Avaya

Installation and Configuration Guide

AVAYA P332GT-ML

STACKABLE SWITCH

SOFTWARE VERSION 4.0

AVAYA

Table of Contents

Before you Install the P332GT-ML

Safety Information

Caution: The Avaya P330 switch and modules contain components sensitive to electrostatic discharge. Do not touch the circuit boards unless instructed to do so.

Caution: Do not leave any slots open. Cover empty slots using the blanking plates supplied.

Warning: The fans are on whenever the power is on in the chassis.

FCC Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications to this equipment not expressly approved by Avaya Inc. could void the user's authority to operate the equipment.

Conventions Used in the Documentation

Documentation for this product uses the following conventions to convey instructions and information:

CLI Conventions

- Mandatory keywords are in the **`computer bold`** font.

- Information displayed on screen is displayed in `computer` font.
- Variables that you supply are in pointed brackets <>.
- Optional keywords are in square brackets [].
- Alternative but mandatory keywords are grouped in braces {} and separated by a vertical bar |.
- Lists of parameters from which you should choose are enclosed in square brackets [ ] and separated by a vertical bar |.
- If you enter an alphanumeric string of two words or more, enclose the string in inverted "commas".

Notes, Cautions and Warnings

Note: Notes contain helpful information or hints or reference to material in other documentation.

Caution: You should take care. You could do something that may damage equipment or result in loss of data.

Warning: This means danger. Failure to follow the instructions or warnings may result in bodily injury. You should ensure that you are qualified for this task and have read and understood *all* the instructions

AVAYA P332GT-ML

SECTION 1: OVERVIEW OF THE P330

Chapter 1

Avaya P332GT-ML Overview

Introduction

The P332GT-ML is a powerful Multilayer Policy Gigabit Ethernet stackable switch. It enhances the P330 line to support high density multilayer Gigabit Ethernet solutions.

The Avaya P330 family of stackable Ethernet workgroup switches includes a range of modules with 10/100/1000 Mbps ports, a Layer 3 capability, and ATM and WAN expansion modules.

An Avaya P330 stack can contain up to 10 switches and backup power supply units. The stacked switches are connected using stacking Modules which plug into a slot in the back of the Avaya P330. They are connected using the X330SC or X330LC cable (if the stack is split between two racks). The Avaya X330RC cable connects the top and bottom switches in the stack; this connection provides redundancy and hot-swappability. A P330 stack is managed as a single IP entity.

About the P332GT-ML

Basic information about the P332GT-ML follows:

- The Avaya P332GT-ML has ten 100/1000Base-T and two GBIC (SFP) ports, and provides Layer 2 and optional Layer 3 Ethernet switching. Like other members of the Avaya P330 family, the P332GT-MLis available in AC and DC versions.
- Multilayer switching with QoS, Policy Management and multiple levels of security and redundancy make the Avaya P332GT-ML an ideal part of a converged network. The P332GT-ML is ready for voice and data applications, and supports IEEE standards for VLAN Tagging, Gigabit Ethernet, Spanning Tree and Flow Control.

The Avaya P332GT-ML can be deployed with other products in the P330 family in stacks of up to ten switches. This makes increasing port density or adding new technologies as simple as “plug and play.”

Avaya P332GT-ML Highlights

- Up to one hundred 100/1000Base-T ports in a stack
- Octaplane™ 8 Gbps stacking fabric
- Stack, Port & LAG Redundancy
- Multiple VLANs per port
- RADIUS protocol for security
- Rapid spanning tree
- IP Multicast filtering
- Terminal and modem interface
- AC and DC versions
- Backup Power Supply

Layer 3 Features P330-ML

- RIP v.1, RIP v.2, OSPF. ARP, ICMP,DHCP/BOOTP relay
- VRRP and SRRP Redundancy
- Quality of Service
- Access control

Network Management and Monitoring

Comprehensive network management and monitoring are key components of today's networks. Therefore we have provided multiple ways of managing the P332GT-ML to suit your needs.

Device Manager (Embedded Web)

The built-in P330 Device Manager (Embedded Web Manager) allows you to manage a P330 stack using a Web browser without purchasing additional software. This application works with the Microsoft® Internet Explorer and Netscape® Navigator web browsers and Sun Microsystems Java™ Plug-in.

Command Line Interface (CLI)

The P330 CLI provides a terminal type configuration tool for configuration of P332GT-ML features and functions. You can access the CLI locally, through the serial interface, or remotely via Telnet.

Avaya Multi-Service Network Manager™ (MSNM)

When you need extra control and monitoring or wish to manage other Avaya equipment, then the MSNM network management suite is the answer. This suite provides the ease-of-use and features necessary for optimal network utilization.

- MSNM is available for Windows® 95/NT®/2000 and Solaris 2.8
- MSNM can operate in Stand-Alone mode with Windows® NT®/2000 and Solaris 2.8.
- MSNM operates under HP OpenView for Windows® 95/NT®/2000.

Port Mirroring

The P332GT-ML provides port mirroring for additional network monitoring functionality. You can filter the traffic and mirror either incoming traffic to the source port or both incoming and outgoing traffic. This allows you to monitor the network traffic you need.

Ports which are members in a Link Aggregation Group (LAG) cannot *also* be used as Port Mirroring Destination or Source ports.

SMON

The P332GT-ML supports Avaya's ground-breaking SMON Switched Network Monitoring, which the IETF has now adopted as a standard (RFC2613). SMON provides unprecedented top-down monitoring of switched network traffic at the following levels:

- Enterprise Monitoring
- Device Monitoring
- VLAN Monitoring
- Port-level Monitoring

This top-down approach gives you rapid troubleshooting and performance trending to keep the network running optimally.

Note: MSNM Licence is required to run SMON monitoring.

Note: You need to purchase one SMON License per P330 Stack

Fans, Power Supply and BUPS-ML Monitoring

The P332GT-ML module has integrated sensors which provide advance warnings of fan failure, power supply failure or Backup Power Supply (BUPS-ML) failure via management.

Standards and Compatibility

Avaya P330 Standards Supported

The Avaya P330 complies with the following standards.

IEEE

- 802.3x Flow Control on all ports
- 802.1Q VLAN Tagging support on all ports
- 802.1p Priority Tagging compatible on all ports
- 802.1D Bridges and STA
- 802.1w Rapid Spanning Tree Protocol
- 802.1X Port Based Network Access Control
- 802.3z Gigabit Ethernet on all ports
- 803.2u Fast Ethernet on ports 1-10
-

IETF - Layer 2

- MIB-II - RFC 1213
- Structure and identification of management information for TCP/IP-based Internet - RFC 1155
- Simple Network Management Protocol (SNMP) - RFC 1157
- PPP Internet Protocol Control Protocol (IPCP) - RFC 1332
- PPP Authentication Protocols (PAP & CHAP) - RFC 1334
- PPP - RFC 1661
- ATM Management - RFC 1695
- RMON - RFC 1757
- SMON - RFC 2613
- Bridge MIB Groups - RFC 2674 dot1dbase and dot1dStp fully implemented. Support for relevant MIB objects: dot1q (dot1qBase, dot1qVlanCurrent)
- The Interfaces Group MIB - RFC 2863
- Remote Authentication Dial In User Service (RADIUS) - RFC 2865

IETF - Layer 3

- Internet Protocol - RFC 791
- Internet Control Message Protocol - RFC 792
- Ethernet Address Resolution Protocol - RFC 826

- Standard for the transmission of IP datagrams over Ethernet - RFC 894
- Broadcasting Internet datagrams in the presence of subnets - RFC 922
- Internet Standard Subnetting Procedure - RFC 950
- Bootstrap Protocol - RCF 951
- Using ARP to implement transparent subnet gateways - RFC 1027
- Routing Information Protocol - RCF 1058
- Hosts Extensions for IP Multicasting - RFC 1112
- Requirements for Internet Hosts - Communications Layers - RFC 1122
- DHCP Options and BOOTP Vendor Extensions - RFC 1533
- Interoperation between DHCP and BOOTP - RFC 1534
- Dynamic Host Configuration Protocol - RFC 1541
- Clarifications and Extensions for the Bootstrap Protocol Information - RFC 1542
- OSPF Version 2 - RFC 1583
- RIP Version 2 Carrying Additional Information - RFC 1723
- RIP Version 2 MIB Extension - RFC 1724
- Requirements for IP Version 4 Routers - RFC 1812
- OSPF Version 2 Management Information Base - RFC 1850
- IP Forwarding Table MIB - RFC 2096
- Virtual Router Redundancy Protocol - RFC 2338

IETF - Network Monitoring

- RMON (RFC 1757) support for groups 1,2,3 and 9
  - — Statistics
  - — History
  - — Alarms
  - — Events
- SMON (RFC 2613) support for groups
  - — Data Source Capabilities
  - — Port Copy
  - — VLAN and Priority Statistics
- Bridge MIB Groups - RFC 2674
  - — dot1dbase and dot1dStp fully implemented.
  - — Support for relevant MIB objects: dot1q (dot1qBase, dot1qVlanCurrent)

Specifications

P332GT-ML Switch

Physical

Height	2U (88 mm, 3.5″)
Width	482.6 mm (19″)
Depth	450 mm(17.7″)
Weight	7.8 kg (17.2 lb)

Power Requirements

	AC	DC
Input voltage	90 to 265 VAC, 50/60 Hz	-36 to -72 VDC
Power dissipation	100 W max	100 W (max.)
Input current	1.5 A@100 VAC 0.75 A@200VAC	4 A (max.)
Inrush current	15 A@100 VAC (max.) 30 A@200VAC (max.)	40 A (max.)

Environmental

Operating Temp.	-5 to 50°C (23-122°F)
Rel. Humidity	5% to 95% non-condensing

Safety

- UL for US approved according to UL195O Std.
- C-UL(UL for Canada) approved according to C22.2 No.950 Std.
- CE for Europe approved according to EN 60950 Std.
- Laser components are Laser Class I approved:
  - EN-60825/IEC-825 for Europe
  - FDA CFR 1040 for USA

Safety - AC Version

- Overcurrent Protection: A readily accessible Listed safety-approved protective device with a 16A rating must be incorporated in series with building installation AC power wiring for the equipment under protection.

Safety - DC Version

- Restricted Access Area: This unit must be installed in Restricted Access Areas only.
- Installation Codes: This unit must be installed in accordance with the US National Electrical Code, Article 110 and the Canadian Electrical Code, Section 12.
- Conductor Ampacity: Per UL 1950, Annex NAE (NEC Article 645-5(a)), the branch-circuit conductors supply shall have the ampacity of not less than 125 percent of the total connected load. For input leads use at least 18 AWG copper conductors.
- Overcurrent Protection: Per UL 1950, Annex NAE (NEC Article 240-3), a readily accessible listed branch-circuit overcurrent protective device rated maximum 10A must be incorporated into the building wiring.

EMC Emissions

Emissions

Approved according to:

- US - FCC Part 15 sub part B, class A
- Europe - EN55022 class A and EN61000-3-2
- Japan - VCCI-A

Immunity

Approved according to:

- EN 55024 and EN61000-3-3

Interfaces

- P332GT-ML: 10 x 100/1000Base-T RJ-45 port connectors + 2 x SFP pluggable gigabit ethernet fiber optic connectors.
- RS-232 for terminal setup via RJ-45 connector on front panel.

Basic MTBF

- P332GT-ML: 109,871 hrs minimum.
- P332GT-ML and X330STK-ML: 105,425 hrs minimum.

Stacking Sub-module

Table B.1 Stacking Sub-module

Name	Number of Ports
X330STK-ML	2

Basic MTBF

- 2,605,528 hrs minimum

100/1000 BaseT Copper Cabling

A Category 5 copper cable with RJ-45 termination should be used for 1000 BaseT ports. You should use all eight wires in the cable.

The maximum copper cable length connected to a 100/1000Base-T port is 100 m (328 ft.)

Approved SFF/SFP GBIC Transceivers

The SFF/SFP GBIC (Gigabit Interface Converter) have been tested for use with the Avaya P332GT-ML Gigabit Ethernet ports. For a list of approved SFF/SFP GBIC transceivers, see: www.avayanetwork.com/

Note: SFF/SFP GBIC transceivers are hot-swappable.

Safety Information

The SFF/SFP GBIC transceivers are Class 1 Laser products. They comply with EN 60825-1 and Food and Drug Administration (FDA) 21 CFR 1040.10 and 1040.11.

The SFF/SFP GBIC transceivers must be operated under recommended operating conditions.

Laser Classification

Note: Class 1 lasers are inherently safe under reasonably foreseeable conditions of operation.

Caution: The use of optical instruments with this product will increase eye hazard.

Usage Restriction

When a SFF/SFP GBIC transceiver is inserted in the module but is not in use, the Tx and Rx ports should be protected with an optical connector or a dust plug.

Caution: Use only approved SFF/SFP GBIC transceivers. All approved SFF/SFP GBIC transceivers:
1) Are 3.3V. Do **not** insert a 5V SFF/SFP GBIC.
2) Use Serial Identification. Do **not** use a GBIC that utilizes Parallel Identification.

Installation

Installing and Removing a SFF/SFP GBIC Transceiver

Caution: Use only 3.3V Avaya-authorized SFF/SFP GBIC transceivers. Use only SFF/SFP GBIC transceivers that use Serial Identification.

The SFF/SFP GBIC transceiver is fastened using a snap-in clip.

To Install the SFF/SFP GBIC transceiver:

- Insert the transceiver (take care to insert it the right way up) until it clicks in place.

To Remove the SFF/SFP GBIC transceiver:

1 Press the clip on the bottom side of the transceiver.
2 Pull the transceiver out.

Specifications

LX Transceiver

A 9 µm or 10 µm single-mode fiber (SMF) cable may be connected to a 1000Base-LX SFF/SFP GBIC port. The maximum length is 10 km (32,808 ft).

A 50 µm or 62.5 µm multimode (MMF) fiber cable may be connected to a 1000Base-LX SFF/SFP GBIC port. The maximum length is 550 m (1,804 ft.) for 50 µm and 62.5 µm cable.

The LX transceiver has a Wavelength of 1300 nm, Transmission Rate of 1.25 Gbps, Input Voltage of 3.3V, and Maximum Output Wattage of -3 dBm.

SX Transceiver

A 50 µm or 62.5 µm multimode (MMF) fiber cable may be connected to a 1000Base-SX SFF/SFP GBIC port. The maximum length is 500 m (1,640 ft.) for 50 µm and 220 m (722 ft.) for 62.5 µm cable.

The SX transceiver has a Wavelength of 850 nm, Transmission Rate of 1.25 Gbps, Input Voltage of 3.3V, and Maximum Output Wattage of -4 dBm.

Agency Approval

The transceivers comply with:

- EMC Emission: US – FCC Part 15, Subpart B, Class A;
  Europe – EN55022 class A
- Immunity: EN50082-1

Safety: UL for US UL 1950 Std., C-UL (UL for Canada) C22.2 No.950 Std., Food and Drug Administration (FDA) 21 CFR 1040.10 and 1040.11, and CE for Europe EN60950 Std. Complies with EN 60825-1.

Gigabit Fiber Optic Cabling

Table B.2 Gigabit Fiber Optic Cabling

Gigabit Interface	Fiber Type	Diameter (μm)	Modal Bandwidth (MhzKm)	Maximum Distance (m)	Minimum Distance (m)	Wavelength (nm)
1000BASE-SX	MM	62.5	160	220	2	850
1000BASE-SX	MM	62.5	200	275	2	850
1000BASE-SX	MM	50	400	500	2	850
1000BASE-SX	MM	50	500	550	2	850
1000BASE-LX	MM	62.5	500	550	2	1310
1000BASE-LX	MM	50	400	550	2	1310
1000BASE-LX	SM	9	NA	10,000	2	1310
1000BASE-ELX	SM	9	NA	70,000	2	1550

Connector Pin Assignments

Console Pin Assignments

For direct Console communications, connect the Avaya P330 to the Console Terminal using the supplied RJ-45 crossed cable and RJ-45 to DB-9 adapter.

Table B.3 Pinout of the Required Connection for Console Communications

Avaya P330 RJ-45 Pin	Name	Terminal DB-9 Pins	Modem DB-25 Pins
1	For future use	NC	See note
2	TXD (P330 input)	3	3
3	RXD (P330 output)	2	2
4	CD	4	8
5	GND	5	7
6	DTR	1	20
7	RTS	8	4
8	CTS	7	5

Note: Pin 1 of the Modem DB-25 connector is internally connected to Pin 7 GND.

AVAYA P332GT-ML

SECTION 4: INSTALLING THE P330

Installation

The P332GT-ML is ready to work after you complete the installation instructions below.

Required Tools

Make sure you have the following tools at hand before undertaking the Installation procedures:

- Philips (cross-blade) screwdriver

Site Preparation

Avaya P330 can be mounted alone or in a stack in a standard 19-inch equipment rack in a wiring closet or equipment room. Up to 10 units can be stacked in this way. When deciding where to position the unit, ensure that:

- It is accessible and cables can be connected easily and according to the configuration rule.
- Cabling is away from sources of electrical noise such as radio transmitters, broadcast amplifiers, power lines and fluorescent lighting fixtures.
- Water or moisture cannot enter the case of the unit.
- There is a free flow of air around the unit and that the vents in the sides of the case are not blocked.

Note: Use Octaplane cables to interconnect with other switches.

- The environmental conditions match the requirements listed below:

Table 4.1 Environmental Prerequisites

Operating Temp.	-5 to 50°C (23 to 122°F)
Relative Humidity	5% to 95% non-condensing

- The power source matches the specifications listed below:

Table 4.2 Power Requirements — AC

Input voltage	90 to 265 VAC, 50/60 Hz
Power dissipation	100 W max
Input current	1.5 A

Table 4.3 Power Requirements — DC

Input voltage	-36 to -72 VDC
Power dissipation	100 W max
Input current	4 A max

Rack Mounting (Optional)

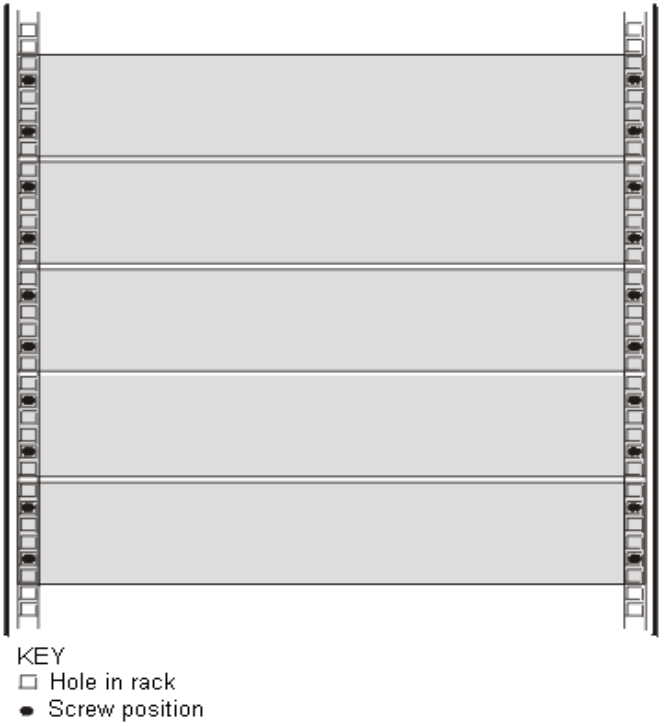
The P332GT-ML case fits in most standard 19-inch racks. P332GT-ML is 2U (88 mm, 3.5″) high.

