Product Overview

This chapter describes the Catalyst 5000 family supervisor engines: Supervisor Engines I, II, II G, III, and III G.

This chapter contains these sections:

Supervisor Engine Features

The following sections describe the Catalyst 5000 family supervisor engine models:

Supervisor Engine I and II

Supervisor Engines I and II have the following features:

- Bridge address table for up to 16,000 active Media Access Control (MAC) addresses and associated VLANs allocated dynamically between active ports
- Switching engine that provides data path and control for all network interfaces including two integrated Fast Ethernet interfaces that can support redundancy using the spanning tree algorithm or load sharing when used with VLANs
- Fast Ethernet interfaces using RJ-45 media-dependent interface crossed-over (MDIX) and media-independent interface (MII) connectors, Fast Ethernet multimode fiber (MMF), or single-mode fiber (SMF) interfaces using SC connectors
- Management functions that include monitoring the interface and environmental status and providing Simple Network Management Protocol (SNMP) management and the console/Telnet interface
- 25-MHz Motorola MC68EC040 Network Management Processor (NMP)
- Switch fabric interface with a capability of over one million packets per second (pps)
- Hardware support for up to 1024 VLANs

The following features are available on Supervisor Engine II only:

- Redundant supervisor engines and clock modules
- Modular feature card for core-switching logic

Supervisor Engines I and II are available in the following three models:

- 100BASE-TX dual Fast Ethernet RJ-45 MDIX and 40-pin MII connector interfaces (see Figure 1-1)
- 100BASE-FX dual Fast Ethernet multimode fiber-optic (MMF) SC connector interfaces (see Figure 1-2)
- 100BASE-FX dual Fast Ethernet single-mode fiber-optic (SMF) SC connector interfaces (see Figure 1-3)

Figure 1-1 Supervisor Engines I and II 10/100BASE-TX

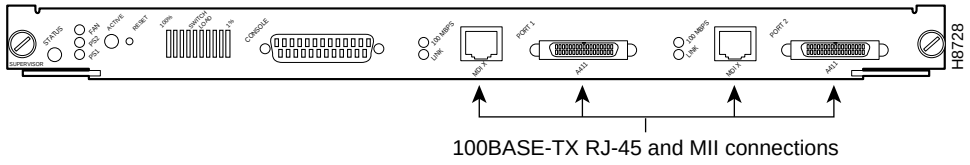


Figure 1-2 Supervisor Engines I and II 100BASE-FX MMF

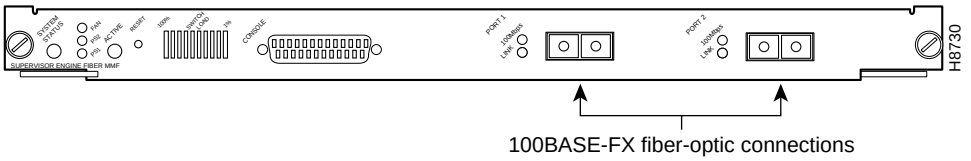
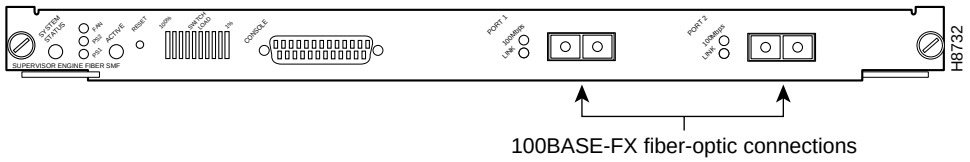


Figure 1-3 Supervisor Engines I and II 100BASE-FX SMF

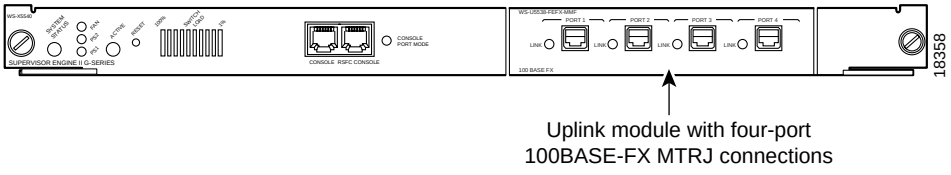


Supervisor Engine II G

Supervisor Engine II G (see Figure 1-4) has the following features:

