0x000000000000 104 DOWN  lan104 snap104 18  ETHER     Yes     119
```

The hardware path of a LinkAggregate has “LinkAggx” (with “x” indicating the LinkAggregate number) instead of a slash (“/”) separated hardware path.

Modifying the Default Configuration

By default, HP APA will automatically aggregate all supported ports. *You do not normally need to modify the default HP APA configuration*. You may want to modify the default HP APA configuration if, for example, you want to restrict certain ports so that they are not aggregated.

HP Auto Port Aggregation uses three configuration files (plus one for LAN Monitor) as follows:

- **/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.
- **/etc/lanmon/lanconf.ascii**

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

Configurable Parameters for Link Aggregates — /etc/rc.config.d/hp_apaconf

Following are the descriptions of the parameters within the **/etc/rc.config.d/hp_apaconf** file.

NOTE Each of the supported parameters must be set on a specific link aggregate prior to aggregating any physical ports.

- *HP_APA_INTERFACE_NAME* — Name of link aggregate (lan100, lan101, and so on).
- *HP_APA_LOAD_BALA*on*NCE_MODE* — Defines the Load Balancing mode for the specified link aggrononegate (*HP_APA_INTERFACE_NAME*). The supported values are as follows:
  - *LB_CPU*

    This algorithm uses the system's CPUs to determine how data flows are distributed across the physical ports in a link aggregate. This option is recommended for Server-to-Server configurations.
  - *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.
  - *LB_IP*

    This algorithm uses a portion of the 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.

The default for *HP_APA_LOAD_BALANCE* is *LB_MAC*.

- *HP_APA_GROUP_CAPABILITY*

  PAgP Group Capability to group ports into a Link Aggregate.

- *HP_APA_KEY*

  LACP administrative key to group ports into a Link Aggregate.

- *HP_APA_HOT_STANDBY*

  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 *On* and *Off*.

  The Default Is *Off*.

- *HP_APA_MANUAL_LA*

  Manually set ports for the specified link aggregate. The ports should be specified with PPA numbers. Each port should be separated by a comma (,).

The parameters listed above can be obtained or set directly via the *lanadmin*(1M) command.

HP_APA_INIT_ARGS="HP_APA_LOAD_BALANCE_MODE HP_APA_HOT_STANDBY HP_APA_MANUAL_LA"

The *HP_APA_INIT_ARGS* are reserved by HP. They are NOT user changeable.

Examples:

- To set the load balancing mode to *CPU* on lan100:

```
HP_APA_INTERFACE_NAME[0]="lan100"
HP_APA_LOAD_BALANCE_MODE[0]="LB_CPU"
HP_APA_HOT_STANDBY[0]="off"
```

- To create a *manually* formed link aggregate having ports with PPAs 2,3, and 4:

NOTE You may need to set the switch configuration appropriately for the manual configuration.

```
HP_APA_INTERFACE_NAME[1]="lan100"
HP_APA_LOAD_BALANCE_MODE[1]="LB_CPU"
HP_APA_HOT_STANDBY[1]="off"
HP_APA_MANUAL_LA[1]="2,3,4"
```

Configurable Parameters for Physical Ports that Support HP APA — /etc/rc.config.d/hp_apaportconf

Following are the descriptions of the parameters within the **/etc/rc.config.d/hp_apaportconf** file.

- *HP_APAPORT_INTERFACE_NAME*

Name of physical interface (lan0, lan1, and so on).

- *HP_APAPORT_GROUP_CAPABILITY*

  Set the group capability for the port. The group capability controls which link aggregates the specified port can be grouped with. The supported values are any positive integers.

  The default group capability is *5*.

- *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 (*HP_APA_HOT_STANDBY=on*).

  The default port priority is *0*.

- *HP_APAPORT_KEY*

  Set the administrative key for the port specified *HP_APAPORT_INTERFACE_NAME*. The key controls which link aggregations the specified port can be grouped with.

  The default administrative key is PPA number.

- *HP_APAPORT_SYSTEM_PRIORITY*

  Set the port system priority for the port specified by *HP_APAPORT_INTERFACE_NAME*. The system priority gives control to the system to resolve waiting ports to be added in a linkagg.

  The default system priority is *0*.

- *HP_APAPORT_COLLECTOR_MAX_DELAY*

  Set the collector maximum delay for the port specified by HP_APAPORT_INTERFACE_NAME. The collector maximum delay tells the partner system to the maximum possible delay of the actor system's receiving of packets.

  The default collector maximum delay is *0*.

- *HP_APAPORT_CONFIG_MODE*

  Set the configuration mode for a physical port. The supported values are listed below:

  — *LACP_AUTO* — IEEE 802.3ad Link Aggregation Control Protocol (LACP) should be started on the port.

  — *FEC_AUTO* — Cisco's Fast EtherChannel (FEC) should be started on the port. This is the default configuration mode for all ports which support the HP APA product.

  — *MANUAL* — Cisco's FEC or IEEE 802.3ad LACP will be disabled on the port, and it must therefore be manually added or removed from a specific link aggregate.

  — *LAN_Monitor* — Cisco's FEC or IEEE 802.3ad LACP will be disabled and the port will be used on LAN Monitor aggregates.

HP_APAPORT_INIT_ARGS="HP_APAPORT_GROUP_CAPABILITY HP_APAPORT_PRIORITY HP_APAPORT_CONFIG_MODE"

The parameters listed above can be obtained or set directly via the *lanadmin*(1M) command. The *HP_APAPORT_INIT_ARGS* are reserved by HP. They are NOT user changeable.

Example:

Use the default Group Capability, but set the other values as listed:

```
HP_APAPORT_INTERFACE_NAME[0]="lan1"
HP_APAPORT_PRIORITY[0]="10"
HP_APAPORT_CONFIG_MODE[0]="FEC_AUTO"
```

For more details on configuring link aggregates, see Appendix B, "Supported lanadmin Commands and Their Usage."

Configuration File Layout (10.20 and 11.x) — /etc/lanmon/lanconfig.ascii

Below is a sample of a *lanconfig.ascii* file.
(Default: */etc/lanmon/lanconfig.ascii*):

```
# ******************************************************
# ********** LAN MONITOR ASCII CONFIGURATION FILE
# *** For complete details about the parameters and how
# *** to set them, consult the lanqueryconf(1m) manpage
# *** or your manual.
# ******************************************************

NODE_NAME                       hpntcyj

POLLING_INTERVAL                10000000

DEAD_COUNT                      3

FAILOVER_GROUP                  lan90

        STATIONARY_IP   193.12.14.55

        PRIMARY         lan4    5

        STANDBY         lan5    3

FAILOVER_GROUP                  lan91

        STATIONARY_IP   192.12.14.55

        PRIMARY         lan6    5

        STANDBY         lan7    3

        STANDBY         lan9    3

        STANDBY         lan8    3

FAILOVER_GROUP                  lan92

        STATIONARY_IP   194.12.14.55

        PRIMARY         lan2    5

        STANDBY         lan3    3
```

Following are the descriptions of the parameters within the **/etc/lanmon/lanconfig.ascii** file.

The ASCII Configuration File default is /etc/lanmon/lanconfig.ascii. It is similar to the MC/SG file `/etc/cmcluster.cnf`. The file contains the following fields:

- **NODE_NAME:** Name of the node. This will be the name of the system as obtained by *gethostname()*. This should be the first line in the file.
- **POLLING_INTERVAL:** 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 1000000 (1 second). May occur more than once in the `config` file. An aggregate's polling interval is set to the most recent that is read.
- **DEAD_COUNT:** (new) Number of polling packets that are missed before deciding that the primary link is down and time to move onto the secondary link. Default will be *3*.
- **FAILOVER_GROUP:** (new) The aggregate name which will form a single link aggregate. This may be specified repeatedly for all the fail-over groups in the system. If the group has multiple links then it will be of the form lan100, lan101, and so on. That is, an aggregate is allocated to it. However, if it is a single link aggregate, then it will be *lanX* where *X* is the PPA of the link.

  — NETWORK_INTERFACE

  — PRIMARY

  — STANDBY

- **PRIMARY/STANDBY:** The LAN interface (for example, lan0, lan1). This may be specified repeatedly for all applicable lan interfaces in the link aggregate. They can be specified only for fail-over groups which have more than one link. These interfaces belong to the last FAILOVER_GROUP that was mentioned. The last parameter is the port priority that will be assigned to the port. This will be used for determining which link is the primary and which will be the standby. The port with the highest priority is the primary link. Besides, there will be a comment at the end of the line stating whether it is the primary or the secondary link.
- **STATIONARY_IP:** This is the IP address dedicated to the link aggregate. This is a required field and has to be set for each link.

3 Configuring Network Connectivity on Link Aggregates

This chapter describes how to configure remote connectivity using SAM. It contains the following sections:

- Step 1: Configuring Network Connectivity

- Step 2: Deleting a Default Gateway (Optional)

Step 1: Configuring Network Connectivity

Your system may not be able to communicate with other systems, for example, PCs, workstations, servers, etc., until you configure system-to-system connections by adding an entry in *hosts* for the remote system. You can use SAM to do this automatically by completing the following steps:

1. At the HP-UX prompt, type: **`sam`**
2. Double click *Networking and Communications* at the SAM main window.
3. Double click *Internet Addresses* to enable your system to communicate with other systems using the TCP/IP protocol.

   SAM displays the remote system names and Internet addresses that are already configured.
4. Choose **`Add`** from the "Actions" menu to open the Add Internet Address window to add the internet address and system name of a remote system.

   Use the SAM online help system for information about adding remote system connections.

   a. Enter the internet address for the remote system.

      Upon exiting the `Internet Address` field, SAM checks to make sure you have entered a valid IP/Internet address. SAM also determines if a gateway is required for the connection (see Step 4.c).

   b. Enter the remote system name.

      Upon exiting the `Remote System Name` field, SAM checks to make sure that connectivity has not already been configured for this system. If it has, SAM displays an error message.

   c. Optionally, choose **`Add Aliases`** to open the Add Aliases window if you want to configure aliases for a remote system.

      You can modify or remove alias names for a remote system on this menu.

      Activate the **OK** button to perform the task and return to the Add Internet Addresses window.

      Proceed to step 5 if a gateway is not required for this remote connection.

      SAM displays fields for entering gateway information if a gateway is required for this remote system connection. Use the SAM online help system for information about gateways.
5. Activate the **OK** button to enable your system to communicate with this system and return to the System-to-System Connectivity object list.

   SAM updates the object list to include the remote system you configured.

NOTE You can modify or remove remote systems and modify default gateways by highlighting the Remote System Name from the object list and choosing Modify, Remove, or Modify Default Gateway from the “Actions” menu.

6. Choose **Exit** from the “File” menu.
7. At the Networking Communications window, choose **Exit SAM** from the “File” menu to leave SAM.
8. Verify remote system configuration.
   a. View the list of remote systems you can communicate with using a symbolic name by typing the following command at the HP-UX prompt:

      more /etc/hosts

   b. View the configured destinations reached through gateways and the gateways used to reach those destinations by typing the following command at the HP-UX prompt:

      netstat -r

To verify that you can communicate with a remote system via the link aggregate, see chapter 5, “Troubleshooting”

Step 2: Deleting a Default Gateway

To delete a default gateway that you have added with SAM, do the following:

1. Enter the following command at the HP-UX prompt:

   route delete default gateway_hostname

   where *gateway_hostname* is the hostname of the default gateway you want to delete.
2. Edit the */etc/rc.config.d/netconf* file to remove the corresponding internet routing configuration parameter values for the gateway. For example:

```
ROUTE_DESTINATION [0] =
ROUTE_GATEWAY [0] =
ROUTE_COUNT [0] =
```

4 HP Auto Port Aggregation (APA) Resources

In addition to this manual, use the following resources to maintain and administer HP APA/9000.

HP-UX Manual Reference Pages (man pages)

While installing, configuring, or troubleshooting HP APA, you may need to refer to any of the following online manual reference pages (man pages) for useful HP-UX operating system or HP APA commands. To display a man page, type 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*(4) 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).
- *netfmt(1M)* formats common tracing and logging binary files.
- *netstat(1)* 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.

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 9000 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, run the command:

nettladm

See the *nettladm(1M) man page for information on using the GUI version, or the nettl(1M)* manual (man) page 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, use:

  nettl -log 0xf -e HP_APA

- To turn on all logging at Cisco's FEC level, use

  nettl -log 0xf -e HP_APAPORT

- To turn on all logging at IEEE 802.3ad level, use

  nettl -log 0xf -e HP_APALACP

- To examine the log file with cause and action descriptions:

  netfmt -v -f /var/adm/nettl.LOG00 | more

- To examine just the log messages in the log file, use:
  netfmt -f var/adm/nettl.LOG00
- To check network logging and tracing status, use:

  nettl -status

- To start Cisco's FEC tracing to the file **/tmp/tracefile.TRC0**, use

  nettl -traceon all -entity HP_APAPORT -file /tmp/tracefile

- To stop Cisco's FEC tracing, use

  nettl -traceoff all -entity HP_APAPORT

- To start LACP tracing to the file **/tmp/tracefile.TRC0**, use

  nettl -traceon all -entity HP_APALACP -file /tmp/tracefile

- To stop LACP tracing, use

  nettl -traceoff all -entity HP_APALACP

- To format the tracefile into the file **/tmp/traceout**, use:

  nettl -f /tmp/tracefile.TRC0 > /tmp/traceout

Refer to the *netfmt(1M)* man page for further information about this card and how to create a filter for trace formatting.

Manual Installation and Configuration

If you want to manually install and configure your HP APA product, refer to the instructions in the *HP Auto Port Aggregation Quick Installation Guide.*

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, execute *what vmunix* and look for the keyword, *hp_apa*.

  To check the version of your kernel, execute *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 the `/etc/hosts`, and `/etc/rc.config.d/netconf` files.

- Execute the *dmesg* command and record messages about the status of the HP APA card.

- Execute the *lanscan -v* command and record the output.

- Execute 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(1M)* command to help collect this information

- 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/9000 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 utility *savecore(1M)* to save a core dump. Send the output to your HP representative.

5 Troubleshooting HP Auto Port Aggregation (APA) Software

This chapter provides guidelines for troubleshooting HP APA. It contains a section giving an overview on troubleshooting and a section giving 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 (thst 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, execute 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” on page 37, to help you effectively communicate what is wrong.

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 Chapter 1, “Summary of APA and LAN Monitor Features and Characteristics” for a list of supported network physical ports (adapter cards).

Table 5-1 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 roundtrip communication between Network Layers on the source and target host using the `ping(1M)` 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 roundtrip communication between Link Levels on the source and target host using the *linkloop(1M)* diagnostic.

Transport Level Loopback Test: Checks roundtrip 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.

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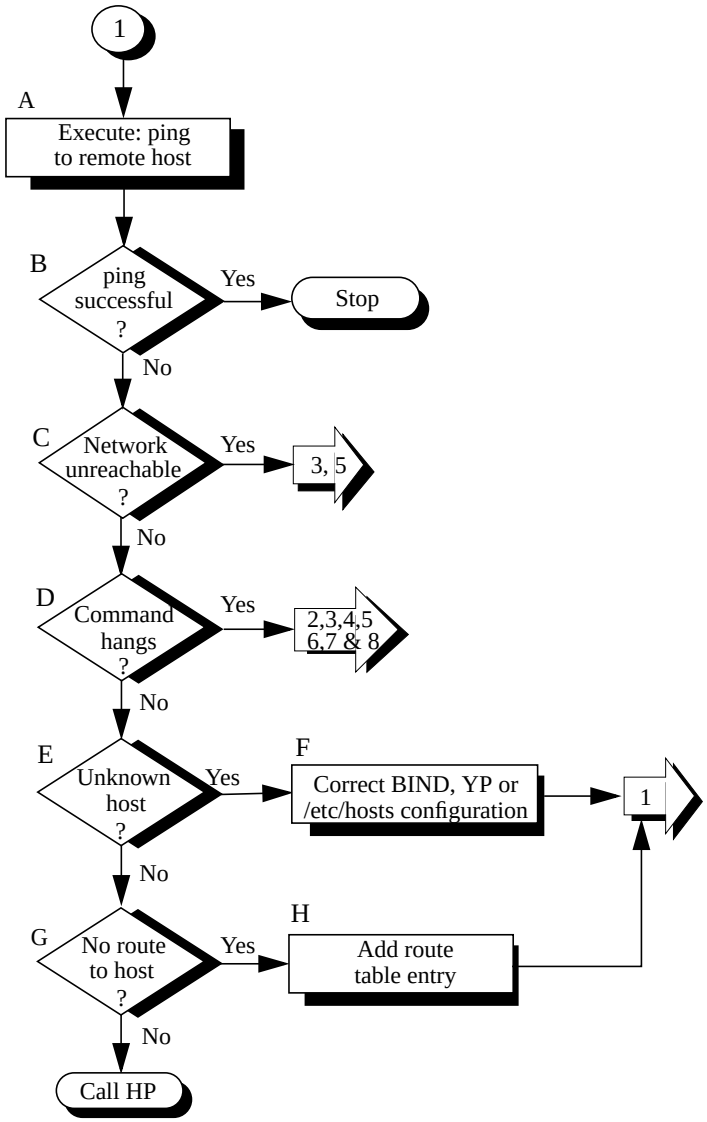
Flowchart 1: Network Level Loopback Test

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

Figure 5-1 Flowchart 1: Network Level Loopback Test



Flowchart 1 Procedures

A. *Execute: ping to remove host.* Using `ping(1M)`, 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. Do *`Cntrl C`* to stop the `ping` output.

C. *`Network unreachable?`* If YES, go to Flowchart 3 to display connection status using the `lanscan(1M)` 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.

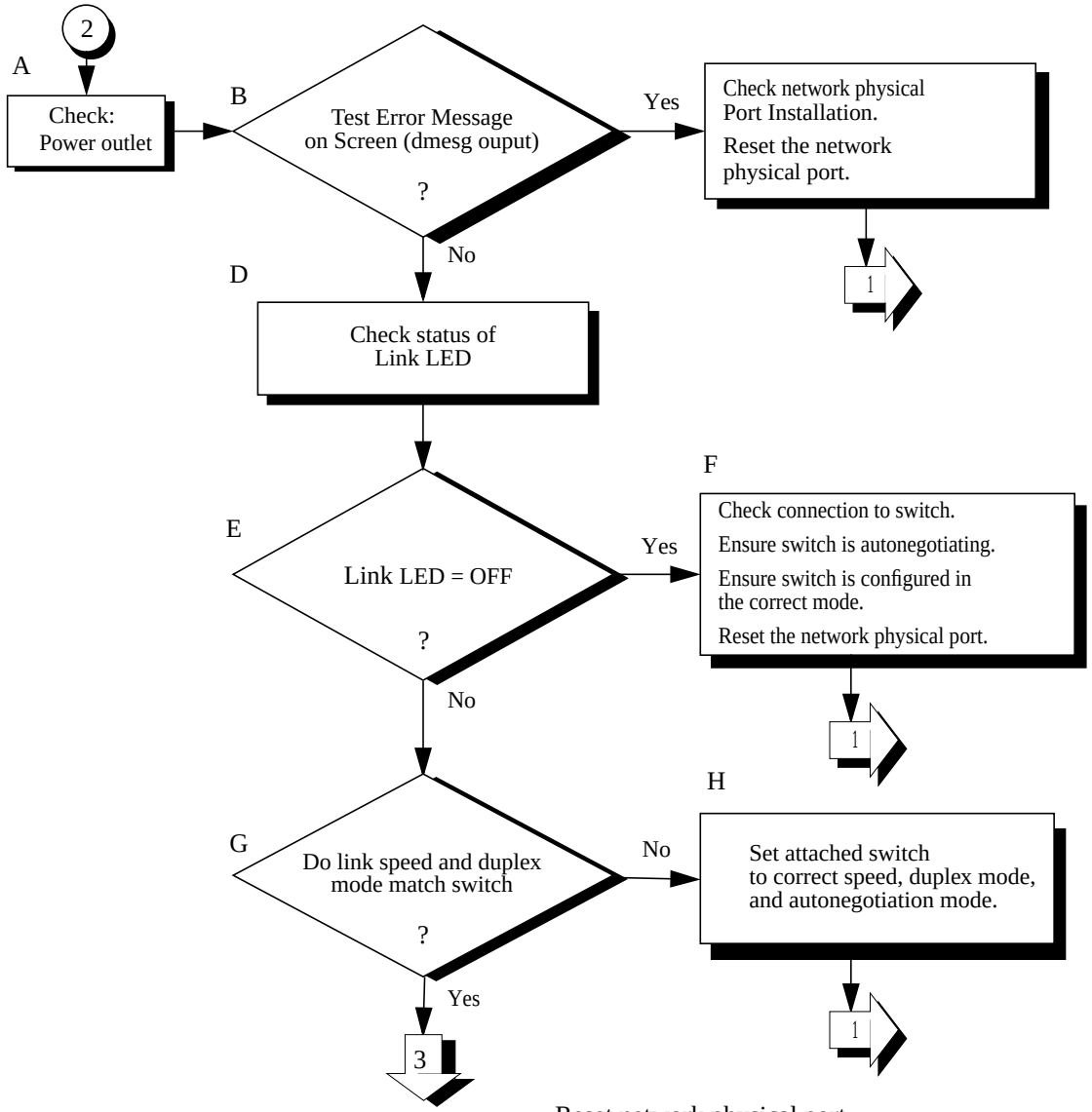
H. *`Add route table entry.`* Using `route`, add a route table entry for that host. Refer to the `route(1M)` online man page for more details. Start again with Flowchart 1.

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.

Refer to Chapter 2, “Modifying Default HP Auto Port Aggregation (APA) Configuration” on page 21, or Appendix B, “Supported lanadmin Commands and Their Usage,” for a detailed description of how to determine which network physical ports are associated with a specific link aggregate.

Figure 5-2 Flowchart 2: Network Physical Port Connections/LED Test



Reset network physical port.

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, type 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.

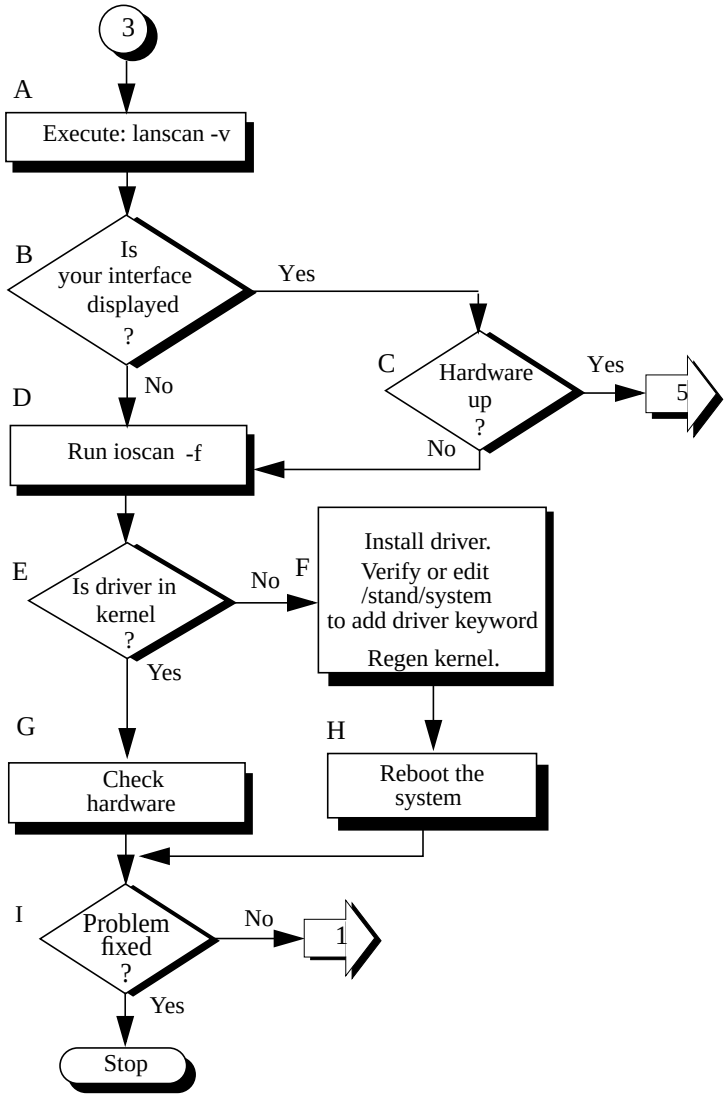
G. *Do link speed and duplex mode match switch?* If they do, proceed to Flowchart 3.

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 HP 9000 server.

Figure 5-3 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. *Execute: 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 Appendix B, "Supported lanadmin Commands and Their Usage," for a detailed description of how to determine which link aggregate a specific network physical port belongs to.

See the `lanscan` online man page 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. *Run ioscan.* `ioscan` will scan the system hardware and list the results. If you execute `ioscan -f`, output similar to the following will be displayed:

```
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 Fa
st/Wide SCSI Interface
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 Adapte
r
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 Keyboa
rd/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):

```
ioscan -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 adpater, 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. Refer to Chapter 1 for a list of required patches.

G *Check Hardware.* Verify that the network card is seated correctly and that it is operational.

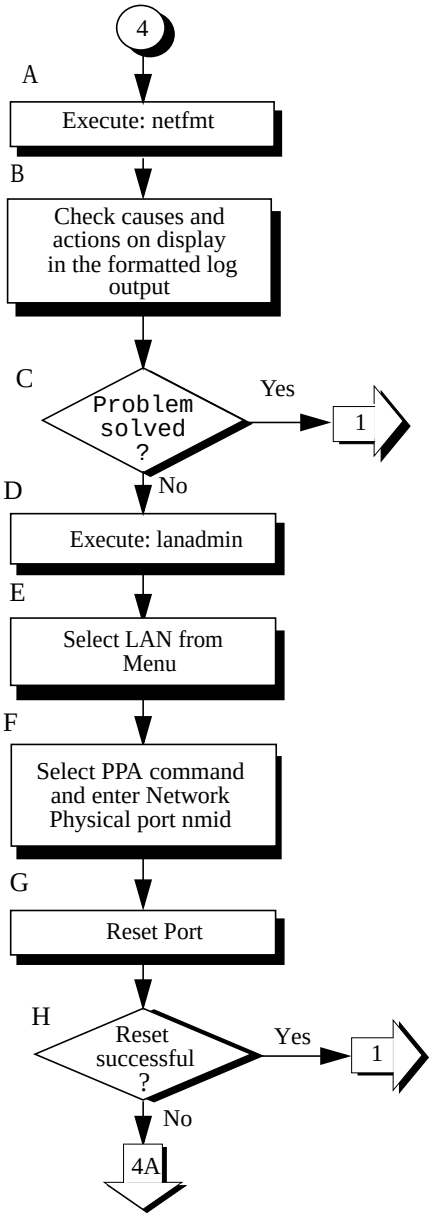
H. *Reboot the system.*

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 5-4 Flowchart 4: Network Physical Port Configuration Test



Flowchart 4 Procedures

A. *Execute: `netfmt`.* Use the netfmt command to view log data (error and disaster messages). An example command is

shown below.

```
netfmt -v -f /var/adm/nettl.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. *Execute lanadmin.* Run `lanadmin(1M)`. For a complete description of this command, refer to the `lanadmin(1M)` online man page.

E. *Select LAN from Menu.* Select lan to enter the LAN Interface diagnostic.

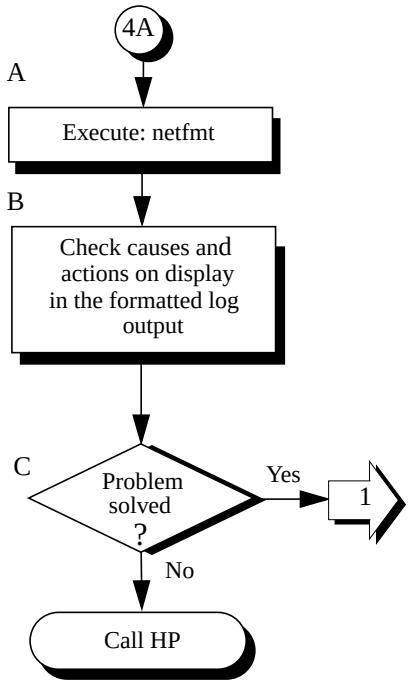
F. *Select the PPA command and enter the Network Physical Port PPA.* You can use the `lanscan` command to find the current PPA for the network physical port. The PPA you enter becomes the current device to be tested.

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



Flowchart 4A Procedures

A. *Execute: netfmt.* Use the `netfmt` command to view log data (error and disaster messages). An example netfmt command is shown below:

```
netfmt -v -f /var/adm/nettl.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.

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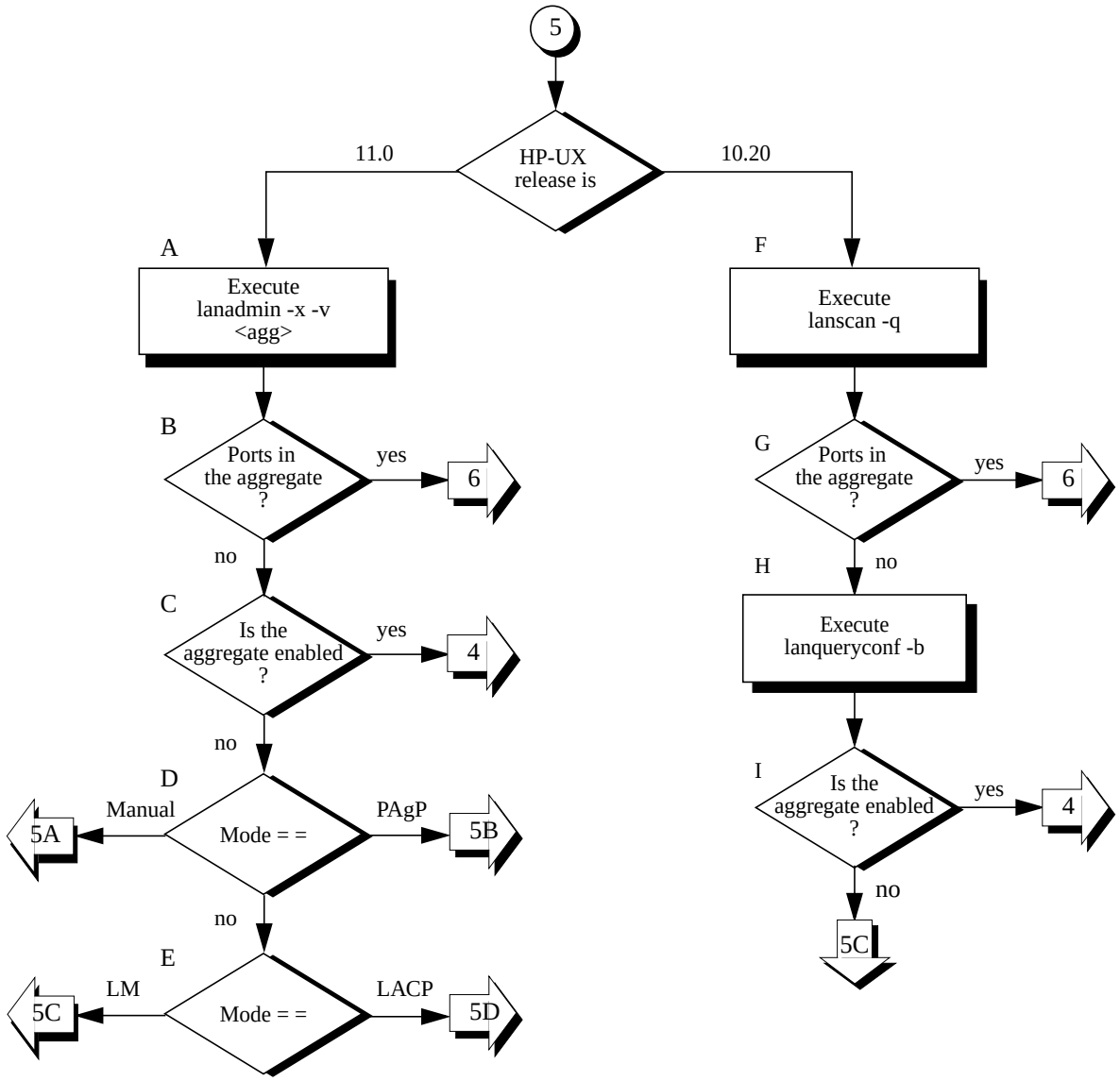
Flowchart 5: Link Aggregate Configuration Test

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

Figure 5-6 Flowchart 5: Link Aggregate Configuration Test



Flowchart 5 Procedures

Depending on whether you are on HP-UX 11.0 or 10.20, the tools you use are different. lanadmin has no LAN Monitor functionality in 10.20. You must use other tools — *lanqueryconf(1M)*, *lanapplyconf(1M)*, or *landeleteconf(1M)*. Also note that in10.20, which supports only link aggregates, instance numbers start at 90; 11.0 instance numbers start at 100, 11i at 900.

HP-UX 11.0 A. *Execute `lanadmin -x -v LinkAggPPA`.* A sample output for three scenarios using linkagg 100 is shown below. Case 1 shows that a linkagg 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 linkagg 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 100
Linkaggregate PPA #     : 100
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 100
Linkaggregate PPA #     : 100
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 101
Linkaggregate PPA #     : 101
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 Appendix B, “Supported lanadmin Commands and Their Usage,” 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.

HP-UX 10.20

F. **Execute lanscan -q** If link aggregates are configured and ports are UP, it can be seen in the *lanscan* output.

Example 1: Shows that link aggregates are either not configured or went down.

```
lanscan -q

0
1
2
3
4
5
90
91
92
93
94
```

Example 2: Shows that link aggregates with ports in them went down.