Place the P332GT-ML in the rack as follows:

1 Snap open the ends of the front panel to reveal the fixing holes.

2 Insert the unit into the rack. Ensure that the four P332GT-ML screw holes are aligned with the rack hole positions as shown in Figure 4.1.

Figure 4.1 P332GT-ML Rack Mounting



3 Secure the unit in the rack using the screws. Use two screws on each side. Do not overtighten the screws.

4 Snap close the hinged ends of the front panel.

5 Ensure that ventilation holes are not obstructed.

Installing the X330STK-ML Stacking Sub-Module (Optional)

Caution: The stacking sub-modules contain components sensitive to electrostatic discharge. Do not touch the circuit board unless instructed to do so.

To install the stacking sub-module in the P332GT-ML:

1 Remove the blanking plate from the back of the P332GTP332GT-ML switch.
2 Insert the stacking sub-module gently into the slot, ensuring that the metal base plate is aligned with the guide rails. The metal plate of the X330STK-ML (and *not* the PCB) fits onto the guide rails.
3 Press the sub-module in firmly until it is completely inserted into the P332GTP332GT-ML.
4 Gently turn the two screws on the side panel of the stacking sub-module until they are secure.

Note: The P332GTP332GT-ML must not be operated with the back-slot open. The stacking sub-module should be covered with the supplied blanking plate if necessary.

Note: Only use the X330STK-ML stacking module with the P332GTP332GT-ML.

Connecting Stacked Switches

Note: The two ends of the Octaplane cable terminate with different connectors. Each connector can only be connected to its matching port.

The following cables are used to connect stacked switches:

- Short Octaplane cable (X330SC) – ivory-colored, used to connect adjacent switches (Catalog No. CB0223) or switches separated by a BUPS unit.
- Long/Extra Long Octaplane cable (X330LC/X330L-LC) – ivory-colored, used to connect switches from two different physical stacks, or switches separated by a BUPS unit (Catalog No. CB0225/CB0270).
- Redundant/Long Redundant Octaplane cable (X330RC/X330L-RC) – black, used to connect the top and bottom switches of a stack (Catalog No. CB0222/CB0269).

These are the same cables that are used with all the P330 switches.

To connect stacked switches:

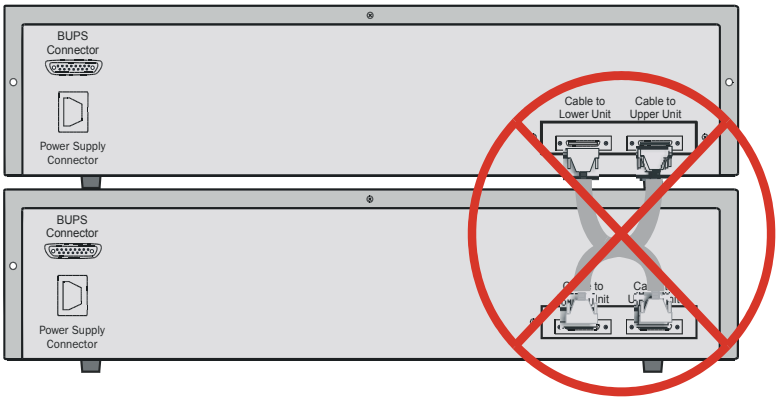
Note: When adding a module to an existing stack, first connect the stacking cables and then power up the module.

1 Plug the light grey connector of the Short Octaplane cable into the port marked "to upper unit" of the bottom P330 Family module.
2 Plug dark grey connector of same Short Octaplane cable to the port marked "to lower unit" in the unit above. The connections are illustrated in Figure 4.3.
3 Repeat Steps 1 and 2 until you reach the top switch in the stack.
4 If you wish to implement stack redundancy, use the Redundant Cable to connect the port marked " to lower unit" on the bottom switch to the port marked "to upper unit" on top switch of the stack.
5 Power up the added modules.

Caution: Do not cross connect two P330 switches with two Octaplane (light-colored) cables. If you wish to cross-connect for redundancy, use one light-colored Octaplane cable and one black redundancy cable. Figure 4.2 shows an incorrect connection.

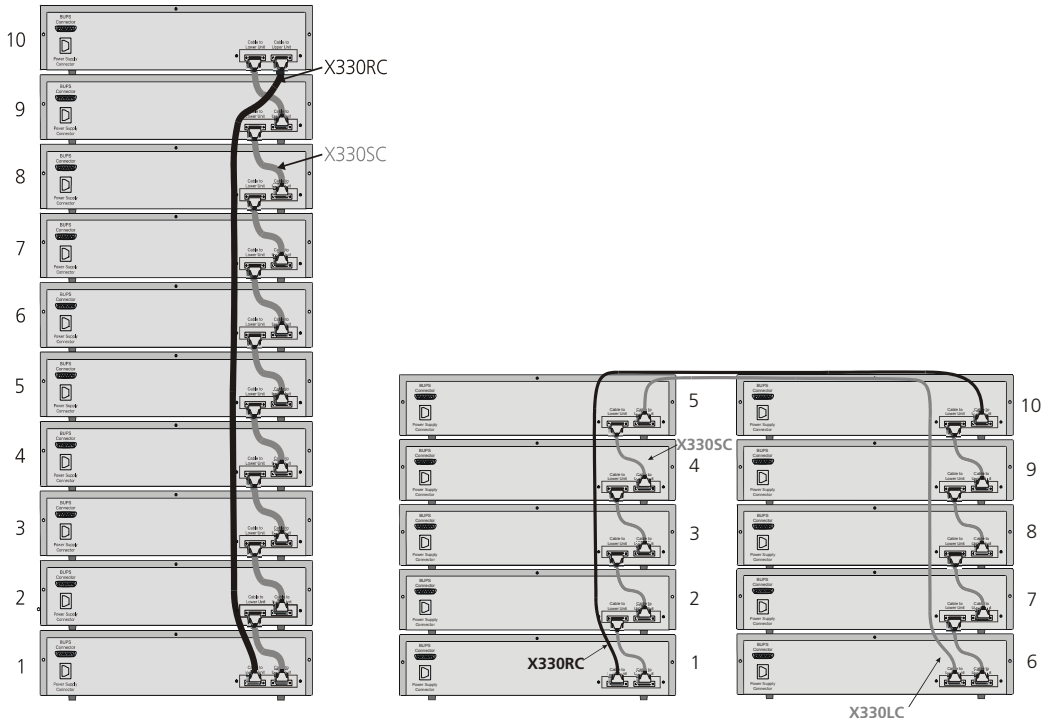
Note: You can build a stack of up to 10 P330 switches (any mixture of P330 and P330-ML modules wihin a stack is possible). If you do not wish to stack all the switches in a single rack, use long Octaplane cables to connect two physical stacks as shown in Figure 4.3.

Figure 4.2 Incorrect Stack Connection



Note: Figures 4.2 and 4.3 show the back panel of a P330 switch AC version. These drawings also apply to the P330-ML products.

Figure 4.3 P330 Stack Connections



Making Connections to Network Equipment

This section describes the physical connections that you can make between the Avaya P330 switch and other network equipment.

Prerequisites

Make sure you have the following before attempting to connect network equipment to the P330 switch:

- a list of network equipment to be connected to the P330 switch, detailing the connector types on the various units
- all required cables (see below). Appropriate cables are available from your local supplier.

Connecting Cables to Network Equipment

P332GT-ML modules include the following types of ports (according to the speed and standard they support): SFP GBIC and 100/1000Base-T

To connect the cables:

1 Insert an SFP GBIC (Small Form Factor Plugable Gigabit Interface Converter) transceiver (not supplied) to port housings numbered 51 and 52.

Note: GBICs are 3.3V.

2 Connect an Ethernet fiberoptic cable (not supplied) to the GBIC transceiver. You can use LC or MT-RJ fiberoptic cables, depending on the GBIC type you are using. For a list of approved SFP GBIC transceivers, see www.avayanetwork.com. For fiberoptic cable properties, see Table 4.4.

3 For all other ports, connect an Ethernet copper cable (not supplied) directly to the ports. The copper ports can function at 1000 Mbps only with 4 pair (8 wire) CAT5 Ethernet cables. If you use 2 pair (4 wire) CAT5 Ethernet cables, you can only work at 100 Mbps. The maximum cable length is 100 m (328 ft.).

4 Connect the other end of the cable to the Ethernet port of the PC, server, router, workstation, switch, or hub.

5 Check that the appropriate link (LNK) LED lights up.

Table 4.4 displays the different types of SFP GBIC interfaces, their fiber type, diameter, modal bandwidth, wavelengths, minimum and maximum distance.

Table 4.4 Gigabit Ethernet Cabling

Gigabit Interface	Fiber Type	Diameter (μm)	Modal Bandwidth (MhzKm)	Maximum Distance (m)	Minimum Distance (m)	Wavelength (nm)
1000BASE-SX	MM	62.5	160	220	2	850
1000BASE-SX	MM	62.5	200	275	2	850
1000BASE-SX	MM	50	400	500	2	850
1000BASE-SX	MM	50	500	550	2	850
1000BASE-LX	MM	62.5	500	550	2	1310
1000BASE-LX	MM	50	400	550	2	1310
1000BASE-LX	SM	9	NA	10,000	2	1310
1000BASE-ELX	SM	9	NA	70,000	2	1550

Powering Up the Avaya P330

This section describes the procedures for powering up the Avaya P330 unit.

Powering On – Avaya P330 Module AC

For the AC input version of the Avaya P330, insert the AC power cord into the power inlet in the back of the unit. The unit powers up.

If you are using a BUPS, insert a power cord from the BUPS into the BUPS-ML connector in the back of the unit. The unit powers up even if no direct AC power is applied to the unit.

After power up or reset, the Avaya P330 performs a self test procedure.

applied to it.

Caution: Ensure that you connect your P330-ML units to the BUPS-ML only. The P330 BUPS is not compatible with P330-ML units.

Powering On – Avaya P330 Module DC

For the DC input version of the Avaya P330, connect the power cable to the switch at the input terminal block.

1 The terminals are marked "+", "-" and with the IEC 5019a Ground symbol.
2 The size of the three screws in the terminal block is M3.5.
3 The pitch between each screw is 9.5mm.

Connect the power cable to the DC power supply. After power up or reset, the Avaya P330 performs a self test procedure.

Warning: Before performing any of the following procedures, ensure that DC power is OFF.

Caution: This product is intended for installation in restricted access areas and is approved for use with 18 AWG copper conductors only. The installation must comply with all applicable codes.

Warning: The proper wiring sequence is ground to ground, positive to positive and negative to negative. Always connect the ground wire first and disconnect it last.

Post-Installation

The following indicate that you have performed the installation procedure correctly:

Table 5.1 Post-Installation Indications

Procedure	Indication	Troubleshooting Information
Powering the P330	All front panel LEDs illuminate briefly	Page 127
Creating Stacks	The LED next to the appropriate connection (“Cable to upper unit” or “Cable to lower unit”) is lit.	Page 127

If you do not receive the appropriate indication, please refer to "Troubleshooting the Installation".

Avaya P332GT-ML Front and Rear Panels

Avaya P332GT-ML Front Panel

The P332GT-ML front panel contains LEDs, controls, and connectors. The status LEDs and control buttons provide at-a-glance information.

The front panel LEDs consist of Port LEDs and Function LEDs. The Port LEDs display information for each port according to the illuminated function LED. The function is selected by pressing the left or right button until the desired parameter LED is illuminated.

The P332GT-ML front panel shown below includes LEDs, buttons, SFP GBIC transceiver housings, 100/1000 Base-T ports, and the RJ-45 console connector. The LEDs are described in Table 6.1.

Figure 6.1 P332GT-ML Front Panel

Figure 6.2 P332GT-ML *LEDs*

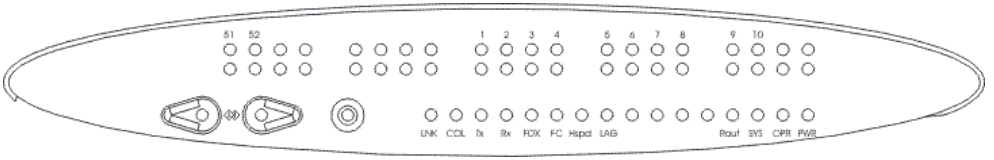


Table 6.1 Avaya P332GT-ML *LED Descriptions*

LED Name	Description	LED Status
PWR	Power Status	OFF – Power is off
		ON – Power is on
		Blink – Using BUPS-ML power only

Table 6.1 Avaya P332GT-ML *LED Descriptions (Continued)*

LED Name	Description	LED Status
OPR	CPU Operation	OFF – Module is booting
		ON – Normal operation
SYS	System Status	OFF – Module is a slave in a stack
		ON – Module is the master of the stack and the Octaplane and Redundant (optional) cable(s) are connected correctly. This LED will also light in Standalone mode.
		Blink – Box is the master of the stack and the Octaplane is in redundant mode.
ROUT	Routing Mode	OFF – Layer 2 mode
		ON – Router mode
The following Function LEDs apply to all ports		
LNK	Port Status	ON – Link is OK OFF – Port is disabled Blink – Port is enabled, but Link is down
COL	Collision	Always OFF. All ports are full-duplex only.
Tx	Transmit to line	OFF – No transmit activity
		ON – Data transmitted on line from the module
Rx	Receive from line	OFF – No receive activity
		ON – Data received from the line into the module
FDX	Full Duplex mode	Always ON. All ports are full-duplex only.

Table 6.1 Avaya P332GT-ML *LED Descriptions (Continued)*

LED Name	Description	LED Status
FC	Flow Control	OFF – No flow control.
		ON – One of the three possible flow control modes is *enabled*.
		Note: FC LED for Gigabit Ethernet ports reflect the last negotiated mode when autonegotiation is enabled and the link is down.
Hspd	High Speed	Ports 1-10 / Ports 51,52 OFF: 100 Mbps / N/A ON: 1000 Mbps / 1000 Mbps
LAG	Link Aggregation Group (Trunking)	OFF – No LAG defined for this port
		ON – Port belongs to a LAG

Note: All LEDs are lit during reset.

Table 6.2 Avaya P332GT-ML <- -> *Select buttons*

Description	Function
Left/Right	Individual – select LED function (see table above)
Reset module	Press both right and left buttons together for approximately 2 seconds. All LEDs on module light up until buttons are released.
Reset stack	Press both Right and Left buttons together for 4 seconds. All LEDs on stack light up until buttons are released.

Avaya P332GT-ML Back Panel

The P332GT-ML back panel contains a Stacking Sub-module slot, power supply and BUPS-ML connector. Figure 6.3 shows the back panel of the AC version switch and Figure 6.4 shows the back panel of the DC version switch with a stacking sub-module installed.

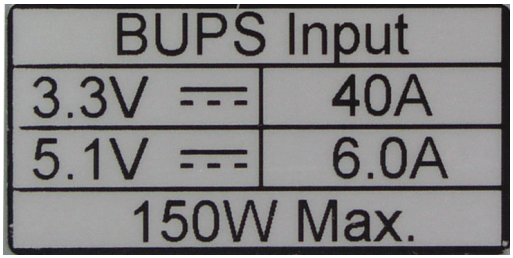
Figure 6.3 P332GT-ML AC version Back Panel (with Stacking Sub-module, BUPS-ML connector cover plate removed)

Figure 6.4 P332GT-ML DC Back Panel (without Stacking Sub-module installed, BUPS-ML connector cover plate shown)

BUPS-ML Input Connector

The BUPS-ML input connector is a 3.3 VDC and 5 VDC connector for use with the P330 BUPS-ML unit only. A BUPS Input sticker appears directly above the BUPS-ML input connector, which is covered with a metal plate.

Figure 6.5 BUPS-ML Input Connector Sticker



Establishing Switch Access

This chapter describes various methods for accessing the Avaya P330 CLI, including:

- a terminal to the serial port on the switch
- P330 Sessions
- a workstation running a Telnet session connected via the network
- a remote terminal/workstation attached via a modem (PPP connection)

Establishing a Serial Connection

This section describes the procedure for establishing switch access between a terminal and the Avaya P330 switch over the serial port provided on the front panel of the P330 (RJ-45 connector labeled "Console").

Configuring the Terminal Serial Port Parameters

The serial port settings for using a terminal or terminal emulator are as follows:

- Baud Rate - 9600 bps
- Data Bits - 8 bits
- Parity - None
- Stop Bit - 1
- Flow Control - None
- Terminal Emulation - VT-100

Connecting a Terminal to the Avaya P330 Serial port

Perform the following steps to connect a terminal to the Avaya P330 Switch Console port for acessing the text-based CLI:

1 The P330 device is supplied with a console cable and a RJ-45-to-DB-9 adaptor. Use these items to connect the serial (COM) port on your PC/terminal to the Avaya P330 console port.

2 Ensure that the serial port settings on the terminal are 9600 baud, 8 bits, 1 stop bit and no parity.

3 When you are prompted for a Login Name, enter the default login. The default login is **`root`**.

4 When you are promoted for a password, enter the user level password **`root`**.

P330 Sessions

You can use sessions to switch between the CLI of P330 modules / other stack entities (for example, an X330 ATM or WAN entity plugged into a specific P330 switch or with the G700 Media Gateway Precessor) or to switch between Layer 2 and Layer 3 commands in the P330-ML/P333R/P333R-LB router module.

To switch between P330 modules use the command:
`session [<mod_num>] <mode>`.

The `<mod_num>` is the number of the module in the stack, counting from the bottom up.

The `<mode>` can be either **switch**, **router, wan, atm, mgp**.

Use **switch** mode to configure layer 2 commands.

Use **router** mode to configure routing commands.

Examples:

To configure router parameters in the module that you are currently logged into, type the following command:

`session router`.

To configure the switch parameters, on module 6, type the command:
`session 6 switch`.

Note: When you use the `session` command the security level stays the same.

Assigning P330's IP Stack Address

Note: All P330 switches are shipped with the same default IP address. You must change the IP address of the master P330 switch in a stack in order to guarantee that the stack has its own unique IP address in the network.

The network management station or a workstaion running Telnet session can establish communications with the stack once this address had been assigned and the stack has been inserted into the network. Use the CLI to assign the P330 stack an IP address and net mask.

To assign a P330 IP stack address:

1 Establish a serial connection by connecting a terminal to the Master P330 switch of the stack.
2 When prompted for a Login Name, enter the default name **`root`**
3 When you are prompted for a password, enter the password **`root.`** You are now in Supervisor Level.