- Bridge address table for up to 16,000 active MAC addresses and associated VLANs allocated dynamically between active ports
- Switching engine that provides data path and control for all network interfaces including two integrated Fast Ethernet interfaces that can support redundancy using the spanning tree algorithm or load sharing when used with VLANs
- Management functions that include monitoring the interface and environmental status and providing SNMP management and the console/Telnet interface
- Redundant supervisor engines and clock modules
- Onboard NetFlow Feature Card II (NFFC II) chipset
- Optional Route Switch Feature Card (RSFC)
- Modular uplink ports (See the “Supervisor Engine Uplink Modules” section on page 1-7 for more information.)

Figure 1-4 Supervisor Engine II G with Uplink Module Installed



Supervisor Engine III

Supervisor Engine III (see Figure 1-5) has the following features:

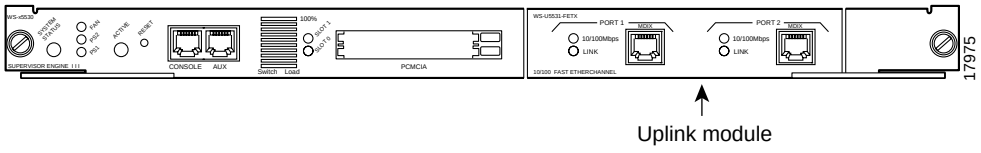
- Bridge address table for up to 16,000 active MAC addresses and associated VLANs allocated dynamically between active ports
- Modular uplink ports (See the "Supervisor Engine Uplink Modules" section on page 1-7 for more information.)
- Management functions that include monitoring the interface and environmental status and providing SNMP management and the console/Telnet interface
- Redundant supervisor engines and clock modules
- Modular NFFC or NFFC II for core-switching logic
- 150-MHz IDT R4700 Reduced Instruction Set Computer (RISC) processor
- All three switching buses can run simultaneously and independently of each other, providing 3.6-Gbps throughput when traffic does not have to cross bus segments
- Hardware support for up to 1024 VLANs
- Two Flash PC card slots for memory or to serve as I/O devices

The Supervisor Engine III is available in the following models, which can be configured with any of the available uplink modules:

- Supervisor Engine III with Enhanced Address Recognition Logic (EARL) 1+
- Supervisor Engine III with the NFFC
- Supervisor Engine III with the NFFC II

Supervisor Engine III with modular uplink ports is shown in Figure 1-5. See the "Supervisor Engine Uplink Modules" section on page 1-7 for uplink module descriptions.

Figure 1-5 Supervisor Engine III with Uplink Module Installed

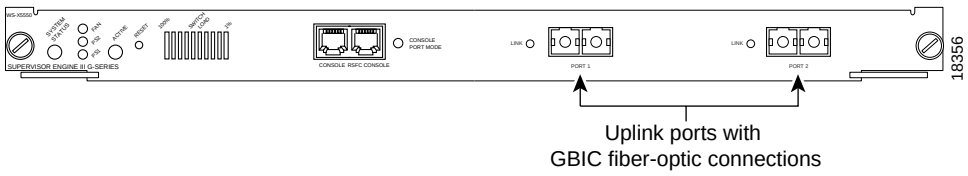


Supervisor Engine III G

Supervisor Engine III G (see Figure 1-6) has the following features:

- Bridge address table for up to 16,000 active MAC addresses and associated VLANs allocated dynamically between active ports
- Switching engine that provides data path and control for all network interfaces including two integrated Fast Ethernet interfaces that can support redundancy using the spanning tree algorithm or load sharing when used with VLANs
- Gigabit Interface Converter (GBIC)-based uplink ports for use with multimode fiber (MMF) or single-mode fiber (SMF) interfaces using SC connectors
- Management functions that include monitoring the interface and environmental status and providing SNMP management and the console/Telnet interface
- Redundant supervisor engines and clock modules
- MCF5102 processor
- All three switching buses can run simultaneously and independently of each other, providing 3.6-Gbps throughput when traffic does not have to cross bus segments
- Hardware support for up to 1024 VLANs
- Onboard NFFC II chipset
- Optional RSFC

Figure 1-6 Supervisor Engine III G



Supervisor Engine Uplink Modules

The supervisor engine uplink modules support multiple media types including Ethernet, Fast Ethernet, and Gigabit Ethernet using a variety of connector types.