```
lanscan -q

0
5
90
91
92
93
94
```

G. **Ports in the aggregate?** If YES, go to Flowchart 6. If No, go to Step H.

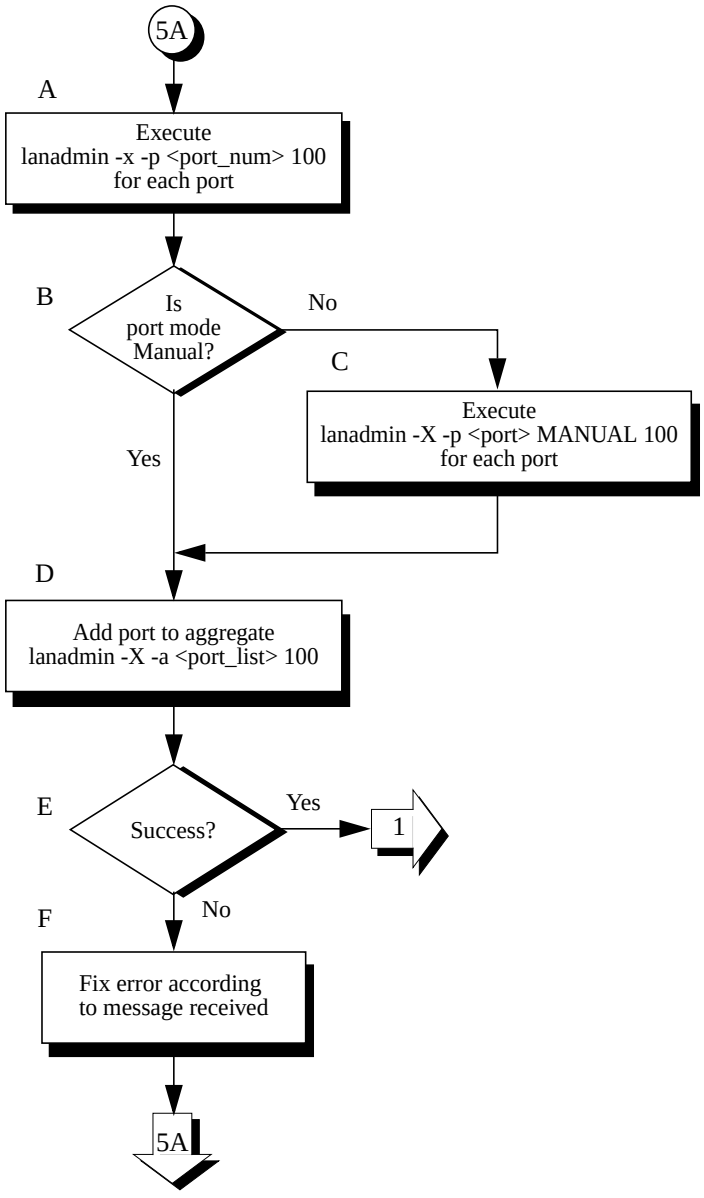
H. **Execute lanqueryconf -b** This shows the present configuration that is effective in the system. The output of this command tells if a link aggregate is now configured, but if ports went down. In the following example, link aggregate 92 is configured and all of its ports went down.

```
lanqueryconf -b
Reading binary file /etc/lanmon/lanconfig
ASCII output is in file
/etc/lanmon/lanconfig.ascii

NODE_NAME                          hpntcyj
POLLING_INTERVAL                   10000000
DEAD_COUNT                         3

FAILOVER_GROUP                     lan90
        STATIONARY_IP     193.33.33.33
        STANDBY           lan9     3
        PRIMARY           lan6     5

FAILOVER_GROUP                     lan91
        STATIONARY_IP     195.55.55.55
        PRIMARY           lan0     5
        STANDBY           lan1     3
        STANDBY           lan2     3
        STANDBY           lan3     3
FAILOVER_GROUP                     lan92
        STATIONARY_IP     194.44.44.44
```

I. **Is the aggregate enabled?** If Yes, go to Flowchart 4. If No go to Flowchart 5C.

Flowchart 5A: Manual Configuration Test

Figure 5-7 Flowchart 5A: Manual Configuration Test



Flowchart 5A Procedures

A. Execute *lanadmin -x -p <portppa> 100* 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 4 100`**

For more examples of the lanadmin command, see Appendix B, “Supported lanadmin Commands and Their Usage.”

B. Examine the output and look at the mode. If the port mode is

not MANUAL (or FEC_MANUAL) go to Step C. Otherwise go to Step D.

C. Execute *lanadmin -X -p <portppa> MANUAL 100* 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 PortPPAs 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 100 the following command should be used:

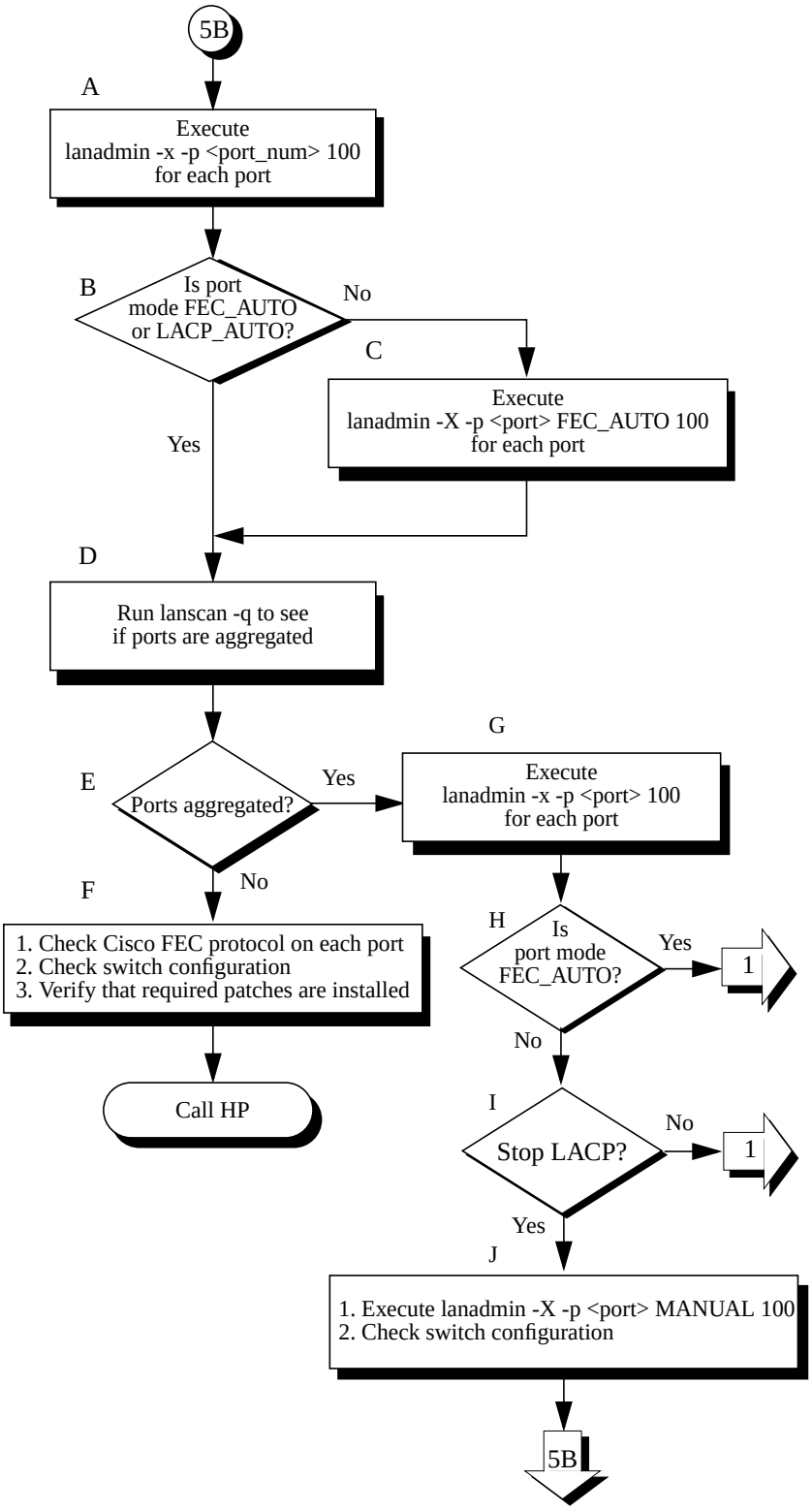
```
lanadmin -X -a 1 2 3 4 100
```

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 5-8 Flowchart 5B: PAgP Configuration Test



Flowchart 5B Procedures

A. Execute *lanadmin -x -p <portppa> 100* 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 port ppa 4, enter:

```
lanadmin -x -p 4 100
```

For more examples of the lanadmin command, see Appendix B, “Supported lanadmin Commands and Their Usage.”

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. Execute: *lanadmin -X -p <portppa> FEC_AUTO 100* 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. Execute *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 should display the following output:

```
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 HP 9000 Server are configured correctly for link aggregation.

3. Required Patches: Verify that required patches are properly installed on your server. See “Patches in this Version” on page 16 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. Execute 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. Execute *lanadmin -X -p <port> MANUAL 100* 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.

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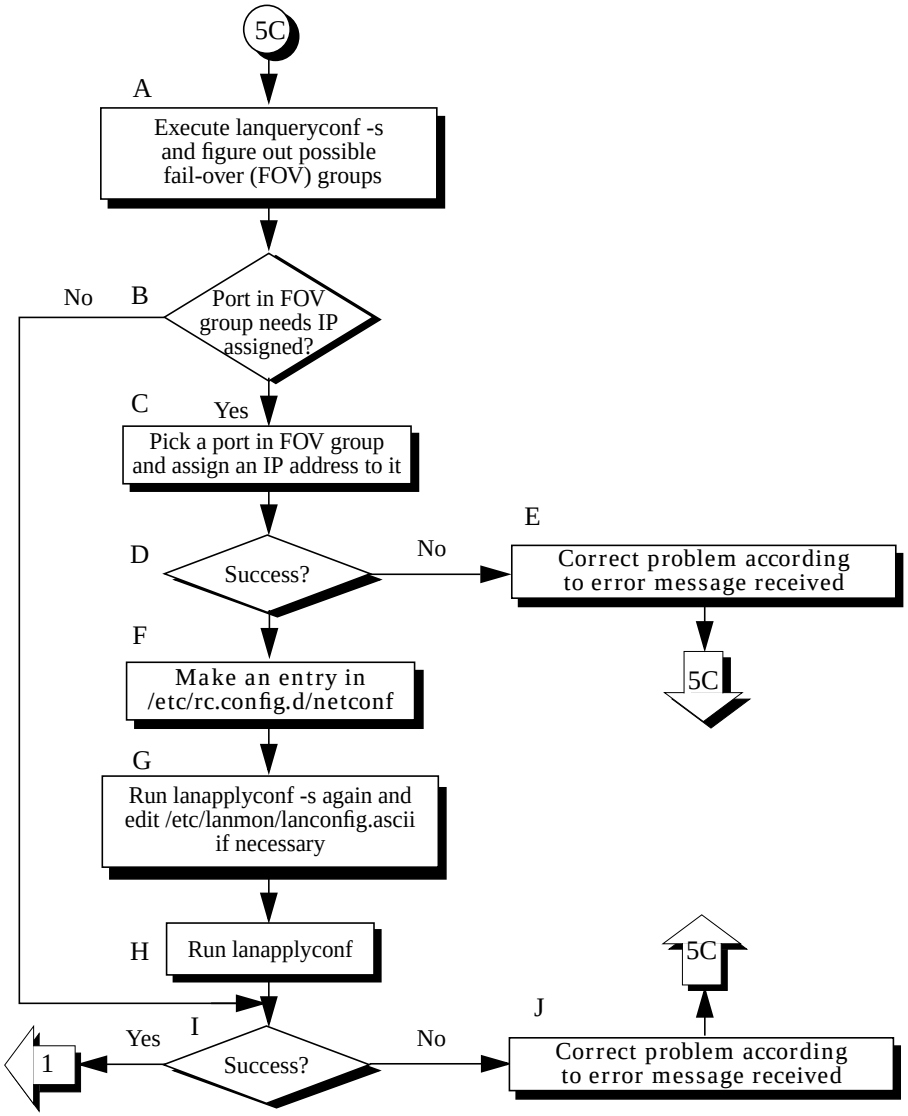
Flowchart 5C: LAN Monitor Configuration Test

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



Flowchart 5C Procedures

A. *lanqueryconf* figures out which set of ports are on the same subnet, and which on e 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 details, see the `lanqueryconf(1M)` man page.

Execute **lanqueryconf -s** to do a system-wide search for ports/links that can form fail-over groups.

Example 1:*lanqueryconf -s* fails to fine ports that can form a fail-over 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 fail-over group.

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

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

```
NODE_NAME                       hpntc6s
POLLING_INTERVAL                10000000
DEAD_COUNT                      3

FAILOVER_GROUP                  lan101
        STATIONARY_IP    194.12.14.56
        PRIMARY          lan0    5
        STANDBY          lan2    3
```

B. If none of the ports in a fail-over group has an IP address assigned, *lanqueryconf* prints a warning message.

C. The port that you choose to assign an IP address to carries all the traffic to and from the fail-over 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 the `ifconfig(1M)` man page.

D. Run *ifconfig <interface>* to check if the command in Step C was successful.

ifconfig lan3

```
lan3: flags=843<UP, BROADCAST RUNNING MUTICAST>
        inet 192.12.14.56 netmask ffffff00 broadcast 192.12.14.255
```

E. Correct any problem with the ifconfig flags or other error indications and repeat from Step A. If necessary use the *ifconfig(1M)* man page to figure out 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. Run *lanqueryconf -s* again so it can determine which ports can form fail-over groups.

H. Run *lanapplyconf*. This takes the information in a configuration file, forms fail-over groups with them as described in the configuration file, and switches the IP address from the primary port to the fail-over group. The default configuration file is `/etc/lanmon/lanconfig.ascii`.

I. If *lanapplyconf* is successful, go to Flowchart 1. Otherwise go to Step J.

J. Correct any problems by using the error messages and then begin again at Step A of this flowchart.

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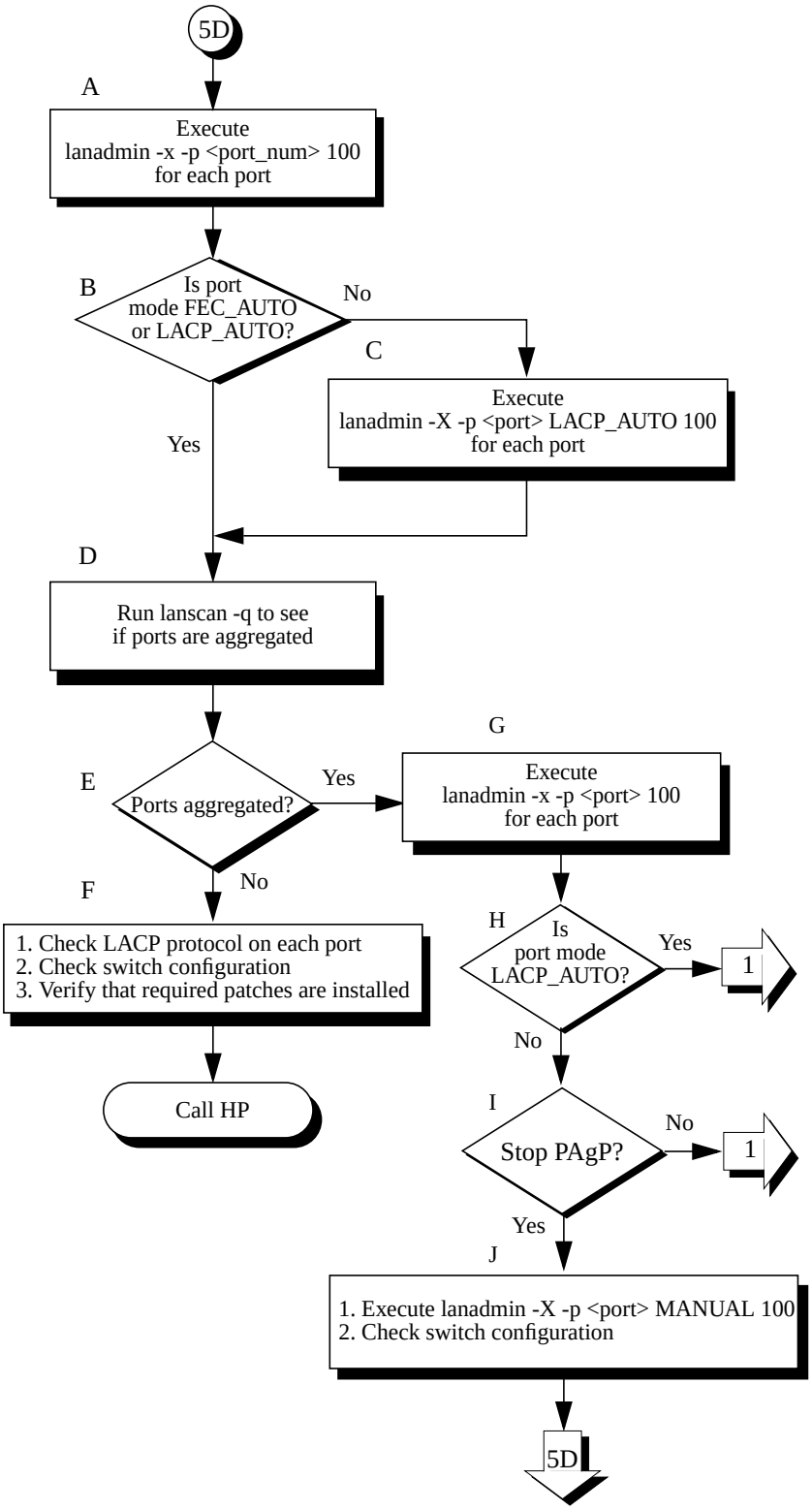
Flowchart 5D: LACP Configuration Test

Figure 5-10 Flowchart 5D: LACP Configuration Test



Flowchart 5D Procedures

A. Execute *lanadmin -x -p <portppa> 100* 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 port ppa 4, enter:

```
lanadmin -x -p 4 100
```

For more examples of the lanadmin command, see Appendix B, “Supported lanadmin Commands and Their Usage.”