4 At the prompt, type:
set interface inband <vlan> <ip_address> <netmask>
Replace <vlan>, <ip_address> and <netmask> with the VLAN, IP address and net mask of the stack.
5 Press Enter to save the IP address and net mask.
6 At the prompt, type **reset** and press Enter to reset the stack. After the Reset, log in again as described above.
7 At the prompt, type **set ip route** <dest> <gateway> and replace <dest> and <gateway> with the destination and gateway IP addresses.
8 Press Enter to save the destination and gateway IP addresses.

Establishing a Telnet Connection

Perform the following steps to establish a Telnet connection to the Avaya P330 for configuration of Stack or Router parameters. You can Telnet the Stack Master IP address:

1 Connect your station to the network.
2 Verify that you can communicate with the Avaya P330 using Ping to the IP of the Avaya P330. If there is no response using Ping, check the IP address and default gateway of both the Avaya P330 and the station.

Note: The Avaya P330 default IP address is 149.49.32.134 and the default subnet mask is 255.255.255.0.

3 From the Microsoft Windows® taskbar of your PC click **Start** and then **Run** (or from the DOS prompt of your PC), then start the Telnet session by typing:
telnet *<P330_IP_address>*
If the IP Address in Telnet command is the IP address of the stack, then connection is established with the Switch CLI entity of the Master module. When you see the "Welcome to P330" menu and are prompted for a Login Name, enter the default name **root**
4 When you are prompted for a password, enter the User Level password **root** in lower case letters (do NOT use uppercase letters). The User level prompt will appear when you have established communications with the Avaya P330.

Establishing a Modem (PPP) Connection with the P330

Overview

Point-to-Point Protocol (PPP) provides a Layer 2 method for transporting multi-protocol datagrams over modem links.

Connecting a Modem to the Console Port

A PPP connection with a modem can be established only after the Avaya P330 is configured with an IP address and net-mask, and the PPP parameters used in the Avaya P330 are compatible with the modem's PPP parameters.

1 Connect a terminal to the console port of the Avaya P330 switch as described in Connecting a Terminal to the Avaya P330 Serial port.
2 When you are prompted for a Login Name, enter the default name **`root`**.
3 When you are prompted for a password, enter the password **`root`**. You are now in Supervisor Level.
4 At the prompt, type:
`set interface ppp <``ip_addr><net-mask>`
with an IP address and netmask to be used by the Avaya P330 to connect via its PPP interface.

Note: The PPP interface configured with the `set interface ppp` command must be on a different subnet from the stack inband interface.

5 Set the baud rate, ppp authentication, and ppp time out required to match your modem. These commands are described in the "Command Line Interface" chapter.
6 At the prompt, type:
`set interface ppp enable`
The CLI responds with the following:
```
Entering the Modem mode within 60 seconds...
Please check that the proprietary modem cable is plugged
into the console port
```
7 Use the DB-25 to RJ-45 connector to plug the console cable to the modem's DB-25 connector. Plug the other end of the cable RJ-45 connector to the Avaya P330 console's RJ-45 port.
8 The Avaya P330 enters modem mode.
9 You can now dial into the switch from a remote station, and open a Telnet session to the PPP interface IP address.

User Authentication

Introduction

A secure system provides safeguards to insure that only authorized personnel can perform configuration procedures. In Avaya P330, these safeguards form part of the CLI architecture and conventions.

Security Levels

There are four security access levels – User, Privileged, Configure and Supervisor.

- The User level ('read-only') is a general access level used to show system parameter values.
- The Privileged level ('read-write') is used by site personnel to access stack configuration options.
- The Configure level is used by site personnel for Layer 3 configuration.
- The Supervisor level ('administrator') is used to define user names, passwords, and access levels of up to 10 local users. In Supervisor level you can also access RADIUS authentication configuration commands.

Note: If you wish to define more than ten users per switch, or accounts for a user on multiple switches, you should use RADIUS (Remote Authentication Dial-In User Service).

A login name and password are always required to access the CLI and the commands. The login name, password, and access-type (i.e., security level) for a user account are established using the `username` command.

Switching between the entities, does not effect the security level since security levels are established specifically for each user. For example, if the operator with a privileged security level in the Switch entity switches to the Router entity the privileged security level is retained.

Note: If you wish to increase security, you can change the default user accounts and SNMP communities.

Note: The Web management passwords are the same as those of the CLI. If you change the passwords of the CLI then those passwords become active for Web management as well.

Entering the Supervisor Level

The Supervisor level is the level in which you first enter P330 CLI and establish user names for up to 10 local users. When you enter the Supervisor level, you are asked for a Login name. Type `root` as the Login name and the default password `root` (in lowercase letters):

```
Welcome to P330
Login: root
Password:****
Password accepted.
Cajun_P330-N(super)#
```

Defining new local users

Define new users and access levels using the following command in Supervisor Level.

In order to...	Use the following command...
Add a local user account and configure a user (name, password and access level)	username
To remove a local user account	no username
Display the username, password and access type for all users on the switch	show username

Exiting the Supervisor Level

To exit the Supervisor level, type the command `exit`.

Entering the CLI

To enter the CLI, enter your username and password. Your access level is indicated in the prompt as follows:

The User level prompt is shown below:

```
Cajun_P330-N>
```

The Privileged level prompt is shown below:

```
Cajun_P330-N#
```

The Configure level prompt for Layer 3 configuration is shown below:

```
P330-N(configure)#
```

The Supervisor level prompt is shown below:

```
Cajun_P330-N(super)#
```

RADIUS

Introduction to RADIUS

User accounts are typically maintained locally on the switch. Therefore, if a site contains multiple Avaya Switches, it is necessary to configure each switch with its own user accounts. Additionally, if for example a 'read-write' user has to be changed into a 'read-only' user, you must change all the 'read-write' passwords configured locally in every switch, in order to prevent him from accessing this level. This is obviously not effective management. A better solution is to have all of the user login information kept in a central location where all the switches can access it. P330 features such a solution: the Remote Authentication Dial-In User Service (RADIUS).

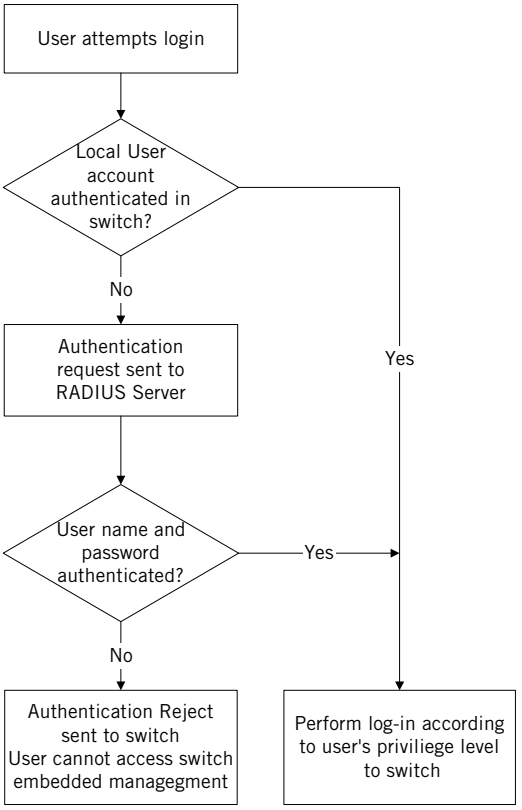
A RADIUS authentication server is installed on a central computer at the customer's site. On this server user authentication (account) information is configured that provides various degrees of access to the switch. The P330 will run as a RADIUS client. When a user attempts to log into the switch, if there is no local user account for the entered user name and password, then the switch will send an Authentication Request to the RADIUS server in an attempt to authenticate the user remotely. If the user name and password are authenticated, then the RADIUS server responds to the switch with an Authentication Acknowledgement that includes information on the user's privileges ('administrator', 'read-write', or 'read-only'), and the user is allowed to gain access to the switch. If the user is not authenticated, then an Authentication Reject is sent to the switch and the user is not allowed access to the switch's embedded management.

The Remote Authentication Dial-In User Service (RADIUS) is an IETF standard (RFC 2138) client/server security protocol. Security and login information is stored in a central location known as the RADIUS server. RADIUS clients such as the P330, communicate with the RADIUS server to authenticate users.

All transactions between the RADIUS client and server are authenticated through the use of a “shared secret” which is not sent over the network. The shared secret is an authentication password configured on both the RADIUS client and its RADIUS servers. The shared secret is stored as clear text in the client’s file on the RADIUS server, and in the non-volatile memory of the P330. In addition, user passwords are sent between the client and server are encrypted for increased security.

Figure 8.1 illustrates the RADIUS authentication procedure:

Figure 8.1 RADIUS Authentication Procedure



Radius Commands

The following radius commands are accessible from Supervisor level.

In order to...	Use the following command...
Enable or disable authentication for the P330 switch. RADIUS authentication is disabled by default	set radius authentication
Set a primary or secondary RADIUS server IP address	set radius authentication server
Configure a character string to be used as a “shared secret” between the switch and the RADIUS server.	set radius authentication secret
Set the RFC 2138 approved UDP port number.	set radius authentication udp-port
Set the number of times an access request is sent when there is no response	set radius authentication retry-number
Set the time to wait before re-sending an access request.	set radius authentication retry-time
Remove a primary or secondary RADIUS authentication server	clear radius authentication server
Display all RADIUS authentication configurations. The shared secrets will not be displayed	show radius authentication

For a complete description of the RADIUS CLI commands, including syntax and output examples, refer to *Avaya P330: Reference Guide*.

Allowed Managers

With the Allowed Managers feature, the network manager can determine who may or may not gain management access to the switch. The feature can be enabled or disabled (default is disabled). When enabled, only those users that are configured in the Allowed Managers table are able to gain Telnet, HTTP, and SNMP management access to the switch.

You can configure up to 20 Allowed Mangers by adding or removing their IP address from the Allowed Managers List.

Note: The identification of an "Allowed Manager" is done by checking the Source IP address of the packets, thus if the Source IP address is modified on the way (NAT, Proxy, etc.), even an "Allowed Manager" will not be able to access the P330.

Allowed Manager CLI Commands

In order to...	Use the following command...
When set to enabled - only managers with ip address specified in the allowed table will be able to access the device	set allowed managers
Add/delete ip address of manager to/from the allowed table	set allowed managers ip
Show the IP addresses of the managers that are allowed to access the device	show allowed managers table
Show whether the status of allowed managers is enabled or disabled	show allowed managers status
Show the IP addresses of the managers that are currently connected	show secure current

AVAYA P332GT-ML

SECTION 3: CONFIGURATION OF THE P330

Default Settings of the P330

This section describes the procedures for the first-time configuration of the Avaya P330. The factory defaults are set out in detail in the tables included in this chapter.

Configuring the Switch

The Avaya P330 may be configured using the text-based Command Line Interface (CLI), the built-in Avaya P330 Device Manager (Embedded Web) or Avaya Multi-Service Network Manager™.

For instructions on the text-based CLI, see the *Avaya P330 Reference Guide*.

For instructions on installation of the graphical user interfaces, see Embedded Web Manager. For instructions on the use of the graphical user interfaces, refer to the Device Manager User's Guide on the Documentation and Utilities CD.

Avaya P330 Default Settings

The default settings for the Avaya P330 switch and its ports are determined by the Avaya P330 software. These default settings are subject to change in newer versions of the Avaya P330 software. See the Release Notes for the most up-to-date settings.

Table 9.1 Default Switch Settings

Function	Default Setting
IP address	149.49.32.134
Subnet Mask	255.255.255.0
Default gateway	0.0.0.0
Management VLAN ID	1
Spanning tree	Enabled
Bridge priority for Spanning Tree	32768
Keep alive frame transmission	Enabled
Network time acquisition	Enabled, Time protocol
Time server IP address	0.0.0.0

Table 9.1 Default Switch Settings

Function	Default Setting
Timezone offset	0 hours
SNMP communities: Read-only Read-write Trap SNMP	 Public Public Public
SNMP retries number	3
SNMP timeout	2000 Seconds
SNMP authentication trap	Disabled
CLI timeout	15 Minutes
User Name/Password	root/root

Note: Functions operate in their default settings unless configured otherwise.

Table 9.3 Default Port Settings

Function	Default Setting	
	Ports 1-10	**Ports 51, 52**
Duplex mode	Full duplex only	Full duplex only
Port speed	100/1000 Mbps Depends on auto-negotiation results	1000 Mbps
Auto-negotiation[1]	Enable	Enable
Flow control auto-negotiation advertisement	Disabled (no pause)	Disabled (no pause)
Administrative state	Enable	Enable
Port VLAN ID	1	1
Tagging mode	Clear	Clear
Port priority	0	0
Spanning Tree cost	19	4
Spanning Tree port priority	128	128

1 Ensure that the other side is also set to Autonegotiation Enabled.

Basic Switch Configuration

Introduction

This chapter describes the parameters you can define for the chassis, such as its name and location, time parameters, and so on.

Use the CLI commands briefly described below for configuring the display on your terminal or workstation.

In order to...	Use the following command...
Open a CLI session to a P330 module in the stack, ATM or WAN expansion modules and Media Gateway Processor of G700.	session
Display or set the terminal width (in characters)	terminal width
Display or set the terminal length (in lines)	terminal length
Display or set the prompt	hostname
Return the prompt to its default value	no hostname
Clear the current terminal display	clear screen
Set the number of minutes before an inactive CLI session automatically logs out	set logout
Display the number of minutes before an inactive CLI session automatically times out	show logout
Access Layer 3 configuration if not logged in as supervisor (see “User Authentication“ chapter)	configure

System Parameter Configuration

Identifying the system

In order to make a P330 switch easier to identify, you can define a name for the switch, contact information for the switch technician and the location of the switch in the organization.

In order to...	Use the following command...
Configure the system name.	set system name
Configure the system contact person	set system contact
Configure the system location	set system location

Operating parameters

You can use the following commands to configure and display the mode of operation for the switch and display key parameters.

In order to...	Use the following command...
Configure the basic mode of operation of a module to either Layer 2 or Router	set device-mode
Display the mode of operation	show device-mode
Display system parameters	show system
Display module information for all modules within the stack	show module

Network Time Acquiring Protocols Parameter Configuration

The P330 can acquire the time form a Network Time Server. P330 supports the SNTP Protocol (RFC 958) over UDP port 123 or TIME protocol over UDP port 37. Use the CLI commands briefly described below for configuring and display time information and acquiring parameters.

In order to...	Use the following command...
Restore the time zone to its default, UTC.	clear timezone
Configure the time zone for the system	set timezone
Configure the time protocol for use in the system	set time protocol
Enable or disable the time client	set time client
Configure the network time server IP address	set time server
Display the current time	show time
Display the time status and parameters	show time parameters
Display the current time zone offset	show timezone
Get the time from the time server	get time

Chapter 11

Avaya P330 Layer 2 Features

This section describes the Avaya P330 Layer 2 features. It provides the basic procedures for configuring the P330 for Layer 2 operation.

Overview

The P330 family supports a range of Layer 2 features. Each feature has CLI commands associated with it. These commands are used to configure, operate, or monitor switch activity for each of the Layer 2 features.

This section of the *User's Guide* explains each of the features. Specifically, the topics discussed here include:

- Ethernet
- VLAN
- Spanning Tree Protocol
- Rapid Spanning Tree Protocol
- MAC Aging
- Link Aggregation Group (LAG)
- Port Redundancy
- IP Multicast Filtering
- Weighted Queuing
- Stack Health
- Stack Redundancy
- Port Classification

Ethernet

Ethernet is one of the most widely implemented LAN standards. It uses the Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method to handle simultaneous demands. CSMA/CD is a multi-user network allocation procedure in which every station can receive the transmissions of every other station. Each station waits for the network to be idle before transmitting and each station can detect collisions by other stations.

The first version of Ethernet supported data transfer rates of 10 Mbps, and is therefore known as 10BASE-T.

Fast Ethernet

Fast Ethernet is a newer version of Ethernet, supporting data transfer rates of 100 Mbps. Fast Ethernet is sufficiently similar to Ethernet to support the use of most existing Ethernet applications and network management tools. Fast Ethernet is also known as 100BASE-T (over copper) or 100BASE-FX (over fiber).
Fast Ethernet is standardized as IEEE 802.3u.

Gigabit Ethernet

Gigabit Ethernet supports data rates of 1 Gbps. It is also known as 1000BASE-T (over copper) or 1000BASE-FX (over fiber).
Gigabit Ethernet is standardized as IEEE 802.3z.

Configuring Ethernet Parameters

Auto-negotiation

Auto-Negotiation is a protocol that runs between two stations, two switchs or a station and a switch. When enabled, Auto-Negotiation negotiates port speed and duplex mode by detecting the highest common denominator port connection for the endstations. For example, if one workstation supports both 10 Mbps and 100 Mbps speed ports, while the other workstation only supports 10 Mbps, then Auto-Negotiation sets the port speed to 10 Mbps.
For Gigabit ports, Auto-Negotiation determines the Flow Control configuration of the port.

Full-Duplex/Half-Duplex

Devices that support Full-Duplex can transmit and receive data simultaneously, as opposed to half-duplex transmission where each device can only communicate in turn.
Full-Duplex provides higher throughput than half-duplex.

Speed

The IEEE defines three standard speeds for Ethernet: 10, 100 and 1000 Mbps (also known as Ethernet, Fast Ethernet and Gigabit Ethernet respectively).

Flow Control

The process of adjusting the flow of data from one device to another to ensure that the receiving device can handle all of the incoming data. This is particularly important where the sending device is capable of sending data much faster than the receiving device can receive it.

There are many flow control mechanisms. One of the most common flow control protocols, used in Ethernet full-duplex, is called xon-xoff. In this case, the receiving device sends a an xoff message to the sending device when its buffer is full. The sending device then stops sending data. When the receiving device is ready to receive more data, it sends an *xon* signal.

Priority

By its nature, network traffic varies greatly over time, so short-term peak loads may exceed the switch capacity. When this occurs, the switch must buffer frames until there is enough capacity to forward them to the appropriate ports.

This, however, can interrupt time-sensitive traffic streams, such as Voice and other converged applications. These packets need to be forwarded with the minimum of delay or buffering. In other words, they need to be given high priority over other types of networkl traffic.

Priority determines in which order packets are sent on the network and is a key part of QoS (Quality of Service). The IEEE standard for priority on Ethernet networks is 802.1p.

Avaya P330 switches supports two internal priority queues – the High Priority queue and the Normal Priority queue.

- Packets tagged with priorities 4-7 are mapped to the High Priority queue; packets tagged with priorities 0-3 are mapped to the Normal Priority queue. This classification is based either on the packet's original priority tag, or, if the packet arrives at the port untagged, based on the priority configured for the ingress port (set using the `set port level` CLI command).

In cases where the packet was received tagged, this priority tag is retained when the packet is transmitted through a tagging port.

In cases where the priority is assigned based on the ingress priority of the port, then on an egress tagging port the packet will carry either priority 0 or priority 4, depending on the queue it was assigned to (High Priority=4, Normal Priority=0).