Table 1-1 lists the uplink modules that are available for Supervisor Engine III including the product numbers and descriptions. Table 1-2 lists the available uplink modules for Supervisor Engines II G and III including the product numbers and descriptions.

Table 1-1 Uplink Modules for Supervisor Engine III Only

Product Number	Description
WS-U5531-FETX	Dual-port 10/100BASE-TX with RJ-45 MDIX interfaces
WS-U5533-FEFX-MMF	Dual-port 100BASE-FX MMF
WS-U5535-FEFX-SMF	Dual-port 100BASE-FX SMF

Table 1-2 Uplink Modules for Supervisor Engine II G and III

Product Number	Description
WS-U5537-FETX	Four-port 10/100BASE-TX with RJ-45 MDIX interfaces
WS-U5538-FEFX-MMF	Four-port 100BASE-FX Fast EtherChannel MMF
WS-U5534-GESX	Dual-port 1000BASE-SX MMF
WS-U5536-GELX	Dual-port 1000BASE-LX/LH MMF or SMF

Figure 1-7 through Figure 1-13 show the uplink module faceplates of the uplink modules described in Table 1-1 and Table 1-2.

Figure 1-7 Dual-port 10/100BASE-TX Uplink Module Faceplate

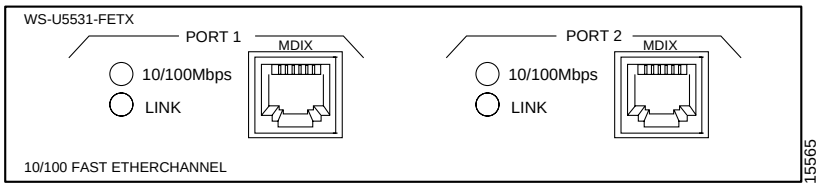


Figure 1-8 Dual-port 100BASE-FX MMF Uplink Module Faceplate

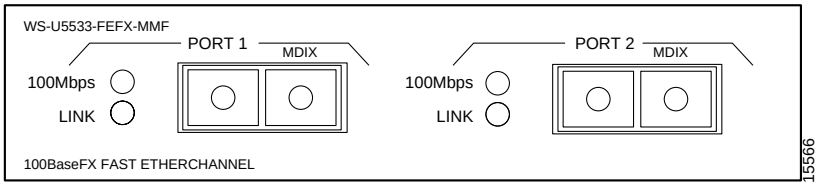


Figure 1-9 Dual-port 100BASE-FX SMF Uplink Module Faceplate

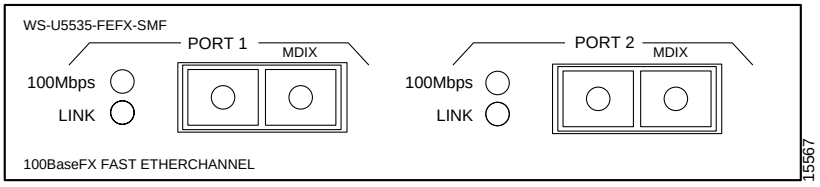


Figure 1-10 Four-port 10/100BASE-TX Uplink Module Faceplate

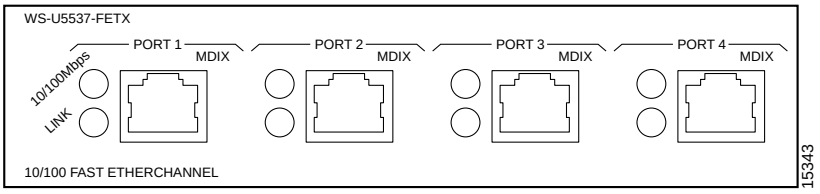


Figure 1-11 Four-port 100BASE-FX Uplink Module Faceplate

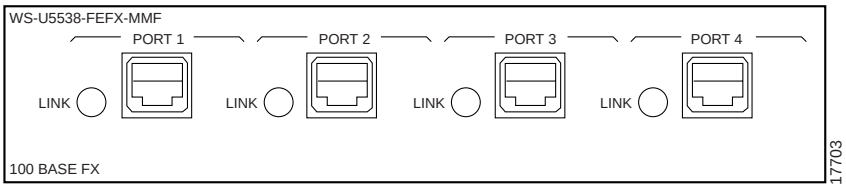


Figure 1-12 Dual-port 1000BASE-SX Uplink Module Faceplate

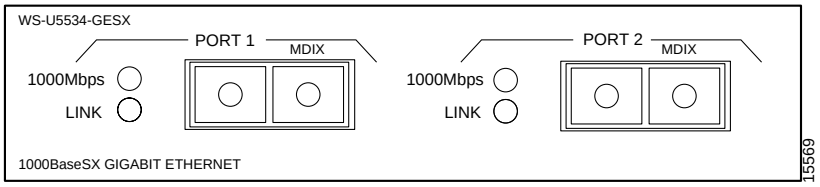
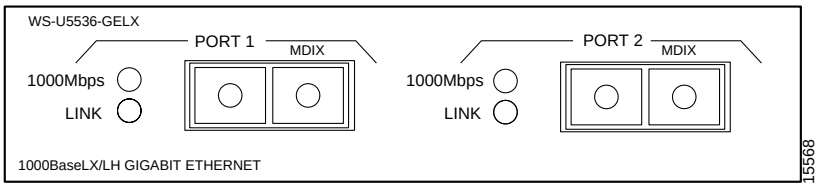


Figure 1-13 Dual-port 1000BASE-LX/LH Uplink Module Faceplate



Front Panel Features

This section describes the front panels on the supervisor engine modules. See Figure 1-14 for Supervisor Engine I and II features, Figure 1-15 for Supervisor Engine III features, Figure 1-16 for Supervisor Engine II G features, and Figure 1-17 for Supervisor Engine III G features.