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. Execute: *lanadmin -X -p <portppa> LACP_AUTO 100* 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. Execute *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 should display the following output:

```
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 HP 9000 Server are configured correctly for link aggregation.

3. Required Patches: Verify that required patches are properly installed on your server. See “Patches in this Version” on page 16 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, correct the problem and go back to Step A.

G. Execute 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 (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. Execute *lanadmin -X -p <port> MANUAL 100* to stop the FEC (PAgP) protocol.

2. Check switch configuration. Check the configuration to ensure the port should not run Cisco's FEC protocol, but IEEE 802.3ad LACP protocol.

Wait 30 seconds for the port to settle down and then start this flowchart's procedure again.

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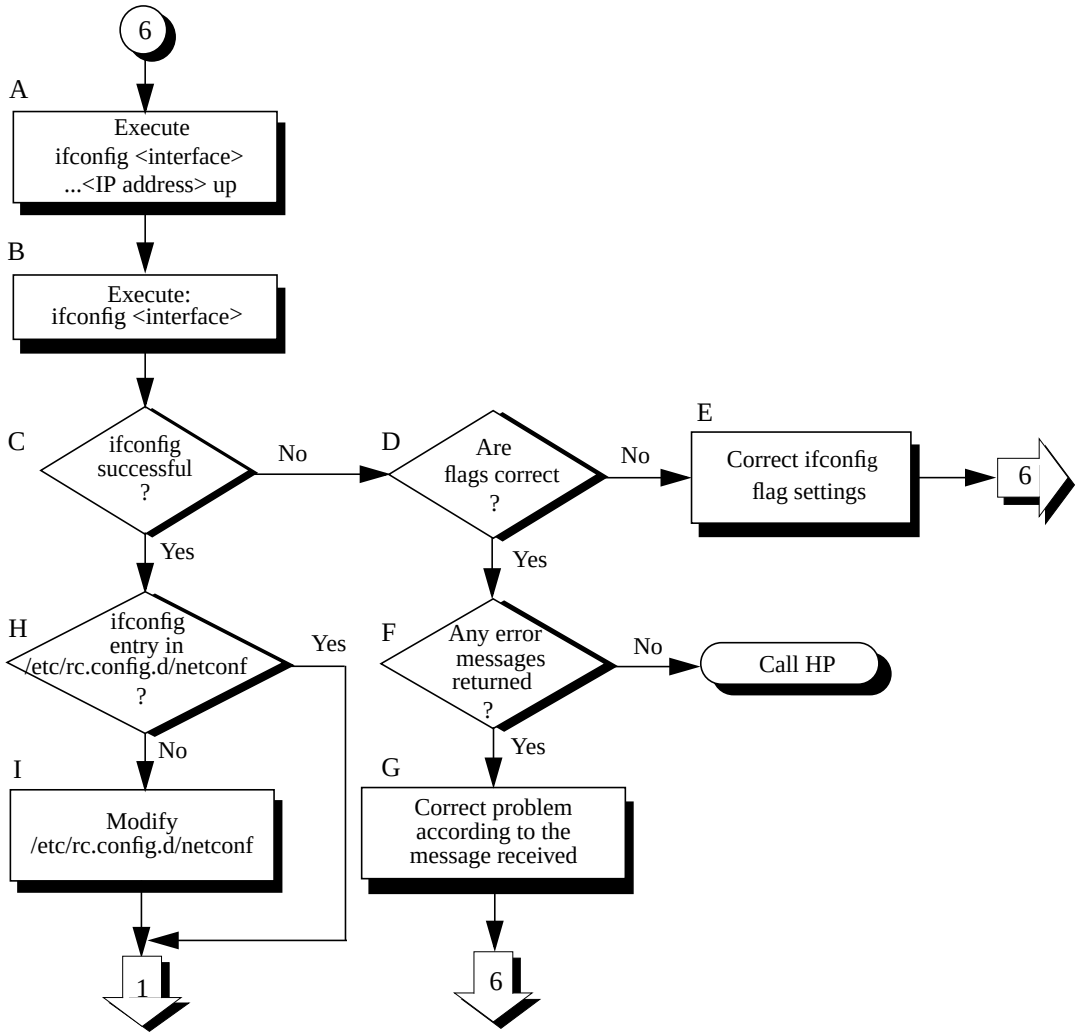
Flowchart 6: Network Configuration Test

Figure 5-11 Flowchart 6: Network Configuration Test



Flowchart 6 Procedures

A. Execute *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 lan100, enter:

```
ifconfig lan100 192.6.1.17 up
```

For more examples of the *ifconfig* command, refer to the *ifconfig(1M)* online man page.

B. Execute *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 lan100, enter:

```
ifconfig lan100
```

C. *ifconfig successful?* `ifconfig` is 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 ifconfig flag settings.* If *ifconfig* returns an incorrect flag setting, re-execute the command with the proper setting. For more information, refer to the *ifconfig(1M)* online man page. 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 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.

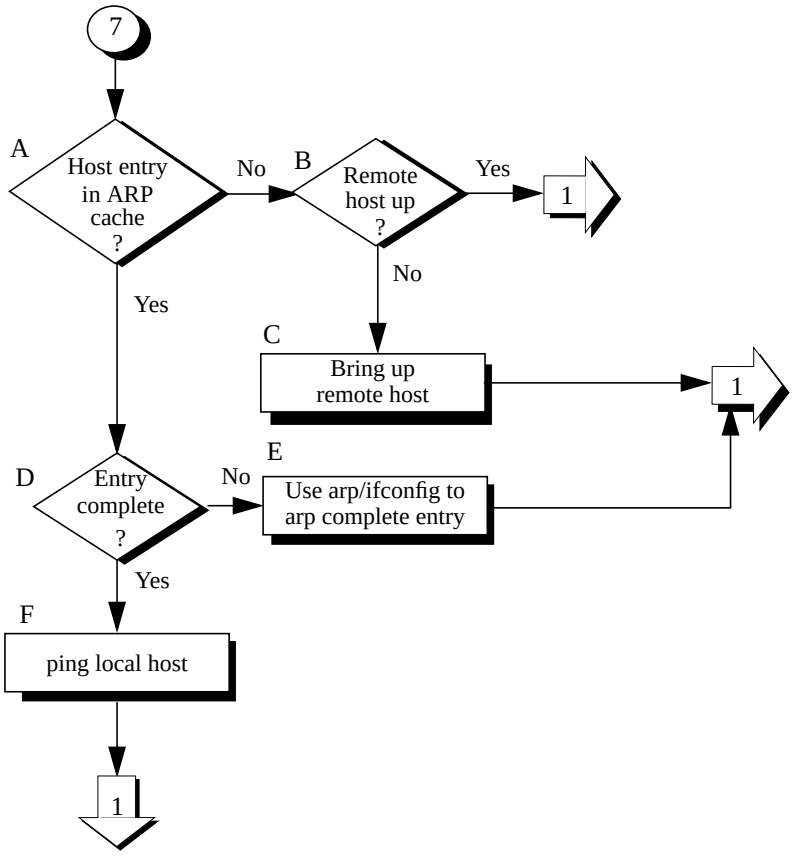
I. *Modify the /etc/rc.config.d/netconf file according the IP address you want assigned to the link aggregate.* Then run the following command:

```
/sbin/init.d/net start
```

For more information, refer to the *ifconfig(1M)* online man page. Go back to Flowchart 1 to verify that the problem has been solved.

Flowchart 7: ARP Verification

Figure 5-12 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:

```
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 remote host.* Have the node manager of the remote host bring that system up and start again with Flowchart 1.

D. *Entry complete?* Perhaps 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 the *arp(1M)* online man page. Also, try running the following commands on the link aggregate which is not working properly. For example, if link aggregate 100 is not working properly execute the following commands:

```
ifconfig lan100 down
ifconfig lan100 up
```

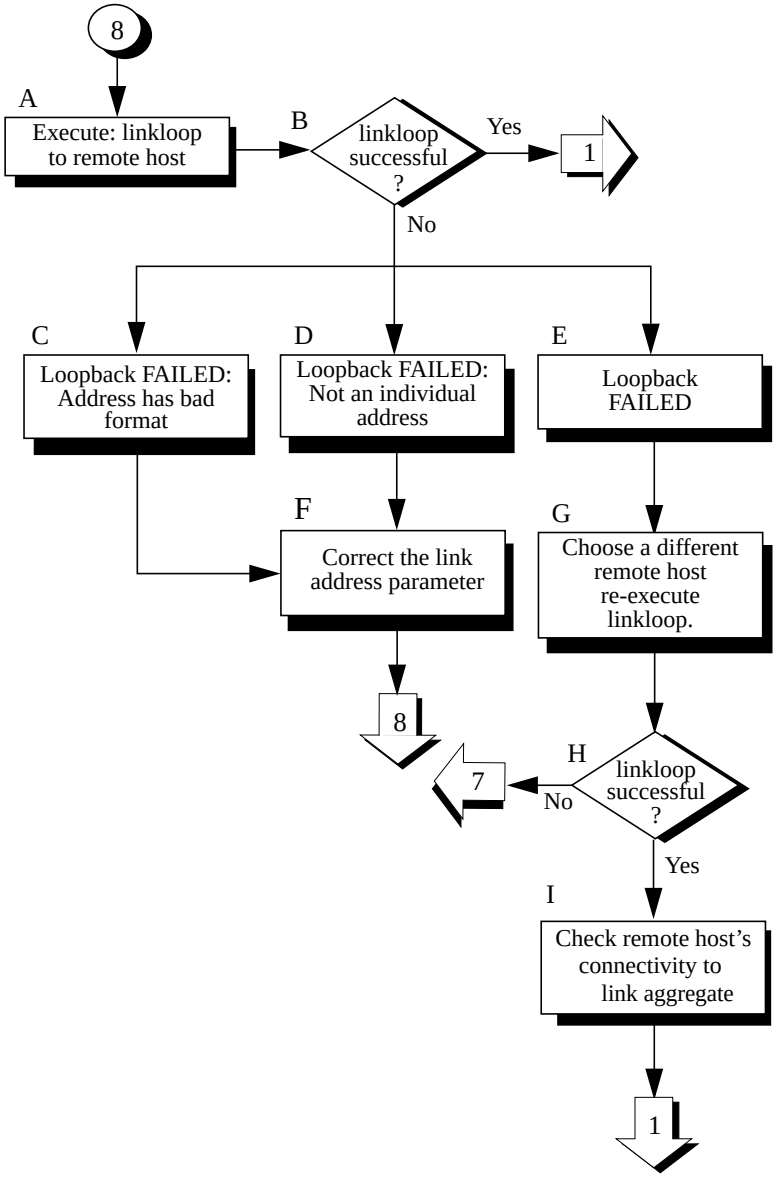
Start again with Flowchart 1.

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 5-13 Flowchart 8: Link Level Loopback Test



Flowchart 8 Procedures

A. *Execute: linkloop to 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"). Execute lanscan (1M) on the local system to find the PPA and obtain the link level address (station address) of the remote host. For more information on linkloop, refer to the linkloop(1M) online man page.

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.

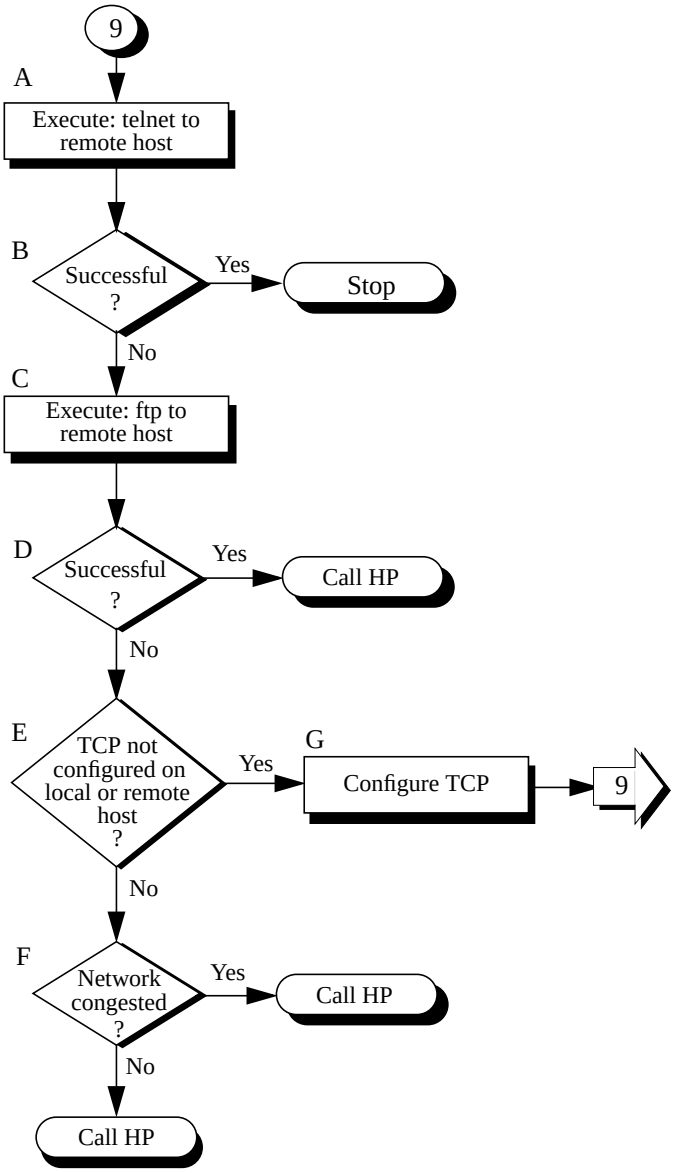
G. *Choose a different remote host; re-execute linkloop.* Restart Flowchart 7 using a different remote host. If this does not work, then check the switch configuration to verify the link aggregate on the switch is configured correctly.

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 5-14 **Flowchart 9: Transport Level Loopback Test (using ARPA)**



Flowchart 9 Procedures

A. *Execute: telnet to 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. *Execute: 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 likely 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.

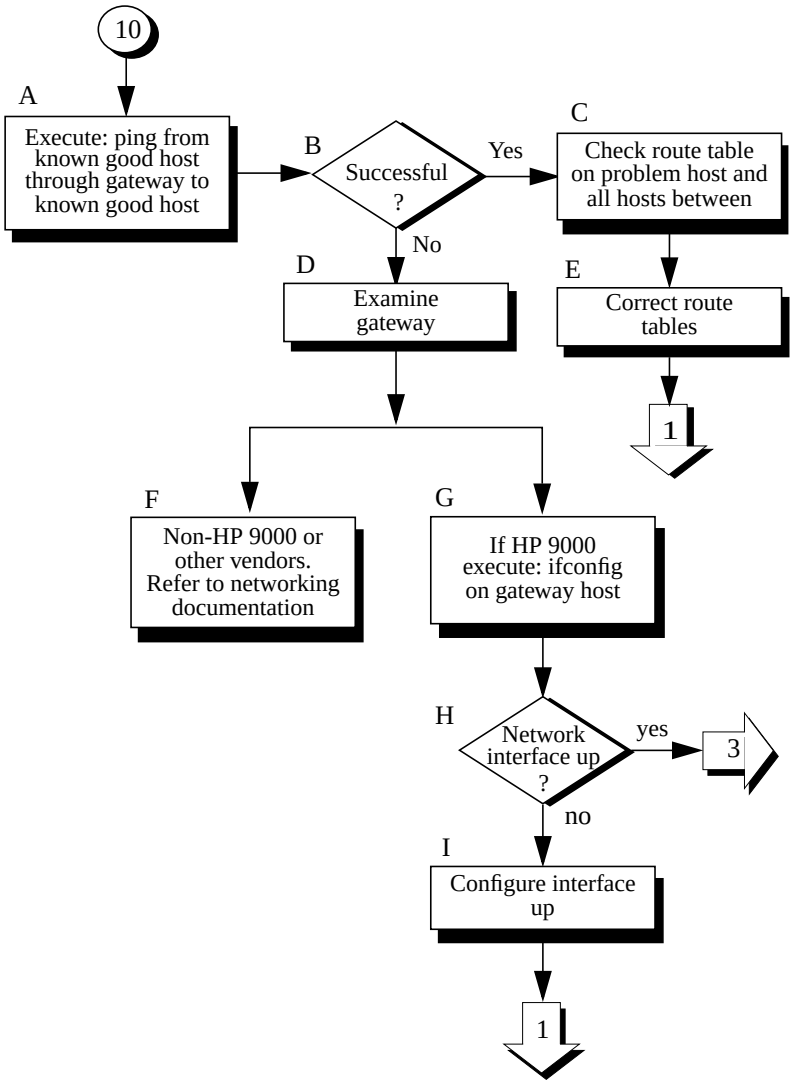
F. *Network congested?* If TCP is installed on both hosts, do a file transfer to another remote host on the network. Use *netstat(1)* to check for lost packets.

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 5-15 Flowchart 10: Bridge and Gateway Loopback Test



Flowchart 10 Procedures

A. *Execute: 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.* Execute `netstat -r` to examine a route table.

D. *Examine gateway.* If the gateway is an HP 9000, 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 9000 or other vendors.* Refer to networking documentation. Refer to the documentation that came with the gateway for additional diagnostics.

G. *If HP 9000, execute ifconfig on gateway host.* Execute *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. Execute *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.* Execute *ifconfig* on each interface to bring it up. Start again with Flowchart 1. Use Flowchart 1 to test all network interfaces on the gateway.

A HP Auto Port Aggregation (APA) Statistics

HP Auto Port Aggregation Statistics

This section describes how link aggregate level statistics are collected and reported. The link aggregate software keeps a counter for each statistic defined in RFC 1213 MIB II. 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.

When a physical port is removed from a link aggregate, each of it's statistics is added to the corresponding link aggregate statistic. When a physical port is added to a link aggregate, it's 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.