MAC Address

The MAC address is a unique 48-bit value associated with any network adapter. MAC addresses are also known as hardware addresses or physical addresses. They uniquely identify an adapter on a LAN.

MAC addresses are 12-digit hexadecimal numbers (48 bits in length). By convention, MAC addresses are usually written in one of the following two formats:

- MM:MM:MM:SS:SS:SS

- MM-MM-MM-SS-SS-SS

The first half of a MAC address contains the ID number of the device manufacturer. These IDs are regulated by an Internet standards body. The second half of a MAC address represents the serial number assigned to the device by the manufacturer.

CAM Table

The *CAM Table* contains a mapping of learned MAC addresses to port and VLANs. The switch checks forwarding requests against the addresses contained in the CAM Table:

- If the MAC address appears in the CAM Table, the packet is forwarded to the appropriate port.
- If the MAC address does not appear in the CAM Table, or the MAC Address mapping has changed, the frame is duplicated and copied to all the ports. Once a reply is received, the CAM table is updated with the new address/VLAN port mapping.

Ethernet Configuration CLI Commands

The following table contains a list of the configuration CLI commands for the Ethernet feature. The rules of syntax and output examples are all set out in detail in the *Reference Guide*.

Table 11.1 Configuration CLI Commands for Ethernet Feature

In order to...	Use the following command...
Set the auto negotiation mode of a port	set port negotiation
Administratively enable a port	set port enable
Administratively disable a port	set port disable
Set the speed for a 10/100 port	set port speed
Configure the duplex mode of a 10/100BASE-T port	set port duplex
Configure a name for a port	set port name
Set the send/receive mode for flow-control frames for a full duplex port	set port flowcontrol
Set the flow control advertisement for a Gigabit port when performing autonegotiation	set port auto-negotiation-flowcontrol-advertisement

In order to...	Use the following command...
Set the priority level of a port	set port level
Display settings and status for all ports	show port
Display per-port status information related to flow control	show port flowcontrol
Display the flow control advertisement for a Gigabit port used to perform auto-negotiation	show port auto-negotiation-flowcontrol-advertisement
Display the CAM table entries for a specific port	show cam
Clear all the CAM entries.	clear cam
Display the autopartition settings	show autopartition

Ethernet Implementation in the Avaya P332GT-ML

This section describes the implementation of the Ethernet feature in the Avaya **P332GT-ML**:

- Speed — 100/1G ports (1-10); 1G ports (51,52)
- Priority queuing — 2 queues
- CAM size — 4K addresses

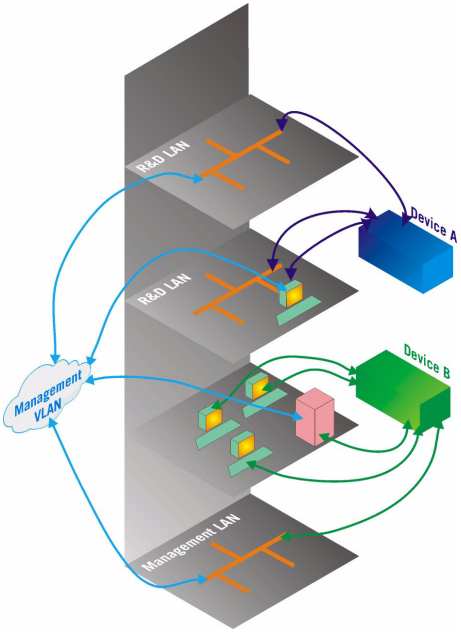
VLAN Configuration

VLAN Overview

A VLAN is made up of a group of devices on one or more LANs that are configured so that they operate as if they form an independent LAN, when in fact they may be located on a number of different LAN segments. VLANs can be used to group together departments and other logical groups, thereby reducing network traffic flow and increasing security within the VLAN.

The figure below illustrates how a simple VLAN can connect several endpoints in different locations and attached to different hubs. In this example, the Management VLAN consists of stations on numerous floors of the building and which are connected to both Device A and Device B.

Figure 11.1 VLAN Overview



In virtual topological networks, the network devices may be located in diverse places around the LAN—such as in different departments, on different floors or in different buildings. Connections are made through software. Each network device is connected to a hub, and the network manager uses management software to assign each device to a virtual topological network. Elements can be combined into a VLAN even if they are connected to different devices.

VLANs should be used whenever there are one or more groups of network users that you want to separate from the rest of the network.

In Figure 11.2, the switch has three separate VLANs: Sales, Engineering, and

Marketing (Mktg). Each VLAN has several physical ports assigned to it with PC's connected to those ports. When traffic flows from a PC on the Sales VLAN for example, that traffic is *only* forwarded out the other ports assigned to that VLAN. Thus, the Engineering and Mktg VLANs are not burdened with processing that traffic.

Figure 11.2 VLAN Switching and Bridging

VLAN Tagging

VLAN Tagging is a method of controlling the distribution of information on the network. The ports on devices supporting VLAN Tagging are configured with the following parameters:

- Port VLAN ID
- Tagging Mode

The Port VLAN ID is the number of the VLAN to which the port is assigned. Untagged frames (and frames tagged with VLAN 0) entering the port are assigned the port's VLAN ID. Tagged frames are unaffected by the port's VLAN ID.

The Tagging Mode determines the behavior of the port that processes outgoing frames:

- If Tagging Mode is set to "Clear", the port transmits frames that belong to the port's VLAN table. These frames leave the device untagged.
- If Tagging Mode is set to "IEEE-802.1Q", all frames keep their tags when they leave the device. Frames that enter the switch without a VLAN tag will be tagged with the VLAN ID of the port they entered through.

Multi VLAN Binding

Multi VLAN binding (Multiple VLANs per port) allows access to shared resources by stations that belong to different VLANs through the same port. This is useful in applications such as multi-tenant networks, where each user has his a VLAN for privacy, but the whole building has a shared high-speed connection to the ISP. In order to accomplish this, P330 allows you to set multiple VLANs per port. The

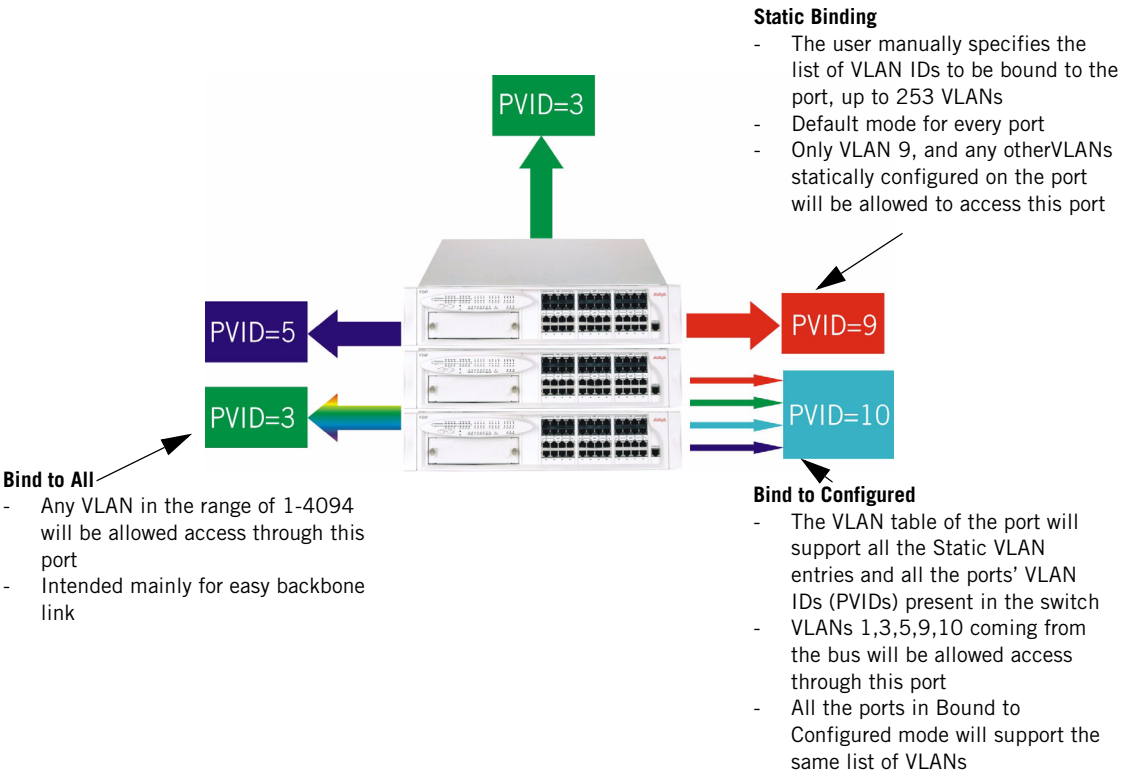
three available Port Multi-VLAN binding modes are:

- **Bind to All** - the port is programmed to support the entire 3K VLANs range. Traffic from any VLAN is forwarded through a port defined as “Bind to All”. This is intended mainly for easy backbone link configuration
- **Bind to Configured** - the port supports all the VLANs configured in the switch/stack. These may be either Port VLAN IDs (PVID) or VLANs that were manually added to the switch.
- **Statically Bound** - the port supports VLANs manually configured on it.

Note: VLAN Binding — The forwarding mechanism of the P330-ML switches is based on frame’s VLAN and MAC address. If a frame is destined to a known MAC address but arrives on a different VLAN than the VLAN on which this MAC address was learnt, this frame will be flooded as unknown to all ports that are bound to its VLAN. Hence, VLAN binding should be executed with care, especially on ports connected to workstations or servers.

Figure 11.3 illustrates these binding modes in P330.

Figure 11.3 Multiple VLAN Per-port Binding Modes



Automatic VLAN Learning

The Avaya P330-ML learns the VLANs automatically from traffic received on ports in "bind-to-all" mode. The maximum number of VLANs, 253, includes these dynamically learned VLANs and any VLANs you added manually.

When the VLAN list for the switch is full, no further dynamic learning or manual VLAN configuration will be possible until the dynamically learned VLANs are deleted from the table. This is accomplished with the `clear dynamic-vlans` CLI command.

Ingress VLAN Security

When a VLAN-tagged packet arrives at a port, only the packets with the VLAN tag corresponding to the VLANs which are configured on the port will be accepted. Packets with other VLAN tags will be dropped.

VLAN CLI Commands

The following table contains a list of the CLI commands for the VLAN feature. The rules of syntax and output examples are all set out in detail in the *Reference Guide*.

Table 11.2 VLAN CLI Commands

In order to...	Use the following command...
Assign the Port VLAN ID (PVID)	set port vlan
Define the port binding method	set port vlan-binding-mode
Define a static VLAN for a port	set port static-vlan
Configure the tagging mode of a port	set trunk
Create VLANs	set vlan
Display the port VLAN binding mode settings	show port vlan-binding-mode
Display VLAN tagging information of the ports, port binding mode, port VLAN ID and the allowed VLANs on a port	show trunk
Display the VLANs configured in the switch.	show vlan
Clear VLAN entries	clear vlan
Clear a VLAN statically configured on a port	clear port static-vlan
Clear the dynamic vlans learned by the switch from incoming traffic	clear dynamic vlans

VLAN Implementation in the Avaya P332GT-ML

This section describes the implementation of the VLAN feature in the Avaya **P332GT-ML**:

- No. of VLANs — 253 tagged VLANs ranging from 1 to 3071

Spanning Tree Protocol

Overview

Avaya P330 devices support both common Spanning Tree protocol (802.1d) and the enhanced Rapid Spanning Tree protocol (802.1w). The 802.1w is a faster and more sophisticated version of the 802.1d (STP) standard. Spanning Tree makes it possible to recover connectivity after an outage within a minute or so. RSTP, with its "rapid" algorithm, can restore connectivity to a network where a backbone link has failed in much less time.

In order to configure the switch to either common Spanning Tree or Rapid Spanning Tree protocol, use the `set spantree version` command.

Spanning Tree Protocol

The Spanning Tree Algorithm ensures the existence of a loop-free topology in networks that contain parallel bridges. A loop occurs when there are alternate routes between hosts. If there is a loop in an extended network, bridges may forward traffic indefinitely, which can result in increased traffic and degradation in network performance.

The Spanning Tree Algorithm:

- Produces a logical tree topology out of any arrangement of bridges. The result is a single path between any two end stations on an extended network.
- Provides a high degree of fault tolerance. It allows the network to automatically reconfigure the spanning tree topology if there is a bridge or data-path failure.

The Spanning Tree Algorithm requires five values to derive the spanning tree topology. These are:

1 A multicast address specifying all bridges on the extended network. This address is media-dependent and is automatically determined by the software.
2 A network-unique identifier for each bridge on the extended network.
3 A unique identifier for each bridge/LAN interface (a port).
4 The relative priority of each port.
5 The cost of each port.

After these values are assigned, bridges multicast and process the formatted frames (called Bridge Protocol Data Units, or BPDUs) to derive a single, loop-free topology throughout the extended network. The bridges exchange BPDU frames quickly, minimizing the time that service is unavailable between hosts.

Spanning Tree per Port

The Spanning Tree can take up to 30 seconds to open traffic on a port. This delay can cause problems on ports carrying time-sensitive traffic. You can therefore enable/disable Spanning Tree in P330 on a per-port basis to minimize this effect.

Rapid Spanning Tree Protocol (RSTP)

About the 802.1w Standard

The enhanced feature set of the 802.1w standard includes:

- Bridge Protocol Data Unit (BPDU) type 2
- New port roles: Alternate port, Backup port
- Direct handshaking between adjacent bridges regarding a desired topology change (TC). This eliminates the need to wait for the timer to expire.
- Improvement in the time it takes to propagate TC information. Specifically, TC information does not have to be propagated all the way back to the Root Bridge (and back) to be changed.
- Origination of BPDUs on a port-by-port basis.

Port Roles

At the center of RSTP—specifically as an improvement over STP (802.1d)—are the roles that are assigned to the ports. There are four port roles:

- Root port — port closest to the root bridge
- Designated port — corresponding port on the remote bridge of the local root port
- Alternate port — an alternate route to the root
- Backup port — an alternate route to the network segment

The RSTP algorithm makes it possible to change port roles rapidly through its fast topology change propagation mechanism. For example, a port in the “blocking” state can be assigned the role of “alternate port.” When the backbone of the network fails the port may be rapidly changed to forwarding.

Whereas the STA *passively* waited for the network to converge before turning a port into the forwarding state, RSTP *actively* confirms that a port can safely transition to forwarding without relying on any specific, programmed timer configuration.

RSTP provides a means of fast network convergence after a topology change. It does this by assigning different treatments to different port types. The port types and the treatment they receive follow:

- Edge ports — Setting a port to "edge-port" admin state indicates that this port is connected directly to end stations that cannot create bridging loops in the network. These ports transition quickly to forwarding state. However, if BPDUs are received on an Edge port, it’s operational state will be changed to "non-edge-port" and bridging loops will be avoided by the RSTP algorithm. The default admin state of all ports is "edge-port".

Note: You must manually configure uplink and backbone ports (including LAG logical ports) to be "non-edge" ports, using the CLI command `set port edge admin state`.

- Point-to-point Link ports — This port type applies only to ports interconnecting RSTP compliant switches and is used to define whether the devices are interconnected using shared Ethernet segment or pont-to-point Ethernet link. RSTP convergence is faster when switches are connected using point-to-point links. The default setting for all ports – automatic detection of point-to-point link – is sufficent for most networks.

Spanning Tree Implementation in the P330 Family

RSTP is implemented in P330 family of products so that it is interoperable with the existing implementation of STP. In order to configure the switch to either common Spanning Tree or Rapid Spanning Tree protocol, use the `set spantree version` command.

- After upgrading to software version 4.0, the default is spanning tree version STP. The default after NVRAM INIT remains STP.

The balance of this section lists the conditions and limitations that govern the implementation of Spanning Tree in the P330 line.

- RSTP's fast convergence benefits are lost when interacting with legacy (STP) bridges.
- When RSTP detects STP Bridge Protocol Data Units (BPDUs type 1) on a specific port, it will begin to "speak" 802.1d on this port only. Specifically, this means:
  - 802.1d bridges will ignore RSTP BPDUs and drop them.
  - 802.1d bridges will send 802.1d format BPDUs back to the switch.
  - The switch will change to 802.1d mode for that port only.

The P330 configured to RSTP is therefore able to simultaneously work with other switches implementing either RSTP or STP without specific user intervention.

- Spanning Tree configuration is performed on the stack level.
- If you do not upgrade all switches in the stack to firmware version 4.0, spanning tree will continue its normal operation. However, configuring Spanning Tree will not be possible until all switches are upgraded to version 4.0.
- RSTP is interoperable with P330 Port Redundancy and PBNAC applications. If either RSTP or PBNAC put the port in blocking, its final state will be "blocking".
- STP and Self Loop Discovery (SLD) are incompatible. However, If Spanning Tree is set to rapid-spanning-tree version, there is no need to use the Self-loop-discovery feature ; the RSTP algorithm avoids loops generated by the IBM token ring cabling.

- The 802.1w standard defines differently the default path cost for a port compared to STP (802.1d). In order to avoid network topology change when migrating to RSTP, the STP path cost is preserved when changing the spanning tree version to RSTP. You can use the default RSTP port cost by using the CLI command `set port spantree cost auto`.

Spanning Tree Protocol CLI Commands

The following table contains a list of CLI commands for the Spanning Tree feature. The rules of syntax and output examples are all set out in detail in the *Reference Guide*.

Table 11.3 Spanning Tree Protocol CLI Commandss

In order to...	Use the following command...
Enable/Disable the spanning tree application for the switch	set spantree
Set the bridge priority for spanning tree	set spantree priority
Set the RSTP bridge spanning tree max-age parameter	set spantree max-age
Set the RSTP bridge hello-time parameter	set spantree hello-time
Set the RSTP bridge forward-delay time prameter	set spantree forward-delay
Select between STP operation or RSTP switch operation	set spantree version
Display the bridge and per-port spanning tree information	show spantree
Set the TX hold count for the STA	set spantree priority
Add a port to the spanning tree application	set port spantree enable
Remove a port from the spanning tree application	set port spantree disable
Set the port spantree priority level	set port spantree priority
Set the cost of a port	set port spantree cost

Table 11.3 Spanning Tree Protocol CLI Commandss

In order to...	Use the following command...
Set the port as an RSTP port (and not as a common STA port)	set port spantree force-protocol-migration
Display a port's edge admin and operational RSTP state	show port edge state
Set the port as an RSTP edge port or non-edge port	set port edge admin state
Set the port point-to-point admin status	set port point-to-point admin status
Show the port's point-to-point admin and operational RSTP status	show port point-to-point status

MAC Aging

Overview

The MAC Aging feature allows the user to configure a time interval after which unused entries in the MAC Table will be deleted.

Configuring the P330 for MAC Aging

This section describes the configuration of the P330 for the MAC Aging functionality.