Figure 1-14 Supervisor Engines I and II Front Panel

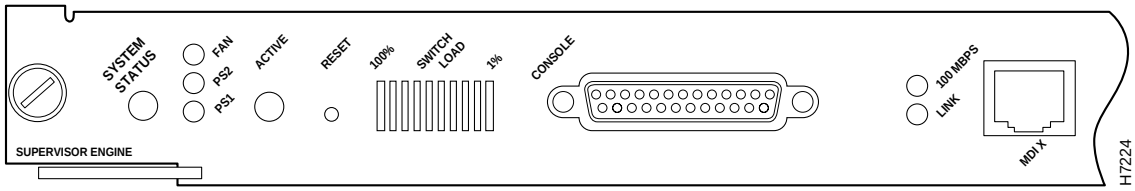


Figure 1-15 Supervisor Engine III Front Panel

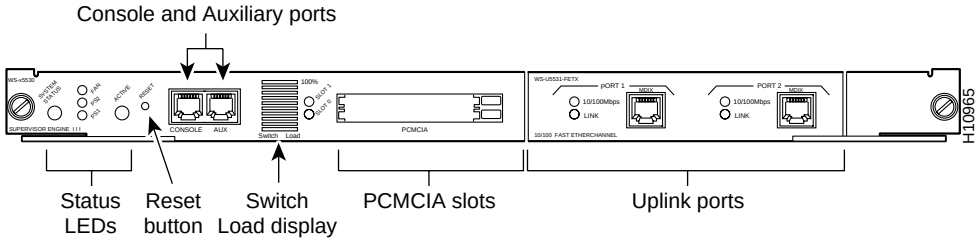


Figure 1-16 Supervisor Engine II G Front Panel

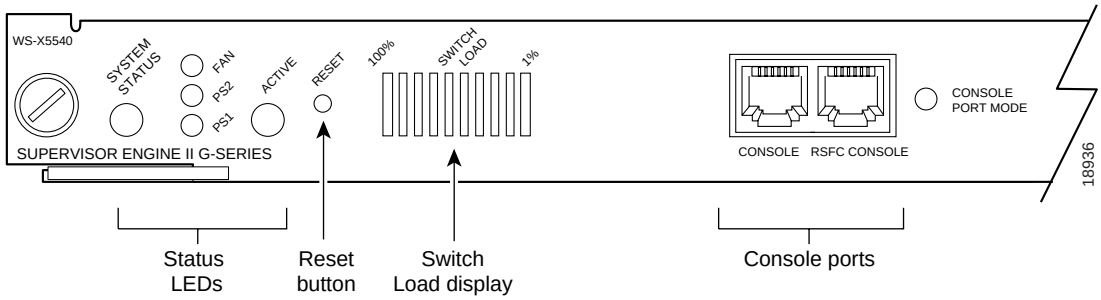
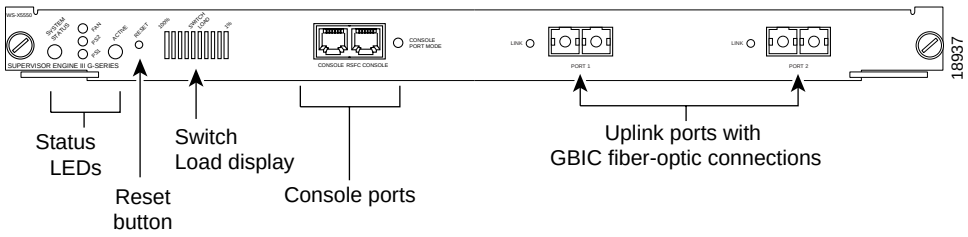


Figure 1-17 Supervisor Engine III G Front Panel



LEDs

The LEDs on the supervisor engine front panels indicate the status of the system, which includes the supervisor engine, the power supplies, and the fan assembly. Table 1-3 describes LED operation.

Table 1-3 Supervisor Engine and Uplink Module LED Descriptions

LED	State	Description
SYSTEM STATUS		Indicates the results of a series of self-tests and diagnostic tests.
	Green	All the tests pass.
	Red	Any test fails.
	Red	During system boot or if the module is disabled.
	Orange	The redundant power supply is installed but not turned on or receiving input.
	Orange	The fan module fails.
FAN		Indicates whether or not the fan is operational.
	Green	The fan is operational.
	Red	The fan is not operational.

Table 1-3 Supervisor Engine and Uplink Module LED Descriptions (continued)

LED	State	Description
PS1		Indicates whether or not the power supply in the left bay is operational.
	Catalyst 5000 switch and Catalyst 5500 series switches:	
	Green	The power supply in the left bay is operational.
	Red	The power supply in the left bay is not operational, switched off, or not receiving input power.
		Note The Catalyst 5500 power supply LED is red when no modules are installed.
	Off	The power supply in the left bay is off or not installed.
	Catalyst 5002 switch:	
	Green	The power supply associated with the PS1 AC receptacle or DC terminal block is operational.
	Red	The power supply associated with the PS1 AC receptacle or DC terminal block is not receiving input power.
PS2		Indicates whether or not the power supply in the right bay is operational.
	Catalyst 5000 switch and Catalyst 5500 series switches:	
	Green	The power supply in the right bay is operational.
	Red	The power supply in the right bay is not operational, switched off, or not receiving input power.
		Note The Catalyst 5500 power supply LED is red when no modules are installed.
	Off	The power supply in the right bay is off or not installed.