LAN Interface Status Display

This section contains a description of the RFC 1213 MIB II statistics fields for LAN interface cards which are displayed on the screen with the display command in lanadmin LAN interface Test Mode. This same command is also used to examine RFC 1213 MIB II statistics for logical link aggregate interfaces. Refer to “View Link Aggregate Statistics Using lanscan” on page 100 for a sample output.

RFC 1213 MIB II

For additional information about the fields described below, refer to RFC 1213.

Field	Description
Network Management ID	A unique ID assigned by the system for the network management of each network interface.
Description	A textual string containing information about the interface.
Type (value)	The type of interface, distinguished according to the physical/link protocols, immediately below the network layer in the protocol stack. 10/100Base-TX can have one of the following values: *ethernet-csmacd(6)*, or *iso88023-csmacd(7*). The following values are for other networking products.
MTU Size	The size of the largest datagram which can be sent/received on the interface specified in octets. This value is 1500.
Speed in bits per second	The speed of the 10/100Base-TX card, 10 Mbit/s or 100 Mbit/s.
Station Address	The interface address at the protocol layer immediately below the network layer in the protocol stack. For interfaces which do not have such an address, such as serial line, this object contains an octet string of zero length.
Administration Status	The desired state of the interface. This parameter is set to `up(1)` and is not configurable. It will have one of the following values: up(1) — Ready to pass packets down(2) — Not operative testing(3) — In test mode
Operation Status	The current operational state of the interface. This value is the same as the hardware status displayed by *lanscan(1M)*. It will have one of the following values. up(1) — Ready to pass packets down(2) — Not operative (card is down) testing(3) — In test mode
Last Change	The value of SysUpTime at the time the interface entered its current operational state. If the current state was entered prior to the last reinitialization of the local network management subsystem, then this object contains a zero

	value.
Inbound Octets	The total number of octets received on the interface, including framing characters.
Inbound Unicast Packets	The number of subnetwork-unicast packets delivered to a high-layer protocol.
Inbound Non-Unicast Packets	The number of non-unicast (subnetwork-broadcast or subnetwork-multicast) packets delivered to a higher-layer protocol.
Inbound Discards	The number of inbound packets that were discarded even though no errors had been detected, to prevent their being delivered to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.
Inbound Errors	The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.
Inbound Unknown Protocols	The number of packets received via the interface which were discarded because of an unknown or unsupported protocol.
Outbound Octets	The total number of octets transmitted out of the interface, including framing characters.
Outbound Unicast Packets	The total number of packets that higher-level protocols requested be transmitted to a subnetwork-unicast address, including those that were discarded or not sent.
Outbound Non-Unicast Packets	The total number of packets that higher-level protocols requested be transmitted to a non-unicast (a subnetwork-broadcast or subnetwork-multicast) address, including those that were discarded or not sent.
Outbound Discards	The number of outbound packets that were discarded even though no errors had been detected to prevent their being transmitted. One possible reason for discarding such a packet could be to free up buffer space.
Outbound Errors	The number of outbound packets that could not be transmitted because of errors.
Outbound Queue Length	The length of the output packet queue (in packets).

B Supported *lanadmin* Commands and Their Usage

Configure Link Aggregates Using `lanadmin`

A link aggregate consists of up to four ports. To configure a link aggregate from the HP-UX command line, you use the *lanadmin -X* command (uppercase X) with options. You can perform the following tasks using the *lanadmin* command:

- Link aggregate specific commands (`lanadmin` options are in parentheses):
  - Manually configure a link aggregate:
    - Add physical ports to a link aggregate (`-X -a` *portPPA* `[`*portPPA...*`]` *linkaggregatePPA*).
    - Delete physical ports from a link aggregate (`-X -d` *portPPA* `[`*portPPA...*`]` *linkaggregatePPA*).
    - De-configure (clear) a link aggregate (`-X -c` *linkaggregatePPA*).
    - Specify load-distribution algorithm (`-X -l` *loaddistalgorithm linkaggregatePPA*).
    - Specify hot-standby mode (`-X -y on|off` *linkaggregatePPA*).
    - View status of a link aggregate (`-x -v` *linkaggregatePPA*).
  - Automatically configure a link aggregate:
    - Enable LACP or FEC on all physical ports. See Port specific commands, below.
    - De-configure a link aggregate.
    - Specify load-distribution algorithm.
    - Specify hot-standby mode.
    - View status of a link aggregate.
- Port specific commands:

NOTE Remember that the portPPAs vary with the operating system you have installed: 10.20, 90; 11.x, 100; and 11i, 900. The following example uses HP-UX 11.x

  - Enable/disable LACP on a port (`-X -p` *portPPA* `LACP_AUTO|MANUAL 100`).
  - Enable/disable FEC on a port (`-X -p` *portPPA* `FEC_AUTO|MANUAL 100`).
  - Specify port priority (`-X -t` *portPPA port_priority* `100`).
  - Specify group capability

(`-X -g` *`portPPA group_capability linkaggregatePPA`*).

— View status of a port (`-x -p` *`portPPA`* `100`).

— Specify port key (*`-X -k portPPA key linkaggregatePPA`*)

`lanadmin` Syntax

You use the *lanadmin* command to manage link aggregates and the addition of ports to a link aggregate. The following options are for use along with the `-X` option:

lanadmin[-X -a *`portPPA`* *[portPPA ...]* *`linkaggregatePPA`**]*

```
[-X -c linkaggregatePPA]
[-X -d portPPA [portPPA ...] linkaggregatePPA]
[-X -e collector_max_delay LinkAggregate PPA
[-X -g portPPA group_capability linkaggregatePPA]
[-X [-h|-H] 100]
[-X -k PortPPA | LinkAggregatePPA admin_key AnyLinkAggregatePPA]
[-X -l load_distribution_algorithm linkaggregatePPA]
[-X -o LinkAggregatePPA]
[-X -p portPPA FEC_AUTO|FEC_MANUAL 100]
[-X -s PortPPA system_priority AnyLinkAggregatePPA
[-X -t portPPA port_priority 100]
[-X -y on|off linkaggregatePPA]
```

`-a` Add ports with the specified *`portPPA`*s, to the link aggregate with the specified *`linkaggregatePPA`* number.

`-c` Clear (remove all) ports from a link aggregate with the specified *`linkaggregatePPA`* number.

`-d` Delete ports with the specified PPAs from the link aggregate with the specified *`linkaggregatePPA`* number.

`-e` Set Collector Max Delay for an LACP aggregator.

`-g` Set group capability for a port with the specified *`portPPA`*. The valid values for *`group_capability`* are integral numbers starting at `0`.

`-h` Print out the help screen.

`-H` Print out the extended help screen.

`-k` Set Administrative key for an LACP port.

`-l` Set the load distribution algorithm for a link aggregate with the specified *`linkaggregatePPA`* number.

The following values are valid for *`load_distrubution_algorithm`*:

`LB_CPU` — Based on the process specific CPU. Appropriate for server-server configuration.

`LB_MAC` — Based on the MAC Address of the outgoing packet. Appropriate for server-to-switch configuration.

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

`-o` Clear Data Flows for a LinkAggregate

`-p` Set Mode for a port with the specified *portPPA* number. You must specify interface `100` as the last argument of this option. 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 802.3 (LACP) on the port.
- `LAN_MONITOR` Provides Hot Standby capability.

`-s` Set System Priority for an LACP port.

`-t` Set port priority for the port with the specified PPA Number. You can specify any valid link aggregate PPA number with this option.

The valid values for *port_priority* are integral numbers starting at `0`.

`-y` Turn `on/off` hot standby for the link aggregate with the specified *linkaggregatePPA* number.

The following options will be passed along with the `-x` option:

```
lanadmin [-x -e linkaggregatePPA]
         [-x -g linkaggregatePPA
         [-x [-h|-H] 100]
         [-x -k PortPPA | LinkAggregatePPA Any LinkAggregatePPA]
         [-x -l linkaggregatePPA]
         [-x -m linkaggregatePPA]
         [-x -n linkaggregatePPA]
         [-x -p portPPA 100]
         [-x -q portPPA 100]
         [-x -s PortPPA | LinkAggregatePPA Any LinkAggregatePPA]
         [-x -t portPPA 100]
         [-x -v linkaggregatePPA]
         [-x -y linkaggregatePPA]
```

`-e` Get collector Maximum Delay for an LACP aggregator.

`-g` Display the current group capability for the link aggregate with the specified *linkaggregatePPA* number.

`-h` Print out the help screen.

`-H` Print out the extended help screen.

`-k` Get administrative and operational key for an LACP port.

`-l` Display the current load distribution algorithm for the link aggregate with the specified *linkaggregatePPA* number.

`-m`	View status for all LinkAggregates.
`-n`	View status for all APA capable ports.
`-p`	Display the present status of a port with the specified *portPPA* number. You must specify interface 100 as the last argument of this option.
`-q`	Display the present status of a port with the specified *portPPA* in the extended format. You must specify interface 100 as the last argument of this option.
`-s`	Get system priority for an LACP port.
`-t`	Display the current port priority for the port with the specified *portPPA* number. You must specify interface 100 as the last argument of this option.
`-v`	View status for a given link aggregate with the specified *linkaggregatePPA* number.
`-y`	Display Hot Standby value for the link aggregate with the specified *linkaggregatePPA* number.

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

When the system comes up, all the links come up configured in automatic aggregation. To remove a port from an automatically formed link aggregate, Cisco's Fast EtherChannel protocol should be turned off on that port. If a port with a PPA number of 2 belongs to link aggregate lan100 (which has a PPA number of 100), then use one of the following two commands:

lanadmin -X -d 2 100 *or*

lanadmin -X -p 2 MANUAL 100

To form a link aggregate of the ports automatically, turn on Cisco's Fast EtherChannel protocol on that port. Suppose port #2 needed to be configured automatically:

lanadmin -X -p 2 FEC_AUTO 100

where 100 is the PPA of the first link aggregate. When the protocol completes successfully, HP_APA will determine which link aggregate port #2 will best fit and add the port there.

To de-configure a link aggregate, say 103, which has ports with PPAs 2, 3, 4, and 5, use the following commands in succession:

```
lanadmin -X -p 2 MANUAL 103
lanadmin -X -p 3 MANUAL 103
lanadmin -X -p 4 MANUAL 103
lanadmin -X -p 5 MANUAL 103
```

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

lanadmin -X -d 2 3 4 5 103

To fully deconfigure a link aggregate, use the following command:

lanadmin -X -c 103

CAUTION Failure to fully deconfigure a link aggregate may result in some properties being retained in the link aggregate, and subsequently, when a new set of ports are added onto the link aggregate they will inherit old properties of the link aggregate. Thus the new link aggregate formed will no longer be new.

To configure ports with PPAs 6, 7, 8 and 9 manually into a link aggregate, for example, lan101, use the following command:

lanadmin -X -a 6 7 8 9 101

CAUTION Be careful while using the "-a" sub-option. This may lead to an invalid link aggregate. This command gives you full control over forming any link aggregate that you want. You can 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.

To delete a single port, say 8, from link aggregate 101 the following can be done:

```
lanadmin -X -d 8 101
```

To also delete 6 and 9:

```
lanadmin -X -d 6 9 101
```

To deconfigure the link aggregate 101 completely:

```
lanadmin -X -c 101
```

This will delete the remaining port, 7, from link aggregate 101, and then clear all the properties from the link aggregate, so that it becomes completely clean.

CAUTION After all the ports have been deleted from link aggregate 101, (after using, for example, **`lanadmin -X -d 7 100`**), failure to use the **`-c`** sub-option may result in some properties being retained in link aggregate 101, and subsequently, when a new set of ports is added to link aggregate 101, they will inherit old properties of the link aggregate. Thus the new link aggregate formed will not be new.

NOTE You may have to set the switch configuration appropriately for the manual configuration.

Using lanadmin Interactively

If you type the command *lanadmin* by itself, or with the *-t* option, the command becomes interactive. The following example illustrates the interactive use of *lanadmin*:

```
lanadmin

                    LAN ONLINE ADMINISTRATION, Version 1.1
                         Tue. May 26, 1998  15:33:05
                    Copyright 1994 Hewlett Packard Company
                           All rights are reserved.

Test Selection mode.
        lan                 = LAN 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=6
        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
        special     = Special menu (driver specific menu)
```

Enter command: **ppa**
Enter PPA Number. currently 6: **100**
LAN Interface test mode. LAN Interface PPA=100

```
        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
        special    = Special menu (driver specific menu)
Enter command: display
```

PPA Number=100

```
Description=lan100 Hewlett-Packard
Linkaggregate Interface
Type (value)=ethernet-csmacd(6)
LinkAggregate Station Address=0x80009e72894
Administration Status (value)=up(1)
Operation Status (value)=up(1)
LinkAggregate Status (value)=enabled(1)
Group Capability=5
LinkAggregate Mode (value)=auto(1)
Distribution algorithm (value)=DA based(1)
Load Balancing (value)=off(0)
Physical Ports=2, 3 and 5
Last Change=100

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

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 test mode. LAN Interface PPA=100
        clear     = Clear statistics registers
        display   = Display LinkAggregate status and statistics registers
        end       = End LAN Interface test mode, return to Test selection mode.
        menu      = Display this menu
        ppa       = PPA Number of the LinkAggregate
        quit      = Terminate the Administration, return to shell
        reset     = Reset LAN Interface to execute its selftest
        special   = Special menu (driver specific menu)
Enter command: special
Valid LAN Interface PPAs: 4 2 5 3.
Driver specific test mode.
        linkagg   = Link Aggregate status
        port      = Port's HP_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
Number of ports             : 4
Ports PPA                   : 4 2 5 3
Link Aggregation Mod        : Automatic Aggregation
Group Capability            : 51
Load Balance Mode            MAC Address based (LB_MAC)
Hot Standby Mode            : ON
Valid LAN Interface PPAs    : 4 2 5 3
Driver specific test mode
        linkagg   = Link Aggregate status
        port      = Port's HP_APA status
        end       = End Driver Specific Test Mode, return to Lan Interface test
                    mode.
        menu      = Display this menu
        ppa       = PPA Number of the LAN Interface
        quit      = Terminate the Administration, return to shell
```

```
Enter command: port
Port Number                 : 4
pagp Enabled                ENABLED
ppMyData.deviceId           : 0x0060B04BAB84
ppMyData.distReq            : LEARNCAP_AGPORT
ppMyData.portPriority       : 2
ppMyData.sentPortIfIndex    : 8
ppMyData.groupCapability    : 51
ppMyData.groupIfIndex       : 13
ppNoPagpTimerI              : 0
ppNoTransTimerQ             : 0
ppTHToTATimerS              : 0
ppSlowHelloTimerA           : 18
ppPartnerCount              : 1
++++++++++++++++++++++++++++++Partner Data+++++++++++++++++
                                        PARTNER 0
          ppPartnerData.deviceId          : 00e01e51dad8
          ppPartnerData.distReq           : LEARNCAP_AGPORT
          ppPartnerData.portPriority      : 128
          ppPartnerData.sentPortIfIndex   : 19
          ppPartnerData.groupCapability   : 1
          ppPartnerData.groupIfIndex      : 0
          ppTimerP                        : 104
          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
Valid LAN Interface PPAs: 4 2 5 3.

Driver specific test mode.
          linkagg           = Link Aggregate status
          port              = Port's HP_APA status
          end               = End Driver Specific Test Mode, return to Lan
                              Interface test mode
          menu              Display this menu
          ppa               PPA Number of the LAN Interface
          quit              Terminate the Administration, return to shell
Enter command: quit
```

View Link Aggregate Statistics Using lanscan

The *lanscan* command now 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

Following are examples of the various outputs from the lanscan command.

- *lanscan* on systems without HP APA installed remains the same.

  # 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
```

- *lanscan* on the same machine, with link aggregation enabled. In this example, the link aggregate lan100 is formed of ports lan2, lan3, lan4 and lan5. The output suppresses the information on lan2, lan3, lan4 and lan5, since these ports cannot be used by themselves any longer. You can only see lan100.

  # 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 100 UP    lan100 snap100 10  ETHER     Yes     119
LinkAgg1 0x000000000000 101 DOWN  lan101 snap101 11  ETHER     Yes     119
LinkAgg2 0x000000000000 102 DOWN  lan102 snap102 12  ETHER     Yes     119
LinkAgg3 0x000000000000 103 DOWN  lan103 snap103 13  ETHER     Yes     119
LinkAgg4 0x000000000000 104 DOWN  lan104 snap104 14  ETHER     Yes     119
```

- *lanscan* with verbose option. This will print some port-aggregate specific information. Below, only a section of lanscan output is shown. In this example, *lanscan* prints out information for lan100. The information includes the list of ports belonging to the link aggregate (lan2, lan3, lan4, and lan5).