- MAC Aging is configured on the stack level.
- MAC Aging can be globally enabled/disabled using the `set mac-aging` command.
  - — After firmware upgrade to version 4.0, MAC Aging default state is disabled.
  - — After NVRAM INIT, MAC Aging default state is enabled.
- "mac-aging-time" is set in minutes:
  - — Default=5 minutes
  - — Minimum time=1 minute; maximum time= 3600 min

Note: On a mixed P330/P330-ML stack, MAC Aging—if enabled—will apply only to P330-ML modules in the stack.

MAC Aging CLI Commands

The following table contains a list of the CLI commands for the MAC Aging feature. The rules of syntax and output examples are all set out in detail in the *P330 Reference Guide*.

Table 11.4 MAC Aging CLI Commands

In order to...	Use the following command...
Enable/Disable MAC Aging	set mac-aging
Set the MAC aging time in minutes (0=don't age).	set mac-aging-time
Display the current status of the MAC aging function	show mac-aging
Display the MAC aging time in minutes.	show mac-aging-time

LAG

LAG Overview

A LAG uses multiple ports to create a high bandwidth connection with another device. For example: Assigning four 100BASE-T ports to a LAG on an Avaya P330 allows the switch to communicate at an effective rate of 400 Mbps with another switch.

LAGs provide a cost-effective method for creating a high bandwidth connection. LAGs also provide built-in redundancy for the ports that belong to a LAG. If a port in a LAG fails, its traffic is directed to another port within the LAG.

The behavior of the LAG is derived from the base port (the first port that becomes a LAG member). The attributes of the base port, such as port speed, VLAN number, etc., are applied to all the other member ports in the LAG.

When created, each LAG is automatically assigned a logical port number (usually designated 10x). This logical port number can then be used as any regular panel port for all configuration required for the LAG (Spanning Tree, Redundancy, etc.)

Note: In the P330-ML switches you need to erase **all** ports in t.he LAG in order to remove it.

LAG CLI Commands

The following table contains a list of the CLI commands for the LAG feature. The rules of syntax and output examples are all set out in detail in the *P330 Reference Guide*.

Table 11.5 LAG CLI Commands

In order to...	Use the following command...
Enable or disable a Link Aggregation Group (LAG) logical port on the switch	set port channel
Display Link Aggregation Group (LAG) information for a specific switch or port	show port channel

LAG Implementation in the Avaya P330 Family of Products

This section describes the implementation of the LAG feature in the P330 Family of products.

With the P332GT-ML, you can aggregate the two GBIC ports to form a LAG, you can aggregate the bandwidth of groups of up to four 1000Base-T ports in a LAG, or pairs of adjacent 1000 Base-T ports within a group, and one LAG of two remaining 1000Base-T ports for a maximum of 6 LAGs per switch. The relationship between the P332GT-ML Port Numbers, the number of the maximum configurable LAGs and the LAG logical Port Numbers that will be assigned to each LAG are depicted below.

Panel Ports in the LAG	Max. Number of LAGs	LAG Logical Port Number
1-4	2	101, 102
5-8	2	103,104
9-10	1	105
51,52	1	106

Port Redundancy

Port redundancy involves the duplication of devices, services, or connections, so that, in the event of a failure, the redundant device, service, or connection can take over for the one that failed.

In addition to Link Aggregation Groups—which comprise the basic redundancy mechanism within the switch—the P330 offers an additional port redundancy scheme. To achieve port redundancy, you can define a redundancy relationship between any two ports in a stack. One port is defined as the primary port and the other as the secondary port. If the primary port fails, the secondary port takes over. You can configure up to 20 pairs of ports (or LAGs) per stack for port redundancy, and 1 pair per stack for intermodule redundancy. Each pair contains a primary and secondary port. You can configure any type of port to be redundant to any other.

Port Redundancy Operation

The Port Redundancy feature supports up to 20 pairs of ports per stack. The redundant or secondary port takes over when the primary port link is down. Port redundancy provides for the following in the P330:

- Switchback from the secondary to primary port is allowed
- Switching time intervals can be set by the user

Note: Port Redundancy interworks with the Spnning Tree Algorithm.

The Port Redundancy feature functions as follows:

- Port Redundancy enables the user to establish 20 pairs of ports. Within each pair, primary and secondary ports are defined. To prevent loops, only one port is enabled at a time.
- Following initialization, the primary port is enabled and the secondary port is disabled.
  - — If the active port link fails, the system enables the secondary port.
  - — If the secondary port is enabled and the primary port link becomes available again, the system will “switchback” to the primary port, unless configured otherwise by the user.
- Two timers are available:
  - — “min-time-between-switchovers” —minimum time (in seconds) between the failure of the primary port link and switchover to the secondary (backup) port.

Note: The first time the primary port fails, the switchover is immediate. This timer applies to subsequent failures.

— "switchback-interval" — the minimum time (in seconds) that the primary port link has to be up (following failure) before the system switches back to the primary port. The "none" parameter, if configured, prevents switching back to the primary.

Intermodule Port Redundancy

The intermodule port redundancy feature supports one pair of redundant ports per stack. The secondary port is activated:

- when the primary port link is down, or
- when the module in the stack holding the primary port has been powered down or removed.

Switching time for intermodule port redundancy is approximately 1 second.

Note: Defining intermodule port redundancy on ports with no link causes both ports to be disabled. You should connect the link prior to attempting to define intermodule port redundancy.

Note: Once a port has been designated in a redundancy scheme, either as a primary or a secondary port, it can not be designated in any other redundancy scheme.

Note: Intermodule Port Redundancy does not interworks with the Spnning Tree Algorithm.

Port Redundancy CLI Commands

The following table contains a list of the CLI commands for the Redundancy feature. The rules of syntax and output examples are all set out in detail in the *P330 Reference Guide*.

Table 11.6 Redundancy CLI Commands (check spec)

In order to...	Use the following command...
Define or remove port redundancy schemes	set port redundancy
Enable the defined port redundancy schemes	set port redundancy enable

In order to...	Use the following command...
Disable the defined port redundancy schemes	set port redundancy disable
Define the timers that control the port redundancy operation	set port redundancy-interval
Display information on port redundancy schemes.	show port redundancy
Define the switch's unique intermodule redundancy scheme	set intermodule port redundancy
Clear the intermodule redundancy	set intermodule port redundancy off
display the intermodule redundancy entry defined for the switch	show intermodule port redundancy

IP Multicast Filtering

Overview

IP Multicast is a method of sending a single copy of an IP packet to multiple destinations. It can be used by different applications including video streaming and video conferencing.

The Multicast packet is forwarded from the sender to the recipients, duplicated only when needed by routers along the way and sent in multiple directions such that it reaches all the members of the Multicast group. Multicast addresses are a special kind of IP addresses (class D), each identifying a multicast group. Stations join and leave multicast groups using IGMP. This is a control-plane protocol through which IP hosts register with their router to receive packets for certain multicast addresses.

IP multicast packets are transmitted on LANs in MAC multicast frames. Traditional LAN switches flood these multicast packets like broadcast packets to all stations in the VLAN. In order to avoid sending multicast packets where they are not required, multicast filtering functions may be added to the layer 2 switches, as described in IEEE standard 802.1D. Layer 2 switches capable of multicast filtering send the multicast packets only to ports connecting members of that multicast group. This is typically based on IGMP snooping.

The Avaya P330 supports multicast filtering. The P330 learns which switch ports need to receive which multicast packets and configures the necessary information into the switch's hardware tables. This learning is based on IGMP (version 1 or 2) snooping.

The multicast filtering function in the P330 is transparent to the IP hosts and routers. It does not affect the forwarding behavior apart from filtering multicast packets from certain ports where they are not needed. To the ports that do get the multicast, forwarding is performed in the same way as if there was no filtering, and the multicast packet will not be sent to any ports that would not receive it if there was no filtering.

The multicast filtering function operates per VLAN. A multicast packet arriving at the device on a certain VLAN will be forwarded only to a subset of the ports of that VLAN. If VLAN tagging mode is used on the output port, then the multicast packet will be tagged with the same VLAN number with which it arrived. This is interoperable with multicast routers that expect Layer 2 switching to be done independently for each VLAN.

IP Multicast Filtering configuration is associated with the setting up of three timers:

- The **Router Port Pruning** timer ages out Router port information if IGMP queries are not received within the configured time.
- The **Client Port Pruning** time is the time after the P330 switch reset that the filtering information is learned by the switch but not configured on the ports.
- The **Group Filtering Delay** time is the time that the switch waits between becoming aware of a Multicast group on a certain VLAN and starting to filter traffic for this group.

IP Multicast CLI Commands

The following table contains a list of the CLI commands for the IP Multicast feature. The rules of syntax and output examples are all set out in detail in the *Reference Guide*.

Table 11.7 IP Multicast CLI Commands

In order to...	Use the following command...
Enable or disable the IP multicast filtering application	set intelligent-multicast
Define aging time for client ports	set intelligent-multicast client port pruning time
Define aging time for router ports	set intelligent-multicast router port pruning time
Define group filtering time delays	set intelligent-multicast group-filtering delay time
Display the status IP multicast filtering application	show intelligent-multicast
Shows whether the connected unit's hardware supports IP multicast filtering	show intelligent-multicast hardware-support

IP Multicast Implementation in the Avaya P332GT-ML

This section describes the implementation of the IP multicast feature in the Avaya **P332GT-ML**:

- No. of multicast groups — 1000

Weighted Queuing

The Weighted Queuing feature allows the user to configure the priority scheme between the internal priority queues as “Strict Priority” or to configure it as a Weighted Round Robin (WRR) scheme, with user-configurable weights.

Note: If the queuing scheme commands are to be implemented on a P330-ML switch other than the stack master, a session should be opened to the relevant switch.

Implementation of Weighted Queuing in the P330-ML

The user is able to set the Priority scheme to either “Strict” or “WWR.” The choice of option impacts in the following way on the operation of the modules installed in the stack.

- When the Priority scheme is set to “Strict”:
  - — Giga ports — the Low priority queue will transmit only if the High priority queue has nothing to transmit.
- When the Priority scheme is set to”WWR” with a weight factor ‘n’:
  - — Giga ports — the High priority queue will transmit ‘n’ packets for each packet that willbe transmitted from the Low priority queue.

Note: By default, the WWR weights between the high and low priority queues are 1:64.

Weighted Queuing CLI Commands

The following table contains a list of the CLI commands for the Weighted Queuing feature. The rules of syntax and output examples are all set out in detail in the *Reference Guide*.

Table 11.8 Weighted Queuing CLI Commands

In order to...	Use the following command...
Switch between the Strict and Weighted queuing schemes, and to set the weights	set queuing scheme
Returns the queuing scheme to WRR with the default weights	set default queuing scheme

Table 11.8 Weighted Queuing CLI Commands

In order to...	Use the following command...
Display the current queuing scheme settings	show queuing scheme

Stack Health

The P330 software provides a Stack Helath feature for verifying the integrity of the P330 stack cascading module and cables.

Overview

The Stack Health feature will identify defective modules and cables that may be installed in the P330 stack. The Stack Health algorithm separately checks all stacking modules and the Octaplane connections (including Redundant cable).

Implementation of Stack Health in the P330 Family

When activating the Stack Health feature, the agents in all modules start sending special packets of various length via all stacking cables to one another. The Master module synchronizes this process and collects the results.

- When the Redundant Cable is present, the user is prompted to disconnect one of the short Octaplane cables and the redundant connection will be checked. Then, when prompted, the cable should be reconnected and the test will run a second time to check the regular Octaplane connections.
- The stack is reset after the Stack Health process completes.

Note: You should not load the stack with traffic during this test.

Note: If the stack health process fails, try to fasten or replace the stack cable between the modules where the failure has occurred. If the problem persists, try to fasten or replace either or both of the stacking modules.

Stack Health CLI Commands

The following table contains a list of the CLI commands for the Stack Health feature. The rules of syntax and output examples are all set out in detail in the *Reference Guide*.

Table 11.9 Stack Health CLI Command

In order to...	Use the following command...
Initiate the stack health testing procedure	set stack health

Port Classification

Overview

With the P330, you can classify any port as regular or valuable. Setting a port to valuable means that, in case of Ethernet link failure of that port, a link fault trap can be sent even when the port is disabled and a fast aging operation on the CAM table will be performed. This feature is particularly useful for the link/intermodule redundancy application, where you need to be informed about a link failure on the dormant port and resume traffic quickly.

Port Classification CLI Commands

In order to...	Use the following command...
Set the port classification to either regular or valuable	set port classification
Display a port's classification	show port classification

Stack Redundancy

In the unlikely event that a P330 switch or Octaplane link should fail, stack integrity is maintained if the redundant cable is connected to the stack. The broken link is bypassed and data transmission continues uninterrupted. The single management IP address for the stack is also preserved for uninterrupted management and monitoring. You can remove or replace any unit within the stack without disrupting operation or performing stack-level reconfiguration.

Since each P330 module has an integral SNMP agent, any module in a stack can serve as the stack Network Managment Agent (NMA) while other NMAs act as redundant agents in “hot” standby. If the “live” NMA fails then a backup is activated instantaneously.

Chapter 12

Avaya P330 Layer 3 Features

Introduction

This section describes the Avaya P330 Layer 3 features. It provides the basic procedures for configuring the P330 for Layer 3 operation.

Note: Layer 3 features are relevant to P332GT-ML operating in router mode. You must purchase a Layer 3 preconfigured P332GT-ML module or a Routing License Key Certificate for the P332GT-ML in order to operate the P332GT-ML in router mode.

What is Routing?

Routing enables transfer of a data packet from source to destination using a device called a router. Routing involves two basic activities:

- determining optimal routing paths
- transmitting information packets through an internetwork

Routers use routing tables to determine the routes to particular network destinations and, in some cases, metrics associated with those routes. Routers communicate with one another and maintain their routing tables through the transmission of a variety of messages.

The Routing Update Message is one such message. Routing Updates generally consist of all or a portion of a routing table. By analyzing Routing Updates from all routers, a router can build a detailed picture of network topology.

A Link-State Advertisement is another example of a message sent between routers. Link-State Advertisements inform other routers of the state of the sender's links. Link information can also be used to build a complete picture of the network's topology. Once the network topology is understood, routers can determine optimal routes to network destinations.

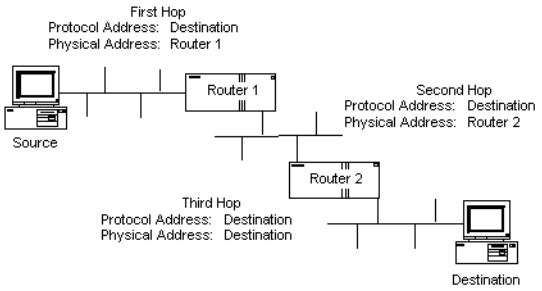
Routers can route only those messages that are transmitted in a routable protocol, such as IP or IPX. Messages in non-routable protocols, such as NetBIOS and LAT, cannot be routed, but they can be transferred from LAN to LAN via a bridge.

When a router receives a packet, it examines the packet's destination protocol address. The router then determines whether it knows how to forward the packet to the next hop. If the router does not know how to forward the packet, it typically drops the packet unless a default gateway is defined. If the router knows how to

forward the packet, it changes the packet destination's physical address to that of the next hop and transmits the packet.

The next hop may or may not be the ultimate destination host. If not, the next hop is usually another router, which executes the same switching decision process. As the packet moves through the internetwork, its physical address changes but its protocol address remains constant. This process is illustrated in the figure below.

Figure 12.1 Routing



The relation between the destination host's protocol address and its physical address is obtained by the routers using the ARP request/reply mechanism, and the information is stored within the ARP table in the router (see "The ARP Table" on page 111).

Within an enterprise, routers serve as an intranet backbone that interconnects all networks. This architecture strings several routers together via a high-speed LAN topology such as Fast Ethernet or Gigabit Ethernet. Within the global Internet, routers do all the packet switching in the backbones.

Another approach within an enterprise is the collapsed backbone, which uses a single router with a high-speed backplane to connect the subnets, making network management simpler and improving performance.

Routing Configuration

Forwarding

The P330 forwards IP packets between IP networks. When it receives an IP packet through one of its interfaces, it forwards the packet through one of its interfaces. The P330 supports multinetting, enabling it to forward packets between IP subnets on the same VLAN as well as between different VLANs. Forwarding is performed through standard means in Router mode.

Multinetting (Multiple Subnets per VLAN)

In Router Mode, most applications such as RIP and OSPF, operate per IP interface. Other applications such as VRRP and DHCP/BOOTP Relay operate per VLAN. Configuration of these applications is done in the Interface mode. When there is only a single interface (subnet) per VLAN then system behavior is intuitive since a subnet and a VLAN are the same.

Multiple interfaces (subnets) per VLAN are more complicated. For example, if there are two interfaces over the same VLAN and you configure DHCP server on one interface, it will be used also for the second interface over the same VLAN. This behavior might be less expected and in some cases wrong.

In order to prevent misconfiguration and unexpected results, the P330 prevents configuration of VLAN-oriented commands on an interface unless explicitly requested by the user via the “enable vlan commands” CLI command.

Configuring the “enable vlan commands” on one interface defeats this option on other interfaces that belong to the same VLAN. This ensures that VLAN-oriented commands can be configured from one interface only.

In case there is only one interface over a VLAN, then VLAN oriented commands for this VLAN can be configured through the single interface without using the “enable vlan commands” command.

Note:
1. VLAN-oriented commands that were configured affect the VLAN of the interface that was used at the time the command was issued.
2. If the interface is moved to another VLAN (using the “ip vlan command”) VLAN oriented configuration still relates to the original VLAN.

IP Configuration

IP Configuration CLI Commands

In order to...	Use the following command...
Enable IP routing	ip routing
Set ICMP error messages	ip icmp-errors
Specify the format of netmasks in the show command output	ip netmask-format
Create and/or enter the Interface Configuration Mode	interface
Assign an IP address and mask to an interface	ip address
Set the administrative state of an IP interface	ip admin-state
Update the interface broadcast address	ip broadcast-address
Define a default gateway (router)	ip default-gateway
Define the interface RIP route metric value	default-metric
Enable net-directed broadcast forwarding	ip directed-broadcast
Set the IP routing mode of the interface	ip routing-mode
Enable or disable the sending of redirect messages on the interface	ip redirect
Check host reachability and network connectivity	ping
Trace route utility	traceroute
Create a router Layer 2 interface	set vlan (Layer 3)
Specify the VLAN on which an IP interface resides	ip vlan/ip vlan name

In order to...	Use the following command...
Use this command before configuring VLAN-oriented parameters, when there is more than one interface on the same VLAN	enable vlan commands
Display information about the IP unicast routing table	show ip route (Layer 3)
Display information for an IP interface	show ip interface
Display the status of ICMP error messages	show ip icmp
Delete a Layer 2 Router interface	clear vlan

Assigning Initial Router Parameters

This section is only applicable if you either purchased a Layer 3 preconfigured P332GT-ML module or purchased a Routing License Key Certificate for P332GT-ML and activated the License Key. For information, on activating a Licence Key, see Obtaining and Activating a License Key below.