Table 1-3 Supervisor Engine and Uplink Module LED Descriptions (continued)

LED	State	Description
	Catalyst 5002 switch:	
	Green	The power supply associated with the PS2 AC receptacle or DC terminal block is operational.
	Red	The power supply associated with the PS2 AC receptacle or DC terminal block is not receiving input power.
SWITCH LOAD	1–100%	If the switch is operational, the switch load display indicates (as an approximate percentage) the current traffic load over the backplane (see Figure 1-18).
ACTIVE	Green	The supervisor engine is operational and active.
	Orange	The supervisor engine module is in standby mode.
SLOT 1 and SLOT 0		Supervisor Engine III only: The Flash PC card SLOT 1 and SLOT 0 LEDs light when their respective slot 1 and slot 0 Flash PC card devices are accessed by the switch.
100 Mbps	Green	The port is operating at 100 Mbps.
1000 Mbps	Green	The port is operating at 1000 Mbps.
LINK	Green	The port is operational.
	Orange	The link has been disabled by software.
	Flashing orange	The link is bad and has been disabled due to a hardware failure.
	Off	No signal is detected.

Reset Button

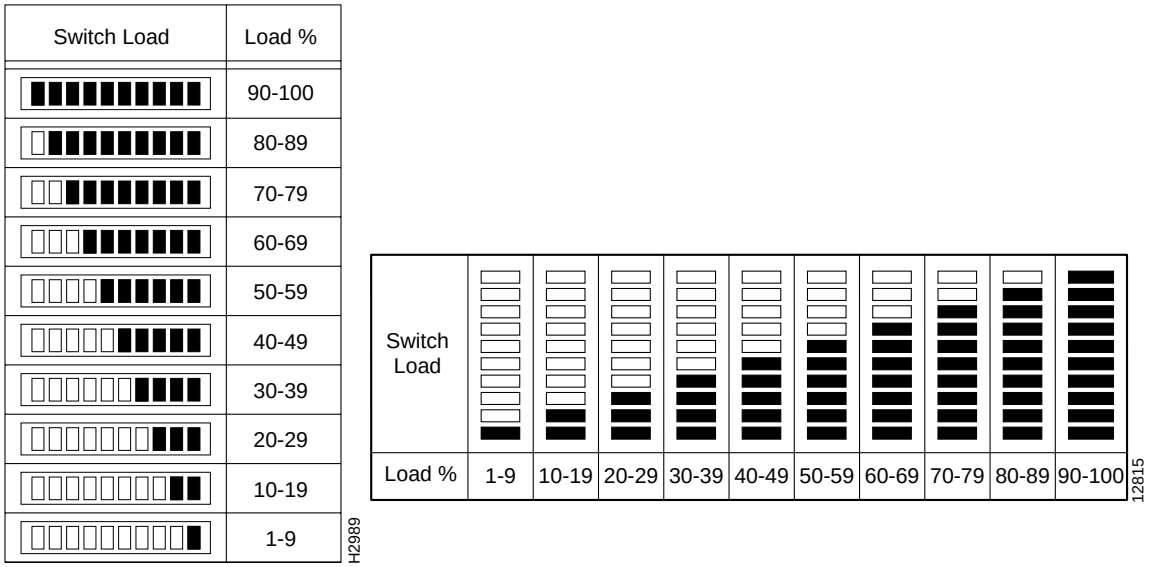
The Reset button allows you to restart the switch.

Note Use a small, pointed object to access the Reset button.

Switch Load Display

The Switch Load display (see Figure 1-18) provides you with an approximation of the current traffic load across the backplane. The Supervisor Engine III Switch Load display has a vertical orientation but functions the same as the Switch Load display in Supervisor Engines I, II, II G, and III G. The Supervisor Engine Switch Load display indicates the current aggregate traffic load across all buses.

Figure 1-18 Switch Load Display



Supervisor Engines I, II, II G, and III G

Supervisor Engine III

Console Port

The console port allows you to perform the following functions:

- Configure the switch from the command-line interface (CLI)
- Monitor network statistics and errors
- Configure SNMP agent parameters
- Download software updates to the switch or distribute software images residing in Flash memory to attached devices

Supervisor Engines I and II Console Port

The console port is a data communications equipment (DCE) DB-25 receptacle, which supports a DCE EIA/TIA-232 interface.