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 100 UP    lan100 snap100 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
```

- *lanscan* with the option -*q* (extended print-ppa).

  lanscan -q

  ```
  6
  0
  1
  7
  100    4 2 5 3
  101
  102
  103
  104
  ```

C Supported LAN Monitor Commands and Their Usage

LAN Monitor Overview

The LAN Monitor feature of the HP Auto-Port Aggregation software provides a link aggregate capability with MC/SG-like configuration tools, even though LAN Monitor does not support MC/SG. In the event of link failure, LAN Monitor will automatically migrate the data flow from the primary link to one of the standby links in the link aggregate.

NOTE In HP-UX 10.20, the term *card instance* is used to indicate the port instance. Some file outputs will use the term PPA for this parameter.

LAN Monitor Features

- Supports all LAN technologies: 100BT, Gigabit, FDDI, and Token Ring
- Automatic link aggregate discovery and configuration commands (*lanqueryconf*, *lanapplyconf*, *lancheckconf*, *landeleteconf*)
- MP scalable
- High Availability via link aggregation
- All links keep their original MAC address
- Hot Standby Mode only — no load balancing
- Link Level and IP Multicast support
- Streams transport for TCP/IP, ARPA, and NFS
- HP DLPI interface support
- LAN commands and tools
- SNMP (interface MIB only) support
- Support for platforms:
  - — HP-UX 10.20: A, D, K, R
  - — HP-UX 11.0: All except T-class

Requirements to Configure Ports in LAN Monitor Mode

The ports should be configured in LAN_MONITOR mode. This is particularly true for FDDI and Token Ring ports, as they are, by default, set to LAN_MONITOR mode.

To examine a port's mode run the following command:

```
# lanadmin -x -p <port instance #> <any aggregate #>
```

To set the port mode to LAN_MONITOR mode run the following command:

```
# lanadmin -X -p <port instance #> LAN_MONITOR <any aggregate #>
```

To check the status, run the following command:

```
# ifconfig lan<primary port instance #>
```

The ports should be up and able to linkloop among themselves; and one of the ports, called Primary, should have an IP address assigned.

Configuration Files

ASCII file

The ascii configuration file is `lanconfig.ascii` (`/etc/lanmon/lanconfig.ascii`).

Sample ascii Configuration File

```
#*****************************************
#******* LAN MONITOR ASCII CONFIGURATION FILE
#*** For complete details about the parameters and how
#*** to set them, consult the lanqueryconf(1m) manpage
#*** or your manual.
#*****************************************
NODE_NAME               hpntcyj
POLLING_INTERVAL        1000000
DEAD_COUNT              3

FAILOVER_GROUP          lan1 # Single Link failover Group
      STATIONARY_IP     193.12.14.55
      POLLING_INTERVAL  5000000
      DEAD_COUNT        2

FAILOVER_GROUP          lan92
      STATIONARY_IP     194.12.14.55
      PRIMARY           lan2          5
      STANDBY           lan3          3

FAILOVER_GROUP          lan91
      STATIONARY_IP     192.12.14.55
      PRIMARY           lan6          5
      STANDBY           lan7          3
      STANDBY           lan9          3
      STANDBY           lan8          3
```

The ASCII config file contains the following fields:

- **NODE_NAME:** The name of the node. This is the name of the system as obtained by *gethostname()* and should be the first line in the file.
- **FAILOVER_GROUP:** The aggregate name which will form a single fail-over group. This may be specified repeatedly for all of the link aggregates in the system. If the link aggregate has multiple links, then it

will be of the form lan100, lan101, ..., that is, an aggregate is allocated to it. However, if it is a single link aggregate, then it will be *lanX*, where *X* is the PPA of the link.

- **PRIMARY/STANDBY:** The LAN interface (for example, lan0, lan1). This may be specified repeatedly for all applicable lan interfaces in the fail-over group. They can be specified only for fail-over groups which have more than one link. These interfaces belong to the last FAILOVER_GROUP that was mentioned. The last parameter is the port priority that will be assigned to the port. The port with an IP address assigned is taken to be primary. The default port priorities have been selected so that fail-over and fail-back works correctly.
- **STATIONARY_IP:** This is the IP address dedicated to the link aggregate. This is a required field and must be set for the primary link before running *lanapplyconf*.
- **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). May occur more than once in the config file. An aggregate's polling interval is set to the most recent that is read.
- **DEAD_COUNT:** The number of polling packets that are missed before deciding to send a nettl log message to the user that the link may be having problems and the network should be checked for problems. Default is 3.

Binary File

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

CAUTION DO NOT manually edit the binary file as you can corrupt the data.

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`).

Usage:

`lanqueryconf [-s] [-b] [-v] [-c ascii_file]`
(At least one of the `-s` or `-b` options must be used.)

The options are:

- -s – queries the system for what can be found
- -b – queries the binary file
- -v – specifies verbose output
- -c ascii_file – specifies the ascii file to be output — the default is `lanconfig.ascii`

Query the system and create an ascii configuration file

lanqueryconf -s

This will create an ascii file that represents the valid LAN Monitor aggregations that can be formed. This file can be edited and then used with the *lanapplyconf* command to form the aggregations.

The output will be similar to the sample file shown on page 105.

Query the system for the binary file

The *lanqueryconf -b* command reads the binary bile `/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/laconfig.ascii
```

lanapplyconf

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

Usage:

`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.

Usage:

```
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 aggregate(s) that have been created in LAN_MONITOR mode.

Usage:

```
landeleteconf [-v][-g PPA number of fail-over group to be deleted]
```

The options are:

- -v – specifies verbose output
- -g PPA# – specifies which link aggregate to delete

For example, to delete a FAILOVER_GROUP with a PPA of 104, enter:

```
landeleteconf -g lan104
```

LAN Monitor Configuration Examples

This section gives examples of using the LAN Monitor commands.

Example 1 — Token Ring 802.5 Link Aggregation

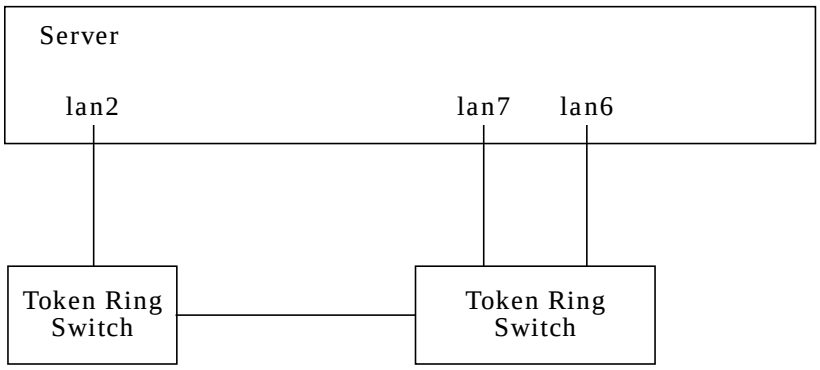
Step 1. Check the existing configuration by running *lanscan* and *netstat -rn*.

```
# lanscan
```

Hardware Path	Station Address	Crd In#	Hdw State	Net-Interface NamePPA	NM ID	MAC Type	HP-DLPI Support	DLPI Mjr#
10/0/1/0	0x0060B0B36525	5	UP	lan5 snap5	1	ETHER	Yes	119
10/0/12/0	0x001083350DDA	0	UP	lan0 snap0	2	ETHER	Yes	119
10/1/6/0	0x00060D0B859F	2	UP	lan2	3	802.5	Yes	119
10/1/8/0	0x000629BE72D0	7	UP	lan7	4	802.5	Yes	119
10/2/3/0	0x0060B058221A	4	UP	lan4	5	FDDI	Yes	119
10/1/5/0	0x0060B058249B	1	DOWN	lan1	6	FDDI	Yes	119
10/2/2/0	0x0060B0B399F7	3	UP	lan3 snap3	7	ETHER	Yes	119
10/4/4/0	0x00060D0B867F	6	UP	lan6	8	802.5	Yes	119
LinkAgg0	0x000000000000	100	DOWN	lan100 snap100	10	ETHER	Yes	119
LinkAgg1	0x000000000000	101	DOWN	lan101 snap101	11	ETHER	Yes	119
LinkAgg2	0x000000000000	102	DOWN	lan102 snap102	12	ETHER	Yes	119
LinkAgg3	0x000000000000	103	DOWN	lan103 snap103	13	ETHER	Yes	119
LinkAgg4	0x000000000000	104	DOWN	lan104 snap104	14	ETHER	Yes	119

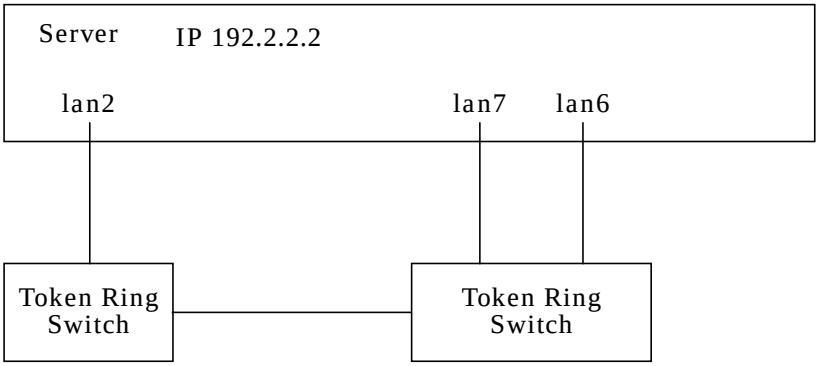
```
#netstat -rn
Routing Tables
Dest/Netmask    Gateway         Flags   Refs    Use     Interface  Pmtu
127.0.0.1       127.0.0.1       UH      0       277     100        4136
15.13.117.154   15.13.117.154   UH      0       4582    lan0       4136
15.13.112.0     15.13.117.154   U       2       0       lan0       1500
127.0.0.0       127.0.0.1       U       0       0       100        4136
default         15.13.117.154   U       0       0       lan0       1500
```

The result is:



Step 2. Run *ifconfig* to configure the primary LAN.

```
# ifconfig lan2 192.2.2.2
```



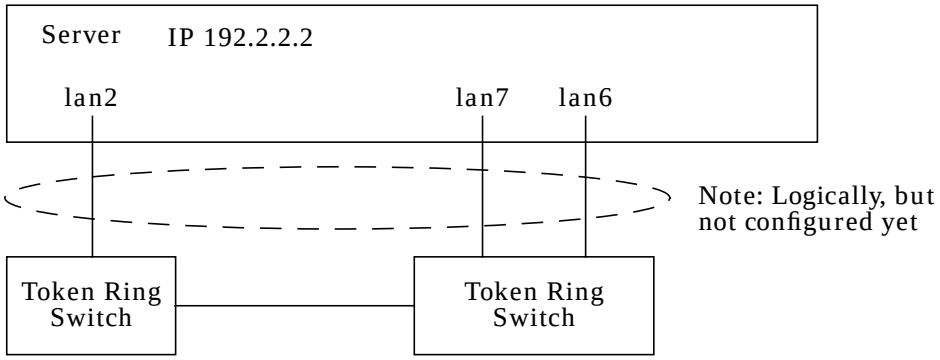
Then run *netstat -rn* again.

```
#netstat -rn
Routing Tables
Dest/Netmask    Gateway         Flags   Refs   Use     Interface  Pmtu
127.0.0.1       127.0.0.1       UH      0      277     100        4136
192.2.2.2       192.2.2.2       UH      0      0       lan2       4136
15.13.117.154   15.13.117.154   UH      0      4586    lan0       4136
192.2.2.2       192.2.2.2       U       2      0       lan2       4500
15.13.112.0     15.13.117.154   U       2      0       lan0       1500
127.0.0.0       127.0.0.1       U       0      0       100        4136
default         15.13.117.154   U       0      0       lan0       1500
```

Step 3. Run *lanqueryconf -s* to create the ASCII configuration file.

```
# lanqueryconf -s
ASCII output is in file /etc/lanmon/lanconfig.ascii
/etc/lanmon/lanconfig.ascii
# ******************************************************
# ********** LAN MONITOR CONFIGURATION FILE ************
# *** For complete details about the parameters and how **
# *** to set them, consult the lanqueryconf(1m) manpage **
# *** or your manual.                                   **
# ******************************************************

NODE_NAME                                   hpntc613

POLLING_INTERVAL                            10000000
DEAD_COUNT                                  3

FAILOVER_GROUP                              lan100
            STATIONARY_IP     192.2.2.2
            PRIMARY           lan2          5
            STANDBY           lan7          3
            STANDBY           lan6          3
```

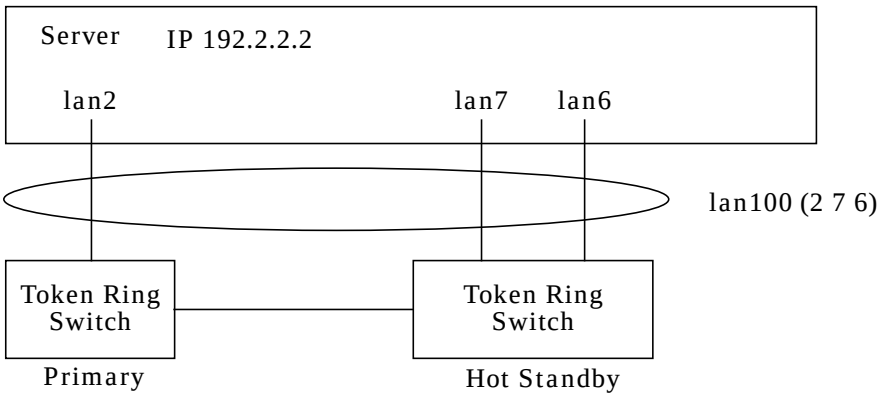
The result is:



Step 4. Run *lanapplyconf* to apply the ASCII configuration file.

```
# lanapplyconf
Reading ASCII file /etc/lanmon/lanconfig.ascii
Creating Fail-Over Group lan100
Updated binary file /etc/lanmon/lanconfig
```

The result is:



Run *lanscan* to check the system configuration.

```
# lanscan
```

Hardware Path	Station Address	Crd In#	Hdw State	Net-Interface NamePPA	NM ID	MAC Type	HP-DLPI Support	DLPI Mjr#
10/0/1/0	0x0060B0B36525	5	UP	lan5 snap5	1	ETHER	Yes	119
10/0/12/0	0x001083350DDA	0	UP	lan0 snap0	2	ETHER	Yes	119
10/2/3/0	0x0060B058221A	4	UP	lan4	5	FDDI	Yes	119
10/1/5/0	0x0060B058249B	1	DOWN	lan1	6	FDDI	Yes	119
10/2/2/0	0x0060B0B399F7	3	UP	lan3 snap3	7	ETHER	Yes	119
LinkAgg0	0x00060D0B859F	100	UP	lan100	10	802.5	Yes	119
LinkAgg1	0x000000000000	101	DOWN	lan101 snap101	11	ETHER	Yes	119
LinkAgg2	0x000000000000	102	DOWN	lan102 snap102	12	ETHER	Yes	119
LinkAgg3	0x000000000000	103	DOWN	lan103 snap103	13	ETHER	Yes	119
LinkAgg4	0x000000000000	104	DOWN	lan104 snap104	14	ETHER	Yes	119

You can run *lanscan -q* to see just the link aggregate PPAs followed by a list of LAN interface PPAs that are configured in the corresponding link aggregates. There are no headings.

```
#lanscan -q
5
0
4
1
3
100      2 7 6
101
102
103
104
```

Run *ifconfig* to verify that the LinkAgg is UP.

```
#ifconfig lan100
lan100:   flags=843<UP,BROADCAST,RUNNING,MULTICAST>
          inet 192.2.2.2 netmask ffffff00 broadcast 192.2.2.255
```

Then run *netstat -rn* again

```
#netstat -rn
Routing Tables
Dest/Netmask    Gateway         Flags   Refs   Use      Interface  Pmtu
127.0.0.1       127.0.0.1       UH      0      277      100        4136
192.2.2.2       192.2.2.2       UH      0      0        lan100     4136
15.13.117.154   15.13.117.154   UH      0      4586     lan0       4136
192.2.2.2       192.2.2.2       U       2      0        lan100     4500
15.13.112.0     15.13.117.154   U       2      0        lan0       1500
127.0.0.0       127.0.0.1       U       0      0        100        4136
default         15.13.117.154   U       0      0        lan0       1500
```

Example 2 — Token Ring and FDDI

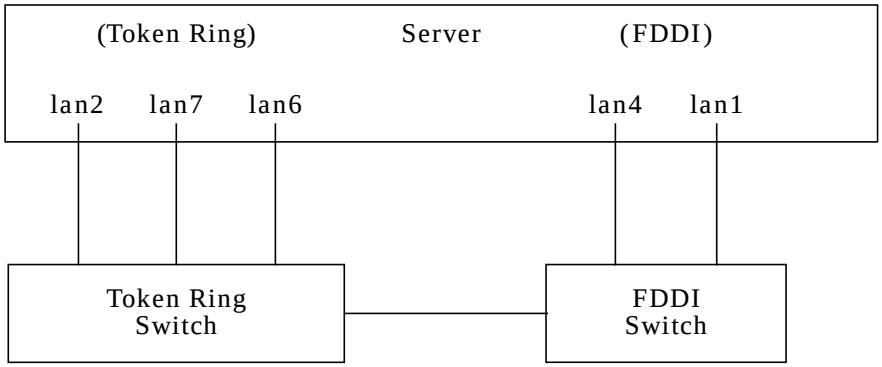
Step 1. Check existing system configuration with *lanscan* and *netstat -rn*.