To configure the initial router parameters perform the following via the CLI:

1 Enter **`set device-mode router`** and press Enter.
You will be prompted to reset the module.

2 Type **`y`**.
Wait for the module to restart and for the CLI prompt to reappear.

3 Type **`show device-mode`** and press Enter to ensure that the module is in router mode.

Note: Assign the stack IP address as described in Assigning P330's IP Stack Address before you assign the Initial Router IP address.

4 To access Router commands from the Master module, type the command **`session`** `<module number>` **`router`** where `<module number>` is the location of the router module in the stack, and press Enter.
The command prompt changes from `P330-N>` to `Router-N#>` where N is the number of the router in the stack (see P330 Sessions).

5 Type **`configure`** and press Enter. The prompt `Router-N(configure)#` appears.

Note: If the IP interface is on VLAN #1, continue with step 7.

6 Create the management/routing VLAN. Use the command **set vlan** <Vlan-id> **name** <Vlan-name> replacing <Vlan-id> by the VLAN number, and <Vlan-name> by the VLAN name. Press Enter.

7 Create an IP interface name. Type:
Router(configure)# interface <interface-name>
Press Enter.
The **Router(configure-if:<interface-name>)#** prompt appears.

8 Assign the IP address and network mask of the IP interface you have created. Use the command**:**
Router(configure-if:<interface-name>)# ip address <ip-address> <netmask>
Press Enter

9 Assign a vlan to the IP interface you have created. Type: Assign a vlan to the IP interface you have created. Type:
Router(configure)# interface <interface-name># ip vlan <vland-id>
Press Enter.

10 Type **exit** and press Enter. This returns you to the prompt:
Router(configure)#

11 If the management station is not on the same subnet as the switch, configure a default gateway (static route). Use the command:
ip default-gateway <ip-address> and press Enter, replacing <ip-address> with the IP address of the default gateway.

12 Save the configuration changes by typing **copy running-config startup-config** and press Enter.

Obtaining and Activating a License Key

In order to benefit from Layer 3 Routing functionality, it is required that you either purchase a Layer 3 preconfigured P330-ML module or a Routing License Key Certificate for the P330-ML.

Each Certificate is specific for:

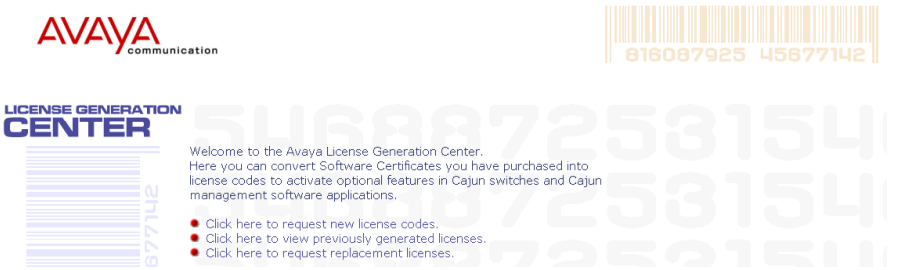
- The module type.
- The required feature.
- The number of devices.

After you purchase a Routing Licence Key Certificate, you must obtain and activate a Routing License Key.

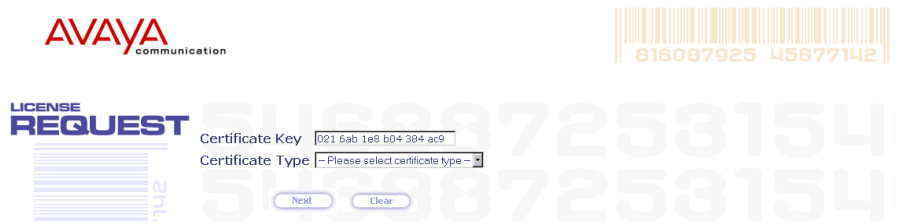
Obtaining a Routing License Key

To obtain a License Key that enables routing features:

1 Go to http://license-lsg.avaya.com and click “request new license”.

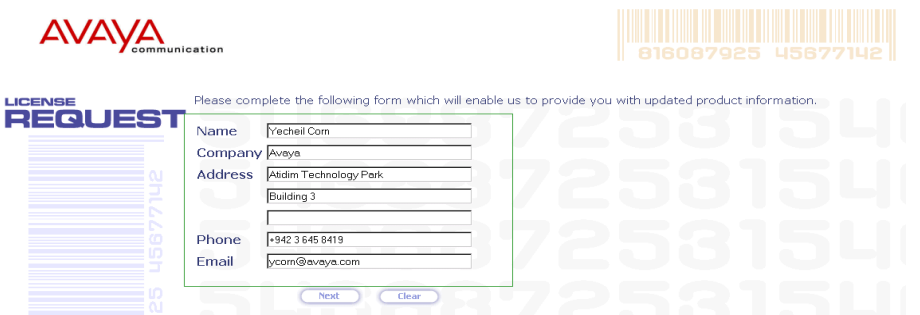


2 Enter the Certificate Key and Certificate Type.



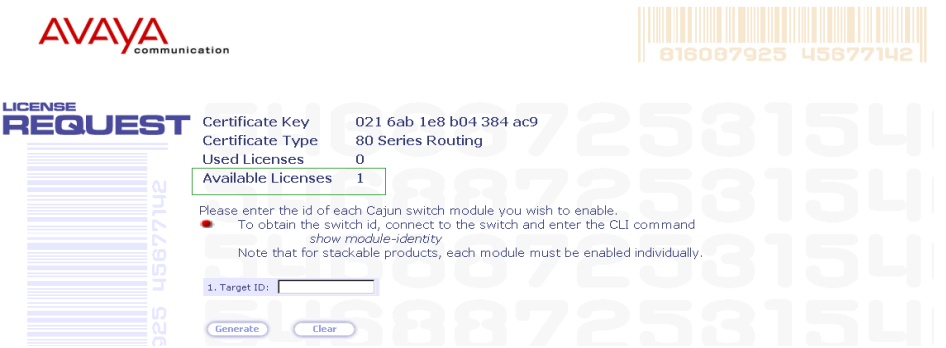
3 Click Next.

4 Enter contact information (once per certificate)

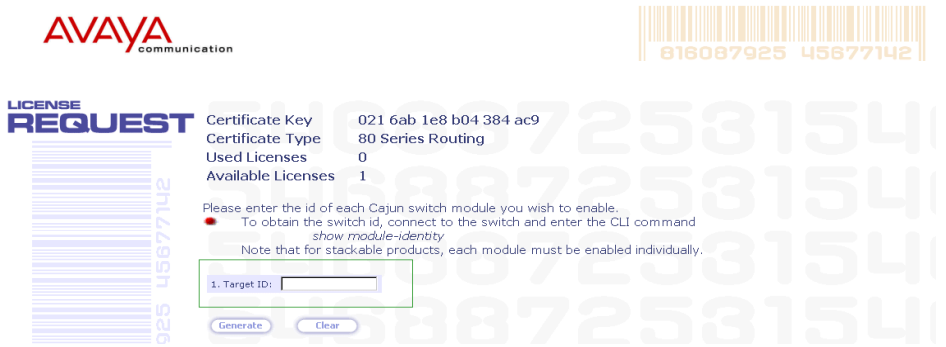


5 Click Next.

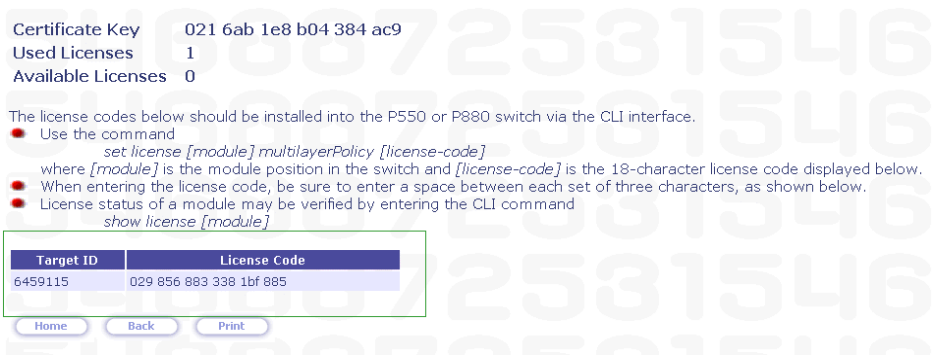
6 View number of licenses left.



7 Enter serial number of the switch(es) or module. To identify serial numbers use the CLI command:`show module-identity`.



8 Click Generate. The feature-enabling license code is generated



Activating a Routing License Key

To activate a Routing License Key:

1 Enter the acquired Routing License Key into the P330-ML module using the `set license` CLI command.
`set license` `[module] [license] [featureName]`

where:

`module` - P330-ML module number (the location of the device in the stack)

`license` - license code

`featureName` - routing

and press Enter.

2 Reset the module.

3 Check that the license is activated using the CLI.
Use the `show license` CLI command.

License Key CLI Commands

In order to...	Use the following command...
Configure the feature license	set license
Display the feature license	show license
Display the switch identity required for acquiring a license	show module-identity

RIP (Routing Interchange Protocol) Configuration

RIP Overview

RIP is a “distance vector protocol”— that is, the router decides which path to use on distance (the number of intermediate hops). In order for this protocol to work correctly, all of the routers (and possibly the nodes) need to gather information on how to reach each destination in the Internet. The very simplicity of RIP has a disadvantage, however: it does not take into account the network bandwidth, physical cost, data priority, and so on.

The P330 supports the widely used RIP routing protocol (both RIPv1 and RIPv2). The RIPv1 protocol imposes some limitations on the network design with regard to subnetting. When operating RIPv1, you must not configure variable length subnet masks (VLMS). Each IP network must have a single mask, implying that all subnets in a given IP network are of the same size. Also, when operating RIPv1, you must not configure supernets, which are networks with a mask smaller than the natural net mask of the address class, such as 192.1.0.0 with mask 255.255.0.0 (smaller than the natural class C mask which is 255.255.255.0). For detailed descriptions of RIP refer to the standards and published literature.

RIPv2 is a new version of the RIP routing protocol but with some advantages over RIPv1. RIPv2 solves some of the problems associated with RIPv1. The most important change in RIPv2 is the addition of a subnet mask field which allows RIPv2 to support variable length subnets. RIPv2 also includes an authentication mechanism similar to the one used in OSPF.

The RIP version, 1 or 2, is configured per IP interface. Configuration must be homogenous on all routers on each subnet—there can not be both RIPv1 and RIPv2 routers configured on the same subnet. However, different IP interfaces of the P330 can be configured with different RIP versions (as long as all routers on the subnet are configured to the same version).

RIPv2 and RIPv1 are considered the same protocol with regard to redistribution to/from OSPF and static route preferences.

RIP2

RIP2 overcomes some of the shortcomings of RIP. The table below summarizes the differences between RIP and RIP2.

Table 12.1 DIfferences Between RIP and RIP2

RIP2	RIP
Multicast addressing	Broadcast Addressing
Event-driven	Timer-based (update every 30 seconds)
VLSM support (subnet information transmitted)	Fixed subnet masks

RIP CLI Commands

In order to...	Use the following command...
Configure the Routing Information Protocol (RIP)	router rip
Specify a list of networks on which the RIP is running	network
Redistribute routing information from other protocols into RIP	redistribute
Specify the RIP version running on the interface basis	ip rip rip-version
Set the interface RIP route metric value	default-metric
Set the RIP Send and Receive mode on an interface	ip rip send-receive
Enable learning of the default route received by the RIP	ip rip default-route-mode
Enable split-horizon with poison-reverse on an interface	ip rip poison-reverse
Enable split-horizon mechanism	ip rip split-horizon

In order to...	Use the following command...
Specify the type of authentication used in RIP Version 2 packets	ip rip authentication mode
Set the authentication string used on the interface	ip rip authentication key
Specify the RIP timers values	timers basic

OSPF (Open Shortest Path First) Configuration

OSPF Overview

OSPF is a routing protocol developed for IP networks based on the shortest path first or link-state algorithm. It was introduced to overcome the limitations of RIP in increasingly complex network designs.

OSPF is based on the cost of a particular path. In contrast, RIP uses hops as a path criterion. Also, updates are sent on a “need to know” basis rather than every 30 seconds as with RIP.

The advantage of shortest path first algorithms is that they result in smaller more frequent updates everywhere. They converge quickly, thus preventing such problems as routing loops and Count-to-Infinity (when routers continuously increment the hop count to a particular network). This stabilizes the network.

The disadvantage of shortest path first algorithms is that they require a lot of CPU power and memory. .

Routers use link-state algorithms to send routing information to all nodes in an internetwork by calculating the shortest path to each node. This calculation is based on a topography of the Internet constructed by each node. Each router sends that portion of the routing table (keeps track of routes to particular network destinations) that describes the state of its own links, and it also sends the complete routing structure (topography).

The P330 supports the OSPF routing protocol. The P330 can serve as an OSPF Autonomous System Boundary Router (ASBR) by configuration of route redistribution. The P330 can be installed in the OSPF backbone area (area 0.0.0.0) or in any OSPF area that is part of a multiple areas network. However, the P330 cannot be configured to be an OSPF area border router itself.

The P330 supports the equal-cost multipath (ECMP) feature which allows load balancing by splitting traffic between several equivalent paths.

While OSPF can be activated with default values for each interface using a single command, many of the OSPF parameters are configurable.

For a detailed description of OSPF, refer to the OSPF standards and published literature.

OSPF CLI Commands

In order to...	Use the following command...
Enable OSPF protocol	router ospf
Configure the area ID of the router	area
Configure router identity	ip ospf router-id
Configure a passive ospf interface	passive-interface
Redistribute routing information from other protocols into OSPF	redistribute
Configure the delay between runs of OSPF's SPF calculation	timers spf
Configure interface metric	ip ospf cost
Specify the time interval between hellos the router sends	ip ospf hello-interval
Configure the interval before declaring the neighbor as dead.	ip ospf dead-interval
Configure interface priority used in DR election	ip ospf priority
Configure the interface authentication password	ip ospf authentication-key
Display general information about OSPF routing	show ip ospf
Display the OSPF-related interface information	show ip ospf interface
Display OSPF neighbor information on a per-interface basis	show ip ospf neighbor
Display lists of information related to the OSPF database for a specific router	show ip ospf database
Configure an interface as passive	passive-interface

Static Routing Configuration

Static Routing Overview

When dynamic routing protocols (RIP or OSPF) are not appropriate, you can manually configure *static routes* to indicate the next hop on the path to the final packet destination.

A static route becomes inactive if the interface over which it is defined is disabled. When the interface is enabled, the static route becomes active again. They are never timed-out, or lost over reboot, and can only be removed by manual configuration. Deletion (by configuration) of the IP interface deletes the static routes using this interface as well.

Static routes can only be configured for remote destinations, i.e. destinations that are reachable via another router as a next hop. The next hop router must belong to one of the directly attached networks for which the P330 has an IP interface. “Local” static routes, such as those that have no next hop, are not allowed.

Two kinds of static routes can be configured:

- High Preference static routes which are preferred to routes learned from any routing protocol
- Low Preference static routes which are used temporarily until the route is learned from a routing protocol. By default, a static route has Low Preference.

Static routes can be advertised by routing protocols (i.e., RIP, OSPF) as described under Route redistribution.

Static routes also support load-balancing similar to OSPF. A static route can be configured with multiple next hops so that traffic is split between these next hops.

This can be used for example to load-balance traffic between several firewalls which serve as the default gateway.

Static Routing Configuration CLI Commands

In order to...	Use the following command...
Establish a static route	ip route
Remove a static route	no ip route
Set the maximum number of route entries in the routing table	ip max-route-entries
Set the maximum number of route entries in the routing table to the default value	no ip max-route-entries
Define a default gateway (router)	ip default-gateway
Remove the default gateway (router)	no ip default-gateway
Delete all the dynamic routing entries from the Routing Table	clear ip route
Display information about the IP unicast routing table	show ip route
Display a routing table for a destination address	show ip route best-match
Display the static routes	show ip route static
Display the number of routes known to the switch	show ip route summary

Route Preferences

The routing table may contain routes from different sources. Routes to a certain destination may be learned independently from RIP and from OSPF, and at the same time, a static route can also be configured to the same destination. While metrics are used to choose between routes of the same protocol, protocol preferences are used to choose between routes of different protocols.

The preferences only apply to routes for the same destination IP address and mask. They do not override the longest-match choice. For example, a high-preference static default route will not be preferred over a RIP route to the subnet of the destination.

P330 protocol preferences are listed below from the most to the least preferred:

1 Local (directly attached net)

2 High-preference static (manually configured routes)
3 OSPF internal routes
4 RIP
5 OSPF external routes
6 Low-preference static (manually configured routes).

Route Redistribution

Route redistribution is the interaction of multiple routing protocols. OSPF and RIP can be operated concurrently in the P330. In this case, the P330 can be configured to redistribute routes learned from one protocol into the domain of the other routing protocol. Similarly, static routes may be redistributed to RIP and to OSPF. Route redistribution involves metric changes and sometimes causes routing loops in the presence of other routes with incompatible schemes for route redistribution and route preferences. Be careful!

The the P330 scheme for metric translation in route redistribution is as follows:

- Static to RIP metric configurable (default 1)
- OSPF internal metric N to RIP metric 1
- OSPF external type 1 metric N to RIP metric 1
- OSPF external type 2 metric N to RIP metric N+1
- Static to OSPF external type 2, metric configurable (default 1)
- RIP metric N to OSPF external type 2, metric N
- Direct to OSPF external type 2, metric 1.

By default, the P330 does not redistribute routes between OSPF and RIP. Redistribution from one protocol to the other can be configured. By default, static routes are not redistributed to RIP and OSPF. The P330 allows the user to globally enable redistribution of static routes to RIP, and separately, to globally enable redistribution of static routes to OSPF. In addition, the P330 lets the user configure, on a per static route basis, whether the route is to be redistributed to RIP and OSPF, and what metric (in the range of 1-15). The default state is to enable the route to be redistributed at metric 1. When static routes are redistributed to OSPF, they are always redistributed as external type 2.

Route Redistribution Commands

In order to...	Use the following command...
Redistribute routing information from other protocols	redistribute

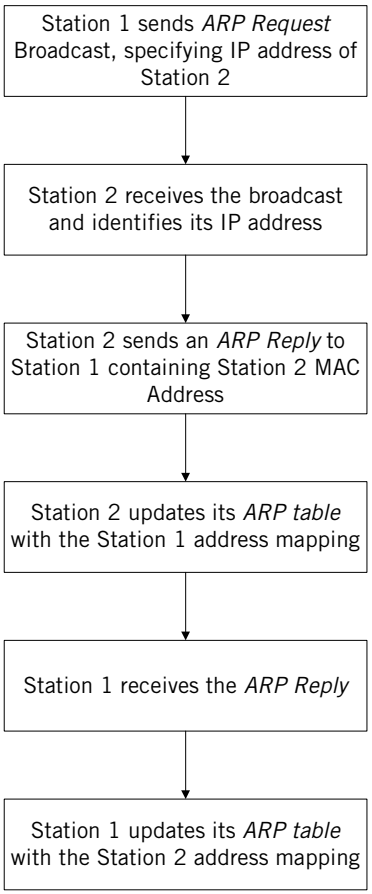
ARP (Address Resolution Protocol) Table Configuration

ARP Overview

IP logical network addresses are independent of physical addresses. Since the physical address must be used to convey data in the form of a frame from one device to another, a mechanism is required to acquire a destination device hardware address from its IP address. This mechanism/ability is called ARP (Address Resolution Protocol).