```
# lanscan
```

Hardware Path	Station Address	Crd In#	Hdw State	Net-Interface NamePPA	NM ID	MAC Type	HP-DLPI Support	DLPI Mjr#
10/0/1/0	0x0060B0B36525	5	UP	lan5 snap5	1	ETHER	Yes	119
10/0/12/0	0x001083350DDA	0	UP	lan0 snap0	2	ETHER	Yes	119
10/1/6/0	0x00060D0B859F	2	UP	lan2	3	802.5	Yes	119
10/1/8/0	0x000629BE72D0	7	UP	lan7	4	802.5	Yes	119
10/2/3/0	0x0060B058221A	4	UP	lan4	5	FDDI	Yes	119
10/1/5/0	0x0060B058249B	1	UP	lan1	6	FDDI	Yes	119
10/2/2/0	0x0060B0B399F7	3	UP	lan3 snap3	7	ETHER	Yes	119
10/4/4/0	0x00060D0B867F	6	UP	lan6	8	802.5	Yes	119
LinkAgg0	0x000000000000	100	DOWN	lan100 snap100	10	ETHER	Yes	119
LinkAgg1	0x000000000000	101	DOWN	lan101 snap101	11	ETHER	Yes	119
LinkAgg2	0x000000000000	102	DOWN	lan102 snap102	12	ETHER	Yes	119
LinkAgg3	0x000000000000	103	DOWN	lan103 snap103	13	ETHER	Yes	119
LinkAgg4	0x000000000000	104	DOWN	lan104 snap104	14	ETHER	Yes	119

```
#netstat -rn
Routing Tables
```

Dest/Netmask	Gateway	Flags	Refs	Use	Interface	Pmtu
127.0.0.1	127.0.0.1	UH	0	277	100	4136
15.13.117.154	15.13.117.154	UH	0	4830	lan0	4136
15.13.112.0	15.13.117.154	U	2	0	lan0	1500
127.0.0.0	127.0.0.1	U	0	0	100	4136
default	15.13.117.154	U	0	0	lan0	1500



Step 2. Check the port mode:

```
# lanadmin -x -p 4 100
**** PORT NUMBER *******
Port FEC Mode           : MANUAL
Port State              : DOWN
Port Group Capability   : 5
Port Priority           : 0
```

If the port is in MANUAL or other non-LAN_MONITOR mode, run the following command:

```
# lanadmin -X -p 4 LAN_MONITOR 100
```

The resulting output should be:

```
Port 4 set to LAN_MONITOR
```

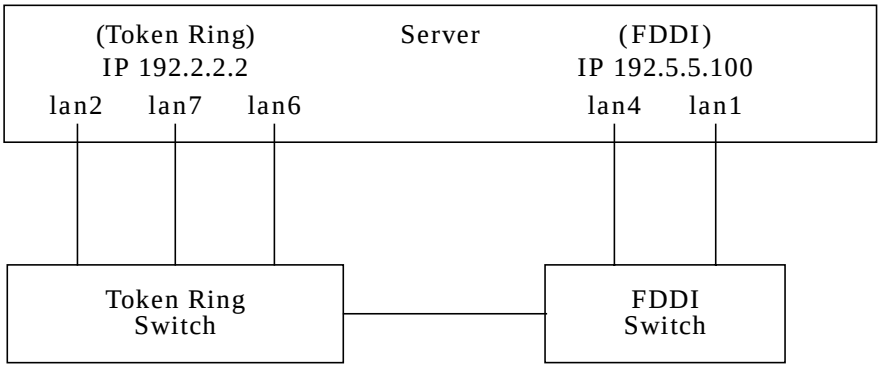
Repeat the above commands for all ports that need to be in LAN_MONITOR mode.

Step 3. Run *ifconfig* to configure the primary LANs.

```
# ifconfig lan2 192.2.2.2
```

```
# ifconfig lan4 192.5.5.100
```

The result is:



Run *netstat -rn* again.

```
#netstat -rn
```

Routing Tables

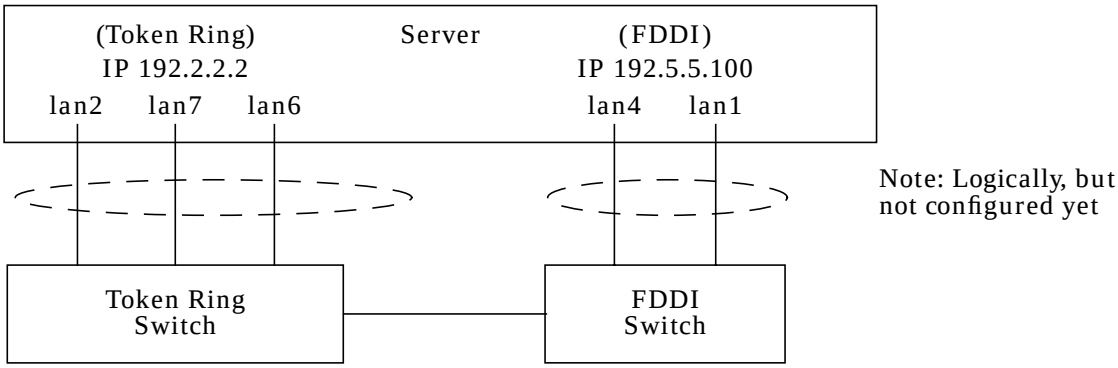
Dest/Netmask	Gateway	Flags	Refs	Use	Interface	Pmtu
127.0.0.1	127.0.0.1	UH	0	277	100	4136
192.2.2.2	192.2.2.2	UH	0	0	lan2	4136
192.5.5.100	192.5.5.100	UH	0	0	lan4	4136
15.13.117.154	15.13.117.154	UH	0	4830	lan0	4136
192.2.2.0	192.2.2.2	U	2	0	lan2	4500

192.5.5.0	192.5.5.100	U	2	0	lan4	4352
15.13.112.0	15.13.117.154	U	2	0	lan0	1500
127.0.0.0	127.0.0.1	U	0	0	100	4136
default	15.13.117.154	U	0	0	lan0	1500

Step 4. Run lanqueryconf -s to create the ascii file.

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

# ********************************************************
# *********** LAN MONITOR CONFIGURATION FILE *************
# *** For complete details about the parameters and how **
# *** to set them, consult the lanqueryconf(1m) manpage **
# *** or your manual.                                    **
# ********************************************************

NODE_NAME                                       hpntc613

POLLING_INTERVAL                                10000000
DEAD_COUNT                                      3

FAILOVER_GROUP                                  lan100
            STATIONARY_IP   192.2.2.2
            PRIMARY                     lan2    5
            STANDBY                     lan7    3
            STANDBY                     lan6    3

FAILOVER_GROUP                                  lan101
            STATIONARY_IP   192.5.5.100
            PRIMARY                     lan4    5
            STANDBY                     lan1    3
```

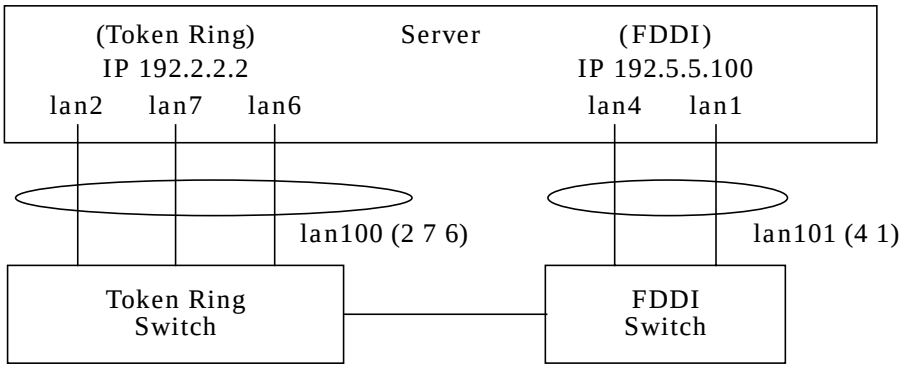
The result is:



Step 5. Run *lanapplyconf* to configure or update the binary file `lanconfig`.

```
# lanapplyconf
Reading ASCII file /etc/lanmon/lanconfig.ascii
Creating Fail-Over Group lan100
Creating Fail-Over Group lan101
Updated binary file /etc/lanmon/lanconfig
```

The result is:



Run *lanscan* to verify the current status of the LinkAggs.

```
# lanscan
```

Hardware Path	Station Address	Crd In#	Hdw State	Net-Interface NamePPA	NM ID	MAC Type	HP-DLPI Support	DLPI Mjr#
10/0/1/0	0x0060B0B36525	5	UP	lan5 snap5	1	ETHER	Yes	119
10/0/12/0	0x001083350DDA	0	UP	lan0 snap0	2	ETHER	Yes	119
10/2/2/0	0x0060B0B399F7	3	UP	lan3 snap3	7	ETHER	Yes	119
LinkAgg0	0x00060D0B859F	100	UP	lan100	10	802.5	Yes	119
LinkAgg1	0x0060B058221A	101	UP	lan101	11	FDDI	Yes	119
LinkAgg2	0x000000000000	102	DOWN	lan102 snap102	12	ETHER	Yes	119
LinkAgg3	0x000000000000	103	DOWN	lan103 snap103	13	ETHER	Yes	119
LinkAgg4	0x000000000000	104	DOWN	lan104 snap104	14	ETHER	Yes	119

Or, you can run *lanscan -q* to see just the link aggregate PPAs followed by a list of LAN interface PPAs that are configured in the corresponding link aggregates. There are no headings.

```
#lanscan -q
5
0
3
100      2 7 6
101      4 1
102
103
104
```

Run *ifconfig* to verify that the LinkAggs are UP.

```
#ifconfig lan100
lan100:  flags=843<UP,BROADCAST,RUNNING,MULTICAST>
         inet 192.2.2.2 netmask ffffff00 broadcast 192.2.2.255
#ifconfig lan101
lan101:  flags=843<UP,BROADCAST,RUNNING,MULTICAST>
         inet 192.5.5.100 netmask ffffff00 broadcast 192.5.5.255
```

Run *netstat -rn* again.

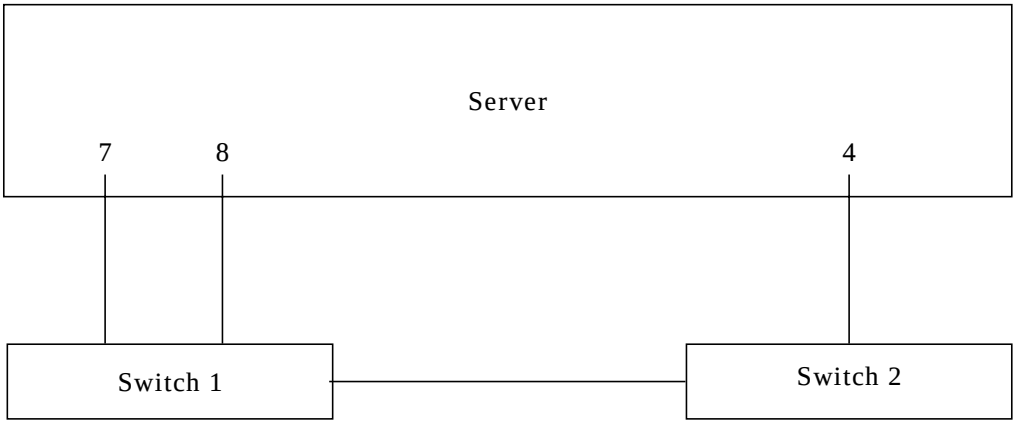
```
#netstat -rn
```

Routing Tables

Dest/Netmask	Gateway	Flags	Refs	Use	Interface	Pmtu
127.0.0.1	127.0.0.1	UH	0	277	100	4136
192.2.2.2	192.2.2.2	UH	0	0	lan100	4136
192.5.5.100	192.5.5.100	UH	0	0	lan101	4136
15.13.117.154	15.13.117.154	UH	0	4830	lan0	4136
192.2.2.0	192.2.2.2	U	2	0	lan100	4500
192.5.5.0	192.5.5.100	U	2	0	lan101	4352
15.13.112.0	15.13.117.154	U	2	0	lan0	1500
127.0.0.0	127.0.0.1	U	0	0	100	4136
default	15.13.117.154	U	0	0	lan0	1500

Example 3 — LAN_MONITOR Configuration (Ethernet)

Step 1. Existing System Configuration



Run *lanscan* to determine the current system configuration.

```
# lanscan
```

Hardware Path	Station Address	Crd In#	Hdw State	Net-Interface NamePPA	NM ID	MAC Type	HP-DLPI Support	HP-DLPI Support
10/4/8.1	0x080009BA22A4	6	UP	lan6 snap6	1	ETHER	Yes	119
8/8/2/0	0x0060B0595EA4	3	UP	lan3 snap3	1	ETHER	Yes	119
8/12/2/0	0x0060B04B8B5F	5	UP	lan5 snap5	1	ETHER	Yes	119
10/8/1/0	0x0060B0595E93	7	UP	lan7 snap7	4	ETHER	Yes	119
10/8/2/0	0x0060B0595E94	8	UP	lan8 snap8	5	ETHER	Yes	119
8/8/1/0	0x0060B0595EA3	2	UP	lan2 snap2	6	ETHER	Yes	119
10/12/6	0x080009DAE821	9	UP	lan9 snap9	7	ETHER	Yes	119
8/12/1/0	0x0060B04B8B5E	4	UP	lan4 snap4	8	ETHER	Yes	119
8/0/1/0	0x0060B0C4E132	10	UP	lan10 snap10	9	ETHER	Yes	119
8/4/1/0	0x0060B0C4E123	0	UP	lan0 snap0	10	ETHER	Yes	119
LinkAgg0	0x000000000000	100	DOWN	lan100 snap100	12	ETHER	Yes	119
LinkAgg1	0x000000000000	101	DOWN	lan101 snap101	13	ETHER	Yes	119
LinkAgg2	0x000000000000	102	DOWN	lan102 snap102	14	ETHER	Yes	119
LinkAgg3	0x000000000000	103	DOWN	lan103 snap103	15	ETHER	Yes	119
LinkAgg4	0x000000000000	104	DOWN	lan104 snap104	16	ETHER	Yes	119

You can also use *lanscan -q* to see just the link aggregate PPAs followed by a list of LAN interface PPAs that are configured in the corresponding link aggregates. There are no headings.

```
# lanscan -q
```

```
6
3
```

```
5
7
8
2
9
4
10
0
100
101
102
103
104
```

Step 2. Create linkagg PAgP (FEC_AUTO) using port 7 and port 8 and use this linkagg as the Primary linkagg (lan100) in a LAN Monitor configuration:

```
# lanadmin -X -p 7 FEC_AUTO 100

Port 7 set to FEC_AUTO

# lanadmin -X -p 8 FEC_AUTO 100

Port 8 set to FEC_AUTO
```

Run *lanscan* to check the system configuration.

```
# lanscan
```

Hardware Path	Station Address	Crd In#	Hdw State	Net-Interface NamePPA	NM ID	MAC Type	HP-DLPI Support	DLPI Mjr#
10/4/8.1	0x080009BA22A4	6	UP	lan6 snap6	1	ETHER	Yes	119
8/8/2/0	0x0060B0595EA4	3	UP	lan3 snap3	2	ETHER	Yes	119
8/12/2/0	0x0060B04B8B5F	5	UP	lan5 snap5	3	ETHER	Yes	119
8/8/1/0	0x0060B0595EA3	2	UP	lan2 snap2	6	ETHER	Yes	119
10/12/6	0x080009DAE821	9	UP	lan9 snap9	7	ETHER	Yes	119
8/12/1/0	0x0060B04B8B5E	4	UP	lan4 snap4	8	ETHER	Yes	119
8/0/1/0	0x0060B0C4E132	10	UP	lan10 snap10	9	ETHER	Yes	119
8/4/1/0	0x0060B0C4E123	0	UP	lan0 snap0	10	ETHER	Yes	119
LinkAgg0	0x0060B0595E93	100	UP	lan100 snap100	12	ETHER	Yes	119
LinkAgg1	0x000000000000	101	DOWN	lan101 snap101	13	ETHER	Yes	119
LinkAgg2	0x000000000000	102	DOWN	lan102 snap102	14	ETHER	Yes	119
LinkAgg3	0x000000000000	103	DOWN	lan103 snap103	15	ETHER	Yes	119
LinkAgg4	0x000000000000	104	DOWN	lan104 snap104	16	ETHER	Yes	119

Or run *lanscan -q* to see just the link aggregate PPAs.

```
# lanscan -q

6
3
5
2
9
4
10
0
100        7 8
101
102
103
104
```

Step 3. Run *ifconfig* to configure the primary LAN (which, in this case happens to be a LinkAgg).

```
# ifconfig lan100 192.5.5.111
```

Run *ifconfig* to verify that the LinkAgg is UP.

```
# ifconfig lan100

lan100:  flags=843<UP,BROADCAST,RUNNING,MULTICAST>
         inet 192.5.5.111 netmask ffffff00 broadcast 192.5.5.255
```

Step 4. Run *lanqueryconf -s* to create the `lanconfig.ascii` file

```
# lanqueryconf -s

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

Use the *more* command to view the ASCII file.

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

# ******************************************************
# *********** LAN MONITOR CONFIGURATION FILE ***********
# *** For complete details about the parameters and how **
# *** to set them, consult the lanqueryconf(1m) manpage **
# *** or your manual.                                    **
# ******************************************************
NODE_NAME                               anconfig.asciihpntc7g
POLLING_INTERVAL                        10000000
DEAD_COUNT                              3
FAILOVER_GROUP                          lan101
```

```
STATIONARY_IP      192.5.5.111
STANDBY            lan4      3
PRIMARY            lan100    5
```

Step 5. Run *lanapplyconf* to create the fail-over group and update the binary file lanconfig.

```
# lanapplyconf

Reading ASCII file /etc/lanmon/lanconfig.ascii
Creating Fail-Over Group lan101
Updated binary file /etc/lanmon/lanconfig
```

Run *lanscan* to verify the system configuration.

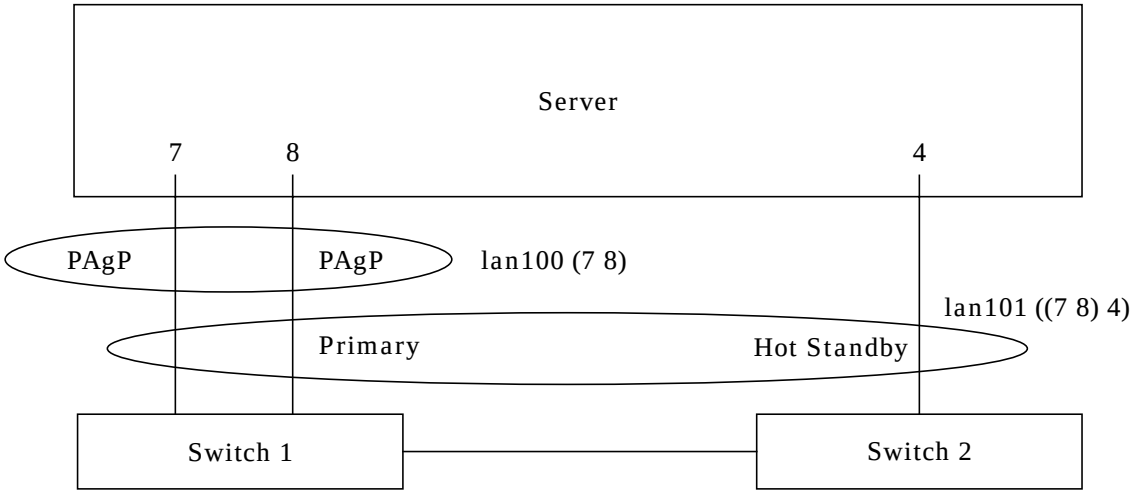
```
# lanscan
```

Hardware Path	Station Address	Crd In#	Hdw State	Net-Interface NamePPA	NM ID	MAC Type	HP-DLPI Support	DLPI Mjr#
10/4/8.1	0x080009BA22A4	6	UP	lan6 snap6	1	ETHER	Yes	119
8/8/2/0	0x0060B0595EA4	3	UP	lan3 snap3	2	ETHER	Yes	119
8/12/2/0	0x0060B04B8B5F	5	UP	lan5 snap5	3	ETHER	Yes	119
8/8/1/0	0x0060B0595EA3	2	UP	lan2 snap2	6	ETHER	Yes	119
10/12/6	0x080009DAE821	9	UP	lan9 snap9	7	ETHER	Yes	119
8/0/1/0	0x0060B0C4E132	10	UP	lan10 snap10	9	ETHER	Yes	119
8/4/1/0	0x0060B0C4E123	0	UP	lan0 snap0	10	ETHER	Yes	119
LinkAgg1	0x0060B0595E93	101	UP	lan101 snap101	13	ETHER	Yes	119
LinkAgg2	0x000000000000	102	DOWN	lan102 snap102	14	ETHER	Yes	119
LinkAgg3	0x000000000000	103	DOWN	lan103 snap103	15	ETHER	Yes	119
LinkAgg4	0x000000000000	104	DOWN	lan104 snap104	16	ETHER	Yes	119

You can also use *lanscan -q* to see just the link aggregate PPAs followed by a list of LAN interface PPAs that are configured in the corresponding link aggregates. There are no headings.

```
# lanscan -q

6
3
5
2
9
10
0
101        100(7 8) 4
102
103
104
```

This diagram shows the resulting configuration.



D LACP or PAgP Configuration

LACP or PAgP Configuration Example

The example will demonstrate configuring a LinkAgg using LACP. Differences for PAgP will be noted.

Step 1. Use *lanscan* to check the existing system configuration

```
# lanscan
```

Hardware Path	Station Address	Crd In#	Hdw State	Net-Interface NamePPA	NM ID	MAC Type	HP-DLPI Support	DLPI
Path	Address	In#	State	NamePPA	ID	Type	Support	Mjr#
10/4/8.1	0x080009D4514A	0	UP	lan0 snap0	1	ETHER	Yes	119
10/4/16	0x10009090C8BE	1	UP	lan1	2	802.5	Yes	119
8/0/1/0	0x0010830497C6	8	UP	lan8 snap8	3	ETHER	Yes	119
8/0/2/0	0x0010830497C7	9	UP	lan9 snap9	4	ETHER	Yes	119
8/12/2/0	0x001083369454	7	UP	lan7 snap7	5	ETHER	Yes	119
10/16/16	0x080009D890AA	13	UP	lan13 snap13	6	ETHER	Yes	119
10/16/8	0x080009DBD100	12	UP	lan12 snap12	7	ETHER	Yes	119
10/12/6	0x080009D45625	2	UP	lan2 snap2	8	ETHER	Yes	119
8/12/1/0	0x001083369453	6	UP	lan6 snap6	9	ETHER	Yes	119
8/4/1/0	0x0060B0C4E134	10	UP	lan10 snap10	10	ETHER	Yes	119
8/8/1/0	0x0060B0C4413D	4	UP	lan4 snap4	11	ETHER	Yes	119
LinkAgg0	0x000000000000	100	DOWN	lan100 snap100	13	ETHER	Yes	119
LinkAgg1	0x000000000000	101	DOWN	lan101 snap101	14	ETHER	Yes	119
LinkAgg2	0x000000000000	102	DOWN	lan102 snap102	15	ETHER	Yes	119
LinkAgg3	0x000000000000	103	DOWN	lan103 snap103	16	ETHER	Yes	119
LinkAgg4	0x000000000000	104	DOWN	lan104 snap104	17	ETHER	Yes	119

You can run *lanscan -q* to see just the link aggregate PPAs followed by a list of LAN interface PPAs that are configured in the corresponding link aggregates. There are no headings.

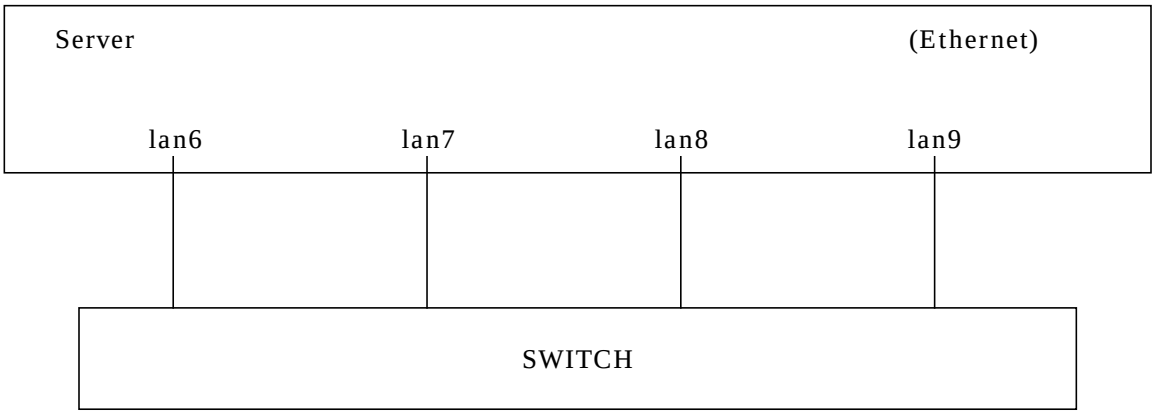
```
# lanscan -q
0
1
8
9
7
13
12
2
6
10
4
```

100
101
102
103
104

Run *lanadmin* to make sure that the ports are not already linkaggregated and that their group capabilities match.

```
# lanadmin -x -p 6 100
**** PORT NUMBER: 6 *******
Port FEC Mode             : MANUAL
Port State                : DOWN
Port Group Capability     : 5
Port Priority             : 0

# lanadmin -x -p 7 100
**** PORT NUMBER: 7 *******
Port FEC Mode             : MANUAL
Port State                : DOWN
Port Group Capability     : 5
Port Priority             : 0

# lanadmin -x -p 8 100
**** PORT NUMBER: 8 *******
Port FEC Mode             : MANUAL
Port State                : DOWN
Port Group Capability     : 5
Port Priority             : 0

# lanadmin -x -p 9 100
**** PORT NUMBER: 9 *******
Port FEC Mode             : MANUAL
Port State                : DOWN
Port Group Capability     : 5
Port Priority             : 0
```

The existing configuration of links is:



Step 2. Verify that the switch has LACP set (if you are configuring for PAgP, make sure the switch is set to that).

Step 3. To turn on LACP on ports on the server run the following commands (note the upper case X).

```
# lanadmin -X -p 6 LACP_AUTO 100
Port 6 set to LACP_AUTO
# lanadmin -X -p 7 LACP_AUTO 100
Port 7 set to LACP_AUTO
# lanadmin -X -p 8 LACP_AUTO 100
Port 8 set to LACP_AUTO
# lanadmin -X -p 9 LACP_AUTO 100
Port 9 set to LACP_AUTO
```

NOTE To turn on PAgP, the command is:

lanadmin -X -p <port #> FEC_AUTO 100

Run *lanscan* to check the system configuration.

```
#lanscan
Hardware    Station         Crd  Hdw    Net-Interface  NM  MAC     HP-DLPI  DLPI
Path        Address         In#  State  NamePPA        ID  Type    Support
10/4/8.1    0x080009D4514A  0    UP     lan0 snap0     1   ETHER   Yes      119
10/4/16     0x10009090C8BE  1    UP     lan1           2   802.5   Yes      119
10/16/16    0x080009D890AA  13   UP     lan13 snap13   6   ETHER   Yes      119
10/16/8     0x080009DBD100  12   UP     lan12 snap12   7   ETHER   Yes      119
```

```
10/12/6    0x080009D45625  2     UP     lan2 snap2     8    ETHER    Yes       119
8/4/1/0    0x0060B0C4E134  10    UP     lan10 snap10   10   ETHER    Yes       119
8/8/1/0    0x0060B0C4413D  4     UP     lan4 snap4     11   ETHER    Yes       119
LinkAgg0   0x001083369453  100   UP     lan100 snap100 13   ETHER    Yes       119
LinkAgg1   0x000000000000  101   DOWN   lan101 snap101 14   ETHER    Yes       119
LinkAgg2   0x000000000000  102   DOWN   lan102 snap102 15   ETHER    Yes       119
LinkAgg3   0x000000000000  103   DOWN   lan103 snap103 16   ETHER    Yes       119
LinkAgg4   0x000000000000  104   DOWN   lan104 snap104 17   ETHER    Yes       119
```

Or run lanscan -q to see just the port PPAs and link aggregate PPAs.

```
#lanscan -q
0
1
13
12
2
10
4
100        6 7 8 9
101
102
103
104
```

Run l*anadmin -x -z lanPPA* to check the configuration.

```
#lanadmin -x -v 100
Link Aggregate PPA #     : 100
Number of Ports          : 4
Ports PPA                : 6 7 8 9
Link Aggregation State   : LINKAGG AUTO
Group Capability         : 5
Load Balance Mode        : CPU Based (LB_CPU)
```

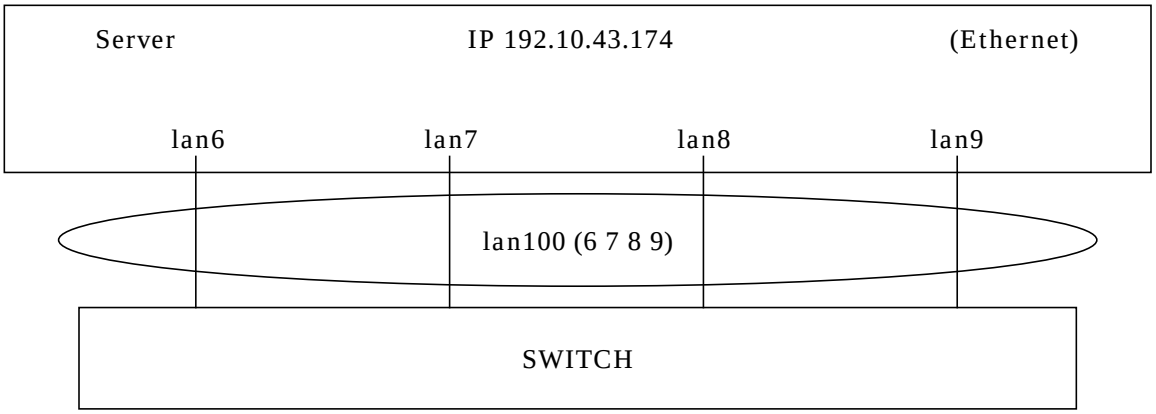
Step 4. Final configuration

```
# ifconfig lan100 192.10.43.174
```

Then run *netstat -rn* to verify the final configuration.

```
# netstat -rn
Routing tables
Dest/Netmask    Gateway         Flags   Refs   Use   Interface    Pmtu
127.0.0.1       127.0.0.1       UH      0      308   lo0          4136
192.10.43.174   192.10.43.174   UH      0      0     lan100       4136
15.13.118.174   15.13.118.174   UH      0      14    lan2         4136
15.13.112.0     15.13.118.174   U       2      0     lan2         1500
192.10.40.0     192.10.43.174   U       2      0     lan100       1500
127.0.0.0       127.0.0.1       U       0      0     lo0          4136
default         15.13.118.174   U       0      0     lan2         1500
```

The finished configuration on the server is:



E Load Balancing and Data Flow Distribution Algorithms

Supported Load Balancing and Data Flow Algorithms

This appendix contains information on the supported Load Balancing and Data Flow Distribution algorithms. The algorithms described below only apply to outbound data transfer. Inbound Load Balancing and Data Flow Distribution are strictly determined by the link partner and have no affect 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's recommended for each supported configuration.

Packet Ordering

Each of the algorithms below guarantee that they will not introduce any severe ordering problems within a specific data flow. This is required to make sure 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 will always flow out through the same physical port (the only exception is CPU based distribution, see page 134); until the data flow is aged out of the distribution table (see below). 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 described as a simple three step process.

1. **Data Flow Lookup** — The Data Flow Distribution algorithm (page 134) 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, it's 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.

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.

  The following command syntax would be used to set MAC based distribution:

  `lanadmin -X -l LB_MAC` *`linkaggPPA`*

  Where linkaggPPA is the PPA number of the link aggregate you want to set the Data Flow Distribution on.

- **Destination IP address**

  The Destination IP address based algorithm uses the least significant byte of the 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.

  The following command syntax would be used to set IP based distribution:

  `lanadmin -X -l LB_IP` *`linkaggPPA`*

  Where linkagPPA is the PPA number of the link aggregate you want to set the Data Flow Distribution on.

- **CPU — No longer recommedned 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.

  Recommended Configuration: Server-to-Server with Multiple CPUs on each server. When using the CPU algorithm you must use processor

affinity.

This configuration should not be used on Uni-Processor 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.

The following command syntax would be used to set CPU based distribution:

`lanadmin -X -l LB_CPU` *`linkaggPPA`*

Where linkagPPA is the PPA number of the link aggregate you want to set the Data Flow Distribution on

- **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 th eports in a Link Aggregate. This algorithm is recommended t be used when connecting two HP 9000 servers in a back-to-back configuration.

  Recommended configuration: Server-to-Server

  The following command syntax should be used to set a TCP/UDP Port-based distribution:

  `# lanadmin -X -l LB_PORT linkaggPPA`

- **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.

  This configuration is recommended for servers which should not have the switch as a single point of failure.

F MAC Addresses for Link Aggregates

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, it's local MAC address is reset to the physical port's permanent MAC address.

Glossary

A

aggregate A group. In this product a group of four ports makes one link aggregate. There can be 50 link aggregates per computer.

aggregation *See* aggregate.

APA Auto Port Aggregation

Auto Port Aggregation (APA) HP's software product that allows grouping up to four ports into an aggregate to boost performance and provide port fail-over.

C

CPU Establishes configuration of Server to Server

D

DA-MAC Establishes configuration of Server to Switch (this is the default algorithm). *See* Appendix E , "Load Balancing and Data Flow Distribution Algorithms," for details.

F

fail-over group a logical grouping of one or more physical ports or Link Aggregates. This term is used to describe LAN Monitor created logical ports.

Fast EtherChannel (FEC) The proprietary name of Cisco's port aggregation product. When referring to FEC mode, it indicates use of PAgP on a link.

FEC *See* Fast EtherChannel

FEC_AUTO The default, automatic configuration mode of FEC.

FEC_MANUAL *See* MANUAL.

flow 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

group capability An integer value used to determine which network physical ports can be aggregated into a common link aggregate.

H

Hot Standby A method of providing high availability

HSC High Speed Connect

I

IP Internet Protocol. Establishes configuration of Server-to-Router.

L

LACP Link Aggregation Control Protocol

LAN Local Area Network

link aggregate A logical grouping of one or more physical ports into a single “fat-pipe”. This term is used to describe LACP, Manual, or PAgP (Cisco Fast EtherChannel) created logical ports.

link aggregation *See* link aggregate

linkaggPPA The PPA number of a link aggregate.

load balancing 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

MANUAL The alternate mode of configuration. Can be performed either from the command line or from within SAM. Formerly FEC_MANUAL.

MAC Media Access Control

MIB Management Information Base

N

network adapter A network device which has one or more network physical ports.

network physical port The communications channel formed when you attach a network cable between a specific network port (adapter card) and a LAN device.

P

PAgP *See* Port Aggregation Protocol.

PCI Peripheral Component Interconnect

physical point of attachment

A unique integer identifier for each network physical port installed on a server.

port The communications channel formed when you attach a network cable between a network physical port and a LAN device.

port aggregate *See* link

aggregate.

port aggregation *See* link aggregate

Port Aggregation Protocol (PAgP) The proprietary port aggregation protocol, developed by Cisco Systems Inc., which automatically determines a bidirectional connection between two network physical ports.

port priority 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.

PPA *See* physical point of attachment

S

SAM System Administration Management

Server-to-Router *See* IP.

Server-to-Server *See* CPU.

Server-to-Switch See DA-MAC or MAC.