The following mechanism describes how a station builds an ARP Table:

Figure 12.2 Building an ARP Table



The ARP Table

The ARP table is used to store recently used pairs of IP/MAC addresses. This saves time and communication costs, since the host looks in the ARP cache first when transmitting a packet. If the information is not there, then the host sends an ARP Request (see Figure 12.2).

ARP CLI Commands

In order to...	Use the following command...
Add a permanent entry to the Address Resolution Protocol (ARP) cache	arp
Configure the amount of time that an entry remains in the ARP cache	arp timeout
Set the amount of time that an entry remains in the ARP cache back to default	no arp timeout
Set the maximum number of ARP cache entries allowed in the ARP cache	ip max-arp-entries
Set the maximum number of ARP cache back to default	no ip max-arp-entries
Enable proxy ARP on an interface	ip proxy-arp
Disable proxy ARP on an interface	no ip proxy-arp
Delete all dynamic entries from the ARP cache and the IP route cache	clear arp-cache
Display the Address Resolution Protocol (ARP) cache	show ip arp
Display the IP address of a host, based on a known MAC address	show ip reverse-arp

BOOTP/DHCP (Dynamic Host Configuration Protocol) Relay Configuration

BOOTP/DHCP Overview

BOOTP

Short for Bootstrap Protocol, BootP is an Internet protocol that enables a diskless workstation to discover its own IP address, the IP address of a BOOTP server on the network, and a file to be loaded into memory to boot the machine. This enables the workstation to boot without requiring a hard or floppy disk drive. It is used when the user/station location changes frequently.

The protocol is defined by RFC 951.

DHCP

Short for Dynamic Host Configuration Protocol, DHCP assigns dynamic IP addresses to devices on a network. With dynamic addressing, a device can have a different IP address every time it connects to the network. In some systems, the device's IP address can even change while it is still connected. DHCP also supports a mix of static and dynamic IP addresses.

Dynamic addressing simplifies network administration because the software keeps track of IP addresses rather than requiring an administrator to manage the task. This means that a new computer can be added to a network without the hassle of manually assigning it a unique IP address. Many ISPs use dynamic IP addressing for dial-up users. However, dynamic addressing may not be desirable for a network server.

DHCP/BOOTP Relay

The P330 supports the DHCP/BOOTP Relay Agent function. This is an application that accepts DHCP/BOOTP requests that are broadcast on one VLAN and sends them to a DHCP/BOOTP server that connects to another VLAN or a server that may be located across one or more routers that would otherwise not get the broadcast request. The relay agent handles the DHCP/BOOTP replies as well, transmitting them to the client directly or as broadcast, according to a flag in the reply message. Note that the same DHCP/BOOTP relay agent serves both the BOOTP and DHCP protocols.

When there is more than one IP interface on a VLAN, the P330 automatically chooses one of the IP interface’s to determine the relay network. Alternatively, you can configure the relay networks that the P330 will use. If you have defined more than one network, the P330 selects the network to be relayed on a Round Robin basis.

The DHCP/BOOTP server uses the relayed network information to decide from which subnet the address should be allocated. Therefore, the DHCP/BOOTP server must be configured to allocate addresses from the relayed networks configured on the P330.

DHCP/BOOTP Relay in P330 is configurable per VLAN and allows you to specify two DHCP/BOOTP servers. In this case, it duplicates each request, and sends it to both servers. This provides redundancy and prevents the failure of a single server from blocking hosts from loading.

You can enable or disable or DHCP/BOOTP Relay in P330.

BOOTP/DHCP CLI Commands

In order to...	Use the following command...
Enable or disable relaying of bootp and dhcp requests to the BOOTP/ DHCP server	[no] ip bootp-dhcp relay (no - restores default)
Add or remove a BOOTP/DHCP server to handle BOOTP/DHCP requests received by this interface	[no] ip bootp-dhcp server (no - restores default)
Select the networks from which the bootp/dhcp server shall allocate an address	[no] ip bootp-dhcp network (no - restores default)

NetBIOS Re-broadcast Configuration

NetBIOS Overview

Short for Network Basic Input Output System, an application programming interface (API) that augments the DOS BIOS by adding special functions for local-area networks (LANs). Almost all LANs for PCs are based on the NetBIOS. Some LAN manufacturers have even extended it, adding additional network capabilities.

The Avaya P330 can be configured to relay netbios UDP broadcast packets. This feature is used for applications such as WINS that use broadcast but may need to communicate with stations on other subnets or VLANs.

Configuration is performed on a per-interface basis. When a netbios broadcast packet arrives from an interface on which netbios rebroadcast is enabled, the packet is distributed to all other interfaces configured to rebroadcast netbios.

If the netbios packet is a net-directed broadcast (e.g., 149.49.255.255), the packet is relayed to all other interfaces on the list, and the IP destination of the packet is replaced by the appropriate interface broadcast address.

If the netbios broadcast packet is a limited broadcast (e.g., 255.255.255.255), it is relayed to all VLANs on which there are netbios-enabled interfaces. In that case, the destination IP address remains the limited broadcast address.

NetBIOS Re-broadcast Configuration CLI Commands

In order to...	Use the following command...
Set NetBIOS rebroadcasts mode on an interface	ip netbios-rebroadcast
Disable NetBIOS rebroadcasts mode on an interface	no ip netbios-rebroadcast

VRRP (Virtual Router Redundancy Protocol) Configuration

VRRP Overview

VRRP is an IETF protocol designed to support redundancy of routers on the LAN, as well as load balancing of traffic. VRRP is transparent to host stations, making it an ideal choice when redundancy, load balancing and ease of configuration are all required.

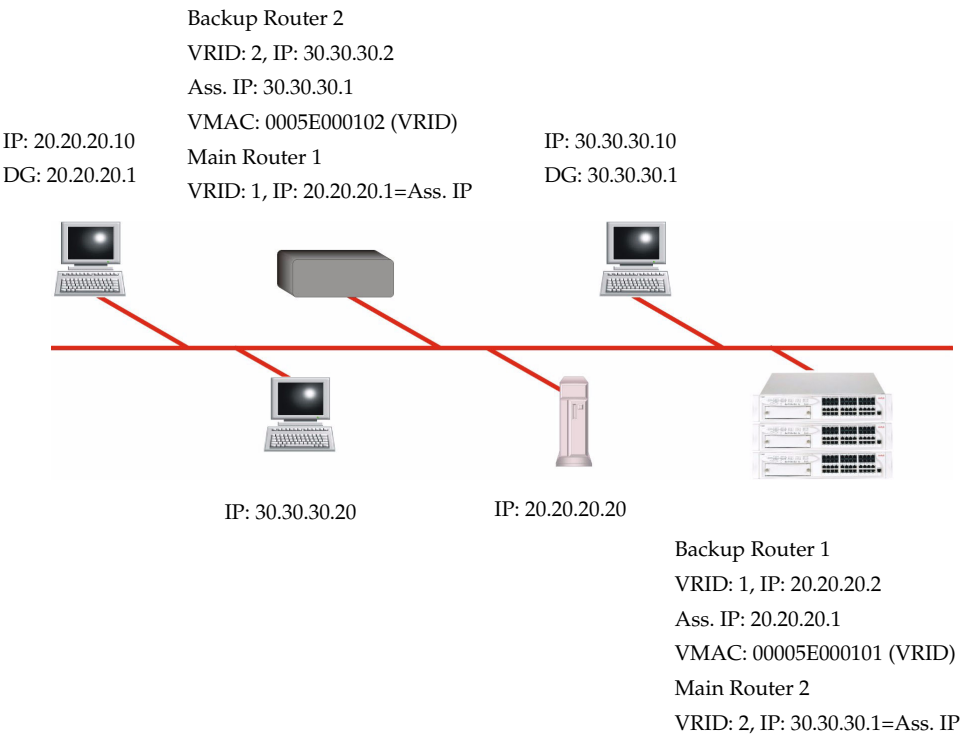
The concept underlying VRRP is that a router can backup other routers, in addition to performing its primary routing functions. This redundancy is achieved by introducing a virtual router. A virtual router is a routing entity associated with multiple physical routers. The routing functions of the virtual router are performed by one of the physical routers with which it is associated. This router is known as the master router. For each virtual router, VRRP selects a master router. If the selected master router fails, another router is selected as master router.

In VRRP, two or more physical routers can be associated with a virtual router, thus achieving extreme reliability. In a VRRP environment, host stations interact with the virtual router. They are not aware that this router is a virtual router, and they are not affected when a new router takes over the role of master router. This makes VRRP fully interoperable with every host station.

VRRP can be activated on an interface using a single command while allowing for the necessary fine-tuning of the many VRRP parameters. For a detailed description of VRRP, refer to VRRP standards and published literature.

VRRP Configuration Example 1

Figure 12.3 VRRP Configuration Example (Case 1, Case 2)



Case#1

One main router on IP subnet 20.20.20.0 (P333R/P330-ML or any third-party router which supports VRRP) and a redundant router (more backup routers may be configured)

- The P330 itself must have an interface on the IP subnet (e.g. 20.20.20.2)
- All the routers are configured under the same VRID (Virtual Router ID- e.g.1) This configuration must be done per VLAN).
- The P330 requires that this VRID must not be used in the network (even in different VLAN)
- By the end of the routers configuration, and when the network is up, the main router for each virtual router will be elected according to this order of preference:
  - The virtual router IP address is also the router's interface IP address
  - It has the highest priority (you can configure this parameter)
  - It has the highest IP address if the previous cases do not apply

- The virtual router IP address needs to be configured as Default Gateway on the stations
- The MAC which will be advertised by the Main router as a response to the stations ARP requests, will be a 6 bytes Virtual MAC address in the format 00.00.5E.00.01.VRID.
- In the meantime, the redundant router will use a VRRP polling protocol (not ping as in SRRP) to check the Main router integrity in one second intervals (default). Otherwise it will be idle.
- If the Main router fails, a redundant router that has not received a response from four consecutive polling requests (default) will take over and start to advertise the same Virtual MAC for the ARP requests. Therefore the stations will not 'sense' any change neither in the configured DG nor in the MAC level.
- VRRP has no provisions for routing data base synchronization among the redundant routers. You need to perform this manually.

Case #2

- One router is Main on one IP subnet (e.g. 20.20.20.0) and redundant on another (e.g. 30.30.30.0)
- In this case each IP subnet must be in different VRID (e.g. 1 & 2)
- The above detailed information is valid for each router in its Main/Redundant roles.

VRRP CLI Commands

In order to...	Use the following command...
Enable or disable VRRP routing globally	router vrrp
Create or delete a virtual router on the interface	ip vrrp
Assign or remove an IP address to the virtual router	ip vrrp address
Set the virtual router advertisement timer value (in seconds) for the virtual router ID	ip vrrp timer
Set the virtual router priority value used when selecting a master route	ip vrrp priority

In order to...	Use the following command...
Set or disable the virtual router simple password authentication for the virtual router ID.	Ip vrrp auth-key
Configure or disable the router to preempt a lower priority master for the virtual router ID	Ip vrrp preempt
Set the primary address that shall be used as the source address of VRRP packets for the virtual router ID	Ip vrrp primary
Accept or discard packets addressed to the IP address(es) associated with the virtual router, such as ICMP, SNMP, and TELNET (if it is not the IP address owner)	Ip vrrp override addr owner
Display VRRP information	show ip vrrp
Display full VRRP-related information	show ip vrrp detail

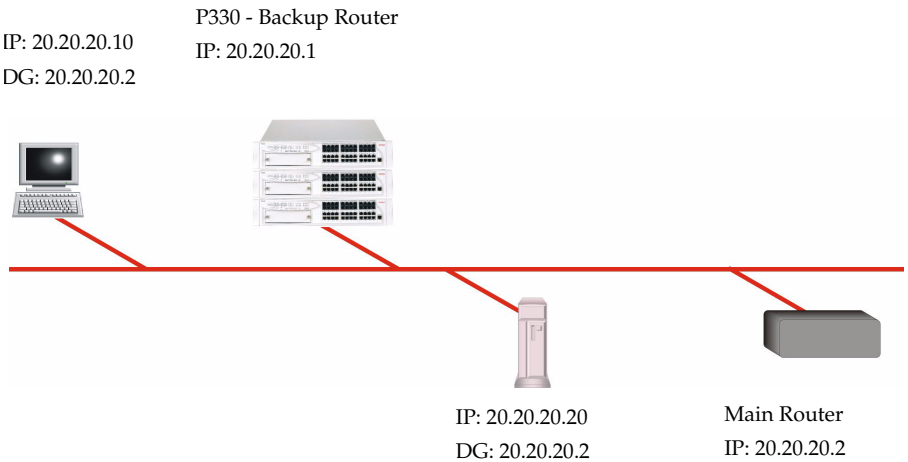
SRRP Configuration

SRRP Overview

Avaya P330 IP SRRP redundancy capabilities provide automatic backup Layer 3 switching for IP stations. P330 units can be configured to back each other up so that if one fails the other will take over its forwarding functions. The backup P330 is not idle. As long as both P330 units are functional, traffic is shared between them. The P330 can back up another P330 unit or any other router.

A P330 unit configured to back up another unit monitors the other's status by polling it at configured intervals, and automatically detects when the other fails and when it becomes functional again. When detecting a failure, the backup P330 sends a gratuitous ARP message that causes all stations to send their IP traffic to the backup P330 MAC address instead of the failed unit MAC address. As long as it is an active backup resulting from the failure of the main unit, the backup P330 answers ARP requests for the main unit, providing its own MAC address

SRRP Configuration Example



- The P330 in SRRP mode can backup any other router
- The integrity of the main router is checked via periodic ping polling (default period is 3 sec.)
- When the backup router doesn't receive ping response after pre-configured period (default 12 sec.), the backup sends an ARP request (broadcast) advertising the failed router IP address with its' own MAC, so all the stations will start to direct their packets to the new MAC.

- The main difference between the VRRP and SRRP is the capability of the first protocol to provide mutual redundancy among any number of routers supporting the protocol while the SRRP is one direction protocol

SRRP CLI Commands

In order to...	Use the following command...
Configure SRRP options, activate SRRP and enter the SRRP configuration mode	router srrp
Disable SRRP	no router srrp
Backup an additional interface of the main router using the SRRP application	ip srrp backup
Configure the polling interval in seconds used by SRRP	poll-interval
Set the polling interval used by SRRP back to default	no poll-interval
Configure the timeout after which SRRP declares the main router dead if it does not reply to polling	timeout
Set back to default the timeout after which SRRP declares the main router dead if it does not reply to polling	no timeout
Display the SRRP configuration and status	show ip srrp

Policy Configuration

Policy Configuration Overview

The P330 supports QoS (Quality of Service) by using multiple priority levels and IEEE 802.1p priority tagging to ensure that data and voice receive the necessary levels of service.

The Avaya P330 can enforce QoS policy on routed packets and change their 802.1p priority, according to the following criteria:

- The packet protocol
- Matching the packet's source or destination IP address to the configured priority policy.
- Whether the packet source or destination TCP/UDP port number falls within a pre-defined range.

In addition, the 802.1p priority of a packet can be modified according to the DSCP value in the IP header based on the DSCP-802.1p mapping configured by the user.

The P330 supports Access Control policy. Access Control rules define how the P330 should handle routed packets. There are three possible ways to handle such packets:

- Forward the packet (Permit operation)
- Discard the packet (Deny operation)
- Discard the packet and notify the management station (Deny and Notify)

The Avaya P330 can enforce Access Control policy on each routed packet, according to the following criteria:

- Matching the packet's source or destination IP address to the configured Access Control policy.
- Determine if the packet protocol and source or destination TCP/UDP port number falls within a pre-defined range.
- Using the ACK bit of the TCP header.

The P330 uses policy lists containing both Access Control rules and QoS rules. The policy lists are ordered by rule indexing.

The Avaya P330 access control rules are set-up using the Command Line Interface and Avaya EZ2Rule central policy management application under Avaya™ MSNM (MultiService Network Manager).

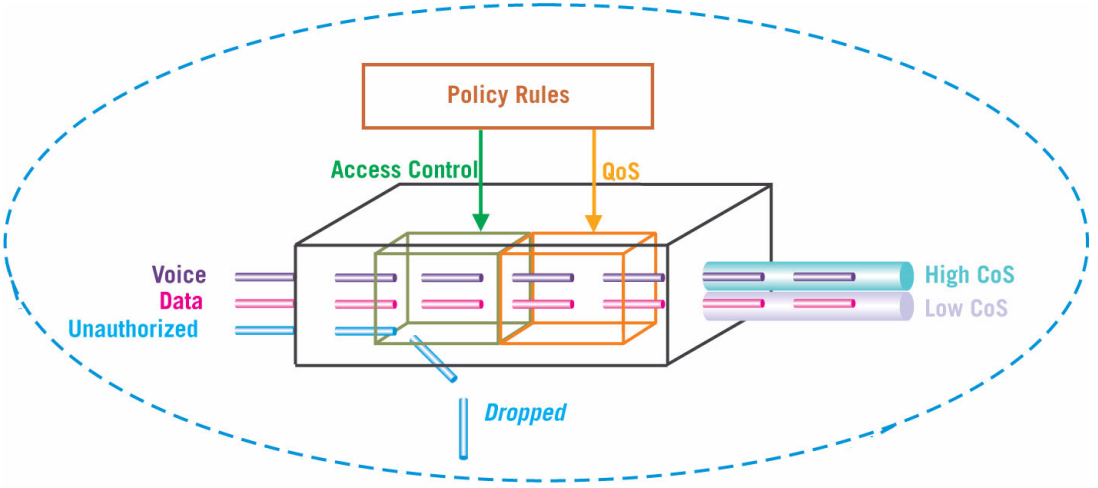
Policy Configuration CLI Commands

In order to...	Use the following command...
Set the default action for a given Policy List.	ip access-default-action
Create an access-list rule in a specific Access List.	ip access-list
Set the source list, destination list, and destination module for copying an entire Policy List	ip access-list-copy
Set the DSCP-to-COS mapping. Based on range and action parameters, system will apply mapping to frames	ip access-list-dscp operation
Designates which original frame fields influence internal queues selection	ip access-list-dscp trust
Assign a name to a Policy List	ip access-list-name
Add the name of an owner to a Policy List	ip access-list-owner
Delete an access-list element or a Policy List	no ip access-list
Activate a Policy List	ip access-group
Deactivate a Policy List	no ip access-group
Display the DSCP to CoS map of a policy-list	show ip access-list dscp
Set the list cookie for a specific policy list	ip access-list-cookie
Display an access list	show ip access-list
Activate the “simulate” process for a packet containing a specific field	ip simulate
Test the validity of a Policy List	validate-group

In order to...	Use the following command...
Display the active policy-list number	show ip access-group
Display the DSCP to CoS map of a policy-list	show ip access-list-dscp
Display summary information regarding all configured access lists	show ip-access-list-summary
Set the policy control source to either local or remote policy server	set qos policy source
Copy current policy and router configuration to the startup configuration file	copy running-config startup-config

Policy Configuration Example

Figure 12.4 Avaya P330 Policy



Policy Configuration Example

The following shows configuration of Access List 100:

1 Assigning priority 6 to all TCP traffic originating in network 149.49.0.0 – rule 1:

```
P330-1(super)# ip access-list 100 1 fwd6 tcp 149.49.0.0
0.0.255.255 any
done!
```

2 Assigning priority 3 to all TCP traffic going to the host 172.44.17.1 – rule 2:

```
P330-1(super)# ip access-list 100 2 fwd3 tcp any host
172.44.17.1
done!
```

3 Denying Telnet sessions originated by the host 192.168.5.33 – rule 3:

```
P330-1(super)# ip access-list 100 3 deny tcp host
192.168.5.33 any eq 23
done!
```

IP Fragmentation and Reassembly

IP Fragmentation and Reassembly Overview

The P330 supports IP Fragmentation and Reassembly. This feature allows the router to send and receive large IP packets where the underlying data link protocol constrains MTU (maximum transport unit).

IP fragmentation involves breaking a datagram into a number of pieces that can be reassembled later. The IP source, destination, identification, total length, and fragment offset fields, along with the "more" fragment and "don't" fragment flags in the IP header, are used for IP fragmentation and reassembly.

IP Fragmentation works as follows:

- IP packet is divided into fragments
- each fragment becomes its own IP packet
- each packet has same identifier, source, destination address
- fragments are usually not reassembled until final destination

IP Fragmentation/Reassembly CLI Commands

In order to...	Use the following command...
Clear the fragment database and restore its defaults	clear fragment
Set the maximum number of fragments that can comprise a single IP packet	fragment chain
Set the maximum number of fragmented IP packets, destined for the router, to reassemble at any given time	fragment size
Set the maximum number of seconds to reassemble a fragmented IP packet destined for the router.	fragment timeout
Display information regarding fragmented IP packets that are destined for the router	show fragment

Layer 3 Configuration File

The Configuration File feature allows the user to read the routing configuration parameters and save them to a file on the station. The routing configuration commands in the file are in CLI format. The user can edit the file (if required) and re-configure the router module by downloading the configuration file.

Although the file can be edited, it is recommended to keep changes to the file to a minimum. The recommended configuration method is using MSNM P330 Device Manager and/or the CLI. Changes to the configuration file should be limited to those required to customize a configuration file from one router to suit another.

Embedded Web Manager

This chapter describes the installation procedures for the Embedded Web Manager of the Avaya P330.

Overview

The Embedded Web Manager provides the following:

- Managing and monitoring Power over Ethernet.
- Device Configuration - Viewing and modifying the different device configurations.
- Virtual LANs - Viewing and editing Virtual LAN information.
- Link Aggregation Groups (LAGs) - Viewing and editing LAG information.
- Software Redundancy - Setting software redundancy for ports in an Avaya P330 Switch.
- Port Mirroring - Setting up port mirroring for ports in an Avaya P330 Switch.
- Trap Managers Configuration - Viewing and modifying the Trap Managers Table.
- Switch Connected Addresses - View devices connected to selected ports. Port Security.
- Intermodule Redundancy
  - — One pair per stack.
  - — Also operates as a result of a module fault, e.g., power failure.

System Requirements

Minimum hardware and Operating System requirements are:

- One of the following operating systems:
  - — Windows® 95
  - — Windows 98 SP1
  - — Windows 98 OSR (Second Edition)
  - — Windows ME
  - — Windows NT® 4 Workstation or Server
  - — Windows 2000 Professional or Server
- Pentium® II 400 Mhz-based computer with 256 Mb of RAM (512 Mb recommended)
- Minimum screen resolution of 1024 x 768 pixels
- Sun Microsystems Java™ plug-in version 1.3.1

- Microsoft® Internet Explorer® **or** Netscape Navigator/Communicator® (see table)

Table 13.1 Embedded Web Manager/Browser Compatability

	Windows 95 or NT	Windows 98, ME or 2000
Internet Explorer	5.0 or higher	5.01 or higher
Netscape Navigator/ Communicator	4.7	4.73

Note for users of Netscape Navigator: The Java plug-in requires certain services from **Windows 95** which are not present if **Internet Explorer** is not installed. In order to add these services to the operating system, please install Internet Explorer version 3 or higher. You can then use either browser to manage the switch.

Running the Embedded Web Manager

Note: You should assign an IP address to the switch before beginning this procedure.

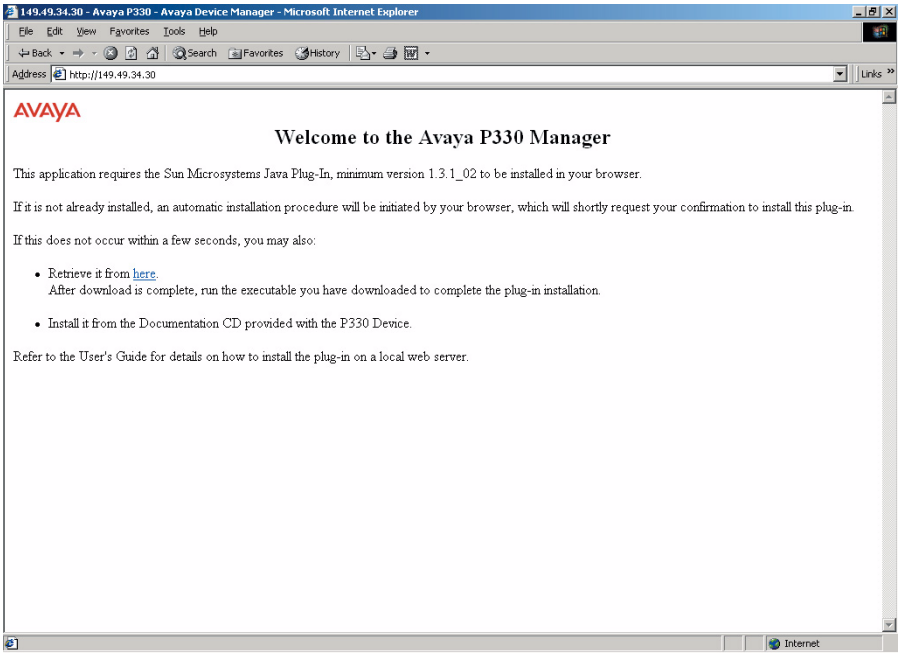
1 Open your browser.
2 Enter the url of the switch in the format **`http://aaa.bbb.ccc.ddd`** where ***`aaa.bbb.ccc.ddd`*** is the IP address of the switch.

Note: The user name is “root”
The default password for read-write access is “root”.

Note: The Web management passwords are the same as those of the CLI. If you have created additional CLI user names or changed the default passwords then you can use those passwords for Web management as well.

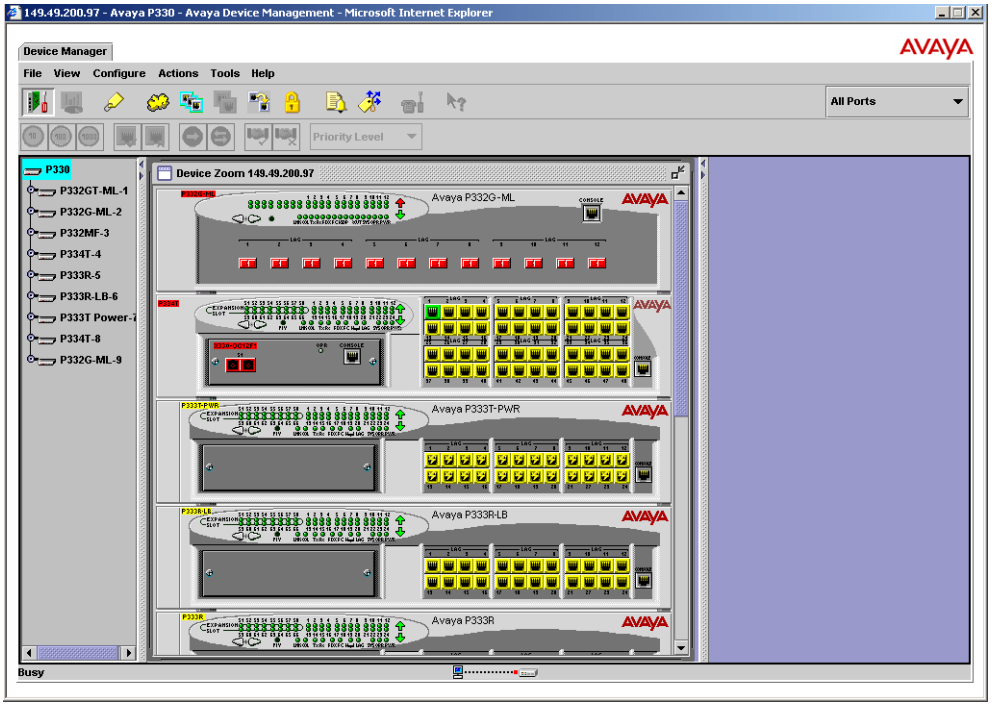
The welcome page is displayed:

Figure 13.1 The Welcome Page



— If you have the Java plug-in installed, the Web-based manager should open in a new window (see Figure 13.2).

Figure 13.2 Web-based Manager



— If you do **not** have the Java plug-in installed, follow the instructions on the Welcome page that offers a variety of options to install the plug-in (see Figure 13.1).

Installing the Java Plug-in

If the network manager has configured the system, the plug-in should be installed automatically.

Note: Ensure that Java or JavaScript is enabled on your Web browser. Please refer to your browser on-line help or documentation for further information.

If the plug-in is not installed automatically, then you have three options for installing it manually:

Installing from the Avaya P330 Documentation and Utilities CD

1 Close all unnecessary applications on your PC.
2 Insert the "Avaya P330 Documentation and Utilities" CD into the CD drive.
3 Click **Start** on the task bar.
4 Select Run.
5 Type ***x:*****\emweb-aux-files\plug-in_1_3_1.exe** where ***x:*** is the CD drive letter.
6 Follow the instructions on screen.

Install from the Avaya Site

Click on the link in the Welcome page.

Install from your Local Web Site

Click on the link in the Welcome page.

Note: This option is only available if the network manager has placed the files on the local Web server.

Installing the On-Line Help and Java Plug-In on your Web Site

Note: This procedure is optional.

Copying the help files and Java plug-in to a local Web server allows users to access the on-line help for the Embedded Manager and enables automatic installation of the Java plug-in the first time the users tries to manage the device.

1 Copy the `emweb-aux-files` directory from the "Avaya P330 Documentation and Utilities" CD to your local Web server. Please refer to your Web server documentation for full instructions.

2 Define the URL in the Avaya P330 using the following CLI command:
`set web aux-files-url` ***`//IP address/directory name`***
where ***`//IP address/directory name`*** is the location of the directory from the previous step.
Refer to Chapter 6 for further details of the command.

AVAYA P332GT-ML

SECTION 4: TROUBLESHOOTING AND MAINTAINING THE P330

Troubleshooting the Installation

Troubleshooting the Installation

This section will allow you to perform basic troubleshooting of the installation. If you are unable to solve the problem after following the procedures in this chapter, please contact Avaya Technical Support. Refer to "How to Contact Us"for full details.

Table 14.1 Troubleshooting

Problem/Cause	Suggested Solution
Switch does not power up	
• AC power cord not inserted or faulty	• Check that the AC power cord is inserted correctly • Replace the power cord
If the cord is inserted correctly, check that the AC power source is working by connecting a different device in place of the P3330. • If that device works, refer to the next step. • If that device does not work, check the AC power	
• P3330 AC power supply not functioning	• Use an optional BUPS (Backup Power Supply) • Contact your local Avaya distributor. *The power supply is not user-replaceable.*
Stacking not functioning	
• X330-STK modules not inserted correctly (LEDs on stacking module do not light)	• Check that modules are installed correctly
• Octaplane™ cables not installed correctly (LEDs on stacking module do not light)	• Check that the cables are inserted correctly • Check that there are no cross-corrections

Maintenance

Introduction

This section provides basic maintenance information for the Avaya P330 switch and its components. For issues that are not covered in this chapter or in "Troubleshooting the Installation," please contact your Avaya representative.

Caution: Please refer to "Before You Install the P330" before undertaking any of the procedures detailed in this section.

Replacing the Stacking Sub-module

To replace the X330STK-ML stacking sub-module:

1 Power to the switch may remain on.

2 Loosen the screws to the stacking sub-module by turning the knobs.

3 Take hold of the two knobs (one near each side of the front panel) and pull gently but firmly towards yourself.

4 Insert the new stacking sub-module gently into the slot, ensuring that the metal base plate is aligned with the guide rails.
The metal plate—*not* the PCB of the X330STK-ML— fits onto the guide rails.

5 Press the sub-module in firmly until it is completely inserted into the Avaya P330.

Caution: Ensure that the screws on the module are properly aligned with the holes in the chassis before tightening them.

6 Gently tighten the two screws on the side panel of the stacking module by turning the screws. **Do not use excessive force when tightening the screws.**

Updating the Software

This section provides the basic procedure for downloading and updating the P330 system software.

Caution: Please refer to "Before You Install the P330" before undertaking any of the procedures detailed in this section.

Software Download

You can perform software download using the CLI or Avaya UpdateMaster (part of the Avaya Multi-Service Network Manager Suite).

Obtain Software Online

You can download the firmware and Embedded Web Manager from the “Software Download” section at www.avaya.com/support.

Downloading Software

Download the firmware and Embedded Web Manager as follows:

Use the command in the Avaya P330 CLI:

`copy tftp SW_image <image-file> EW_archive <filename> <ip> <mod_num>`

image-file	firmware image file name (full path)
filename	Embedded Web Manager image file name (full path)
ip	The IP address of the TFTP server
mod_num	Target module number

Please see the CLI Chapters of the User’s Guides for related information.

Note: Please download both the new Avaya firmware and the new Embedded Web Manager versions. Whichever version of the firmware you decide to run, always be sure to match the correct firmware and Embedded Web Manager versions.

Download New Version without Overwriting Existing Version

Sometimes it is desirable to upgrade to a new software version while retaining the option of booting from the previous version. The following process copies the previous version from memory Bank B to Bank A, and download the new version to Bank B. This process accomplishes the following:

- prevents the embedded web image-file from being downloaded into Bank A - by providing a non-existant file name for the Embedded Web image file.
- preserves the old version in Bank A
- allows the user to boot from either Bank A or Bank B (i.e., using either the old or new software version)

Note: In normal operation, the Embedded Web file should be copied to Bank A, and the new software version should be downloaded to Bank B. This process copies the old software version to Bank A and the new software version to Bank B, and allows the user to boot from either version via the `set boot bank` command.

To perform this process:

copy tftp SW_image <new_ver_file> EW_image <dummy_file_name> <TFTP_server_IP_addr> <module_number>

Example:

copy tftp SW_image c:\versions\p330\p333t EW_image x 149.49.138.170 1

Note: Since file "x" doesn't exist the Embedded web image will not be downloaded.

How to Contact Us

To contact Avaya's technical support, please call:

In the United States

Dial 1-800-237-0016, press 0, then press 73300.In the EMEA (Europe, Middle East and Africa) Region

Country	Local Dial-In Number
Albania	+31 70 414 8001
Austria	+43 1 36 0277 1000
Azerbaijan	+31 70 414 8047
Bahrain	+800 610
Belgium	+32 2 626 8420
Belorussia	+31 70 414 8047
Bosnia Herzegovina	+31 70 414 8042
Bulgaria	+31 70 414 8004
Croatia	+31 70 414 8039
Cyprus	+31 70 414 8005
Czech Rep.	+31 70 414 8006
Denmark	+45 8233 2807
Egypt	+31 70 414 8008
Estonia	+372 6604736
Estonia	+372 6604736
Latvia	+371 721 4368

Country	Local Dial-In Number
Finland	+358 981 710 081
France	+33 1 4993 9009
Germany	+49 69 95307 680
Ghana	+31 70 414 8044
Gibraltar	+31 70 414 8013
Greece	+00800 3122 1288
Hungary	+06800 13839
Iceland	+0800 8125
Ireland	+353 160 58 479
Israel	+1 800 93 00 900
Italy	+39 02 7541 9636
Jordan	+31 70 414 8045
Kazakhstan	+31 70 414 8020
Kenya	+31 70 414 8049
Kuwait	+31 70 414 8052
Saudi Arabia	+31 70 414 8022

Country	Local Dial-In Number
Lebanon	+31 70 414 8053
Lithuania	+370 2 756 800
Luxemburg	+352 29 6969 5624
Macedonia	+31 70 414 8041
Malta	+31 70 414 8022
Mauritius	+31 70 414 8054
Morocco	+31 70 414 8055
Netherlands	+31 70 414 8023
Nigeria	+31 70 414 8056
Norway	+47 235 001 00
Oman	+31 70 414 8057
Pakistan	+31 70 414 8058
Poland	+0800 311 1273
Portugal	+351 21 318 0047
Qatar	+31 70 414 8059
Romania	+31 70 414 8027
Russia	+7 095 733 9055

Country	Local Dial-In Number
Slovakia	+31 70 414 8066
Slovenia	+31 70 414 8040
South Africa	+0800 995 059
Spain	+34 91 375 3023
Sweden	+46 851 992 080
Switzerland	+41 22 827 8741
Tanzania	+31 70 414 8060
Tunisia	+31 70 414 8069
Turkey	+800 4491 3919
UAE	+31 70 414 8036
Uganda	+31 70 414 8061
UK	+44 0207 5195000
Ukraine	+31 70 414 8035
Uzbekistan	+31 70 414 8046
Yemen	+31 70 414 8062
Yugoslavia	+31 70 414 8038
Zimbabwe	+31 70 414 8063

E-mail: csctechnical@avaya.com

In the AP (Asia Pacific) Region

Country	Local Dial-In Number
Australia	+1800 255 233
Hong Kong	+2506 5451
Indonesia	+800 1 255 227
Japan	+0 120 766 227
Korea	+0 80 766 2580

Country	Local Dial-In Number
Malaysia	+1800 880 227
New Zealand	+00 800 9828 9828
Philippines	+1800 1888 7798
Singapore	+1800 872 8717
Taiwan	+0 80 025 227

E-mail: sgcoe@avaya.com

In the CALA (Caribbean and Latin America) Region

E-mail: caladatasupp@avaya.com

Hot Line:+1 720 4449 998

Fax:+1 720 444 9103

For updated information, visit www.avaya.com/support and click “Global Support Organization (GSO)”.