Note EIA/TIA-232 was known as recommended standard RS-232 before its acceptance as a standard by the Electronic Industries Association (EIA) and Telecommunications Industry Association (TIA).

Supervisor Engines III Console and AUX Port

Note The auxiliary (AUX) port is currently not supported.

The console port is an EIA/TIA-232 asynchronous, serial, full-featured data terminal equipment (DTE) connection with hardware flow control and an RJ-45 connector. A console port accessory kit with the necessary cabling and adapters is provided for making your terminal connection.

For detailed information on using this port, see the "Connecting a Terminal to the Console Port" section on page 3-16.

Supervisor Engines II G and III G RSFC Console Port

Note The RSFC is an optional feature of the Supervisor Engine II G and Supervisor Engine III G.

The RSFC console port is an EIA/TIA-232 asynchronous, serial, full-featured data terminal equipment (DTE) connection with hardware flow control and an RJ-45 connector. A console port accessory kit with the necessary cabling and adapters is provided for making your terminal connection.

The RSFC console port allows you to configure your Catalyst 5000 family RSFC (if present) for multiprotocol routing using IOS software.

To install the RSFC, see the "Installing the RSFC" section on page 3-12. To configure the RSFC, refer to the *Layer 3 Services Software Configuration Guide* for your switch.

Console Port Mode Switch (Supervisor Engines II G and III G Only)

The console port mode switch allows you to connect a terminal to the supervisor engine using a Catalyst 5000 family Supervisor Engine III console cable.

Note The cable and adapters shipped with the switch are the same ones used on the Cisco 2500 series routers (and other Cisco products).

You also can connect a modem to the console port using the cable and adapter provided with the switch.

Use the console port mode switch as follows:

- Mode 1—Switch in the *in* position. Use this mode to connect a terminal to the console port using the console cable and data terminal equipment (DTE) adapter (labeled "Terminal") that shipped with the switch.

  You can also use this mode to connect a modem to the console port using the console cable and data communications equipment (DCE) adapter (labeled "Modem") that shipped with the switch.

- Mode 2—Switch in the *out* position. Use this mode to connect a terminal to the console port using the Supervisor Engine III console cable (not provided).

For more information on using the console port, see the "Connecting a Terminal to the Console Port" section on page 3-16.

Flash PC Card Slots (Supervisor Engine III Only)

The Flash PC card slots are for additional system Flash memory. You can use Flash memory to store and run IOS images or to serve as an I/O device.

For detailed information on using the Flash PC cards, see the "Installing Flash PC Cards (Supervisor Engine III)" section on page 3-14. For detailed information on configuring the supervisor engine to boot from Flash memory, refer to the *Software Configuration Guide* for your switch.

Fast Ethernet Ports

Supervisor engine Fast Ethernet ports operate in full- or half-duplex mode. The connector and physical media type depends on the supervisor engine model. These connector and cable types are available:

- RJ-45 MDIX and 40-pin MII connectors with 100BASE-TX Category 5 UTP cabling
- MT-RJ connectors with 100BASE-FX MMF cabling
- Fast Ethernet MMF or SMF interfaces, using SC connectors with multimode or single-mode fiber-optic cabling

Gigabit Ethernet Ports

The Gigabit Ethernet ports operate in full-duplex mode only. These ports support the 1000BASE-SX MMF and 1000BASE-LX/LH MMF and SMF interfaces, using SC connectors with multimode fiber-optic cabling.

Supervisor Engine III G has Gigabit Ethernet ports that you can configure with GBICs. See the "Connecting Gigabit Ethernet Modules" section on page 3-23 for more information.

For detailed information on using these ports, see the "Connecting 100BASE-FX, 1000BASE-SX, and 1000BASE-LX/LH (Single-Mode or Multimode Fiber-Optic) Connectors" section on page 3-21.

General Switch Architecture

The Catalyst 5000 family switch architecture is based on high-speed switching network principles, using a queuing model for input. Each switch port maintains its own frame buffer memory. Each frame is stored in a frame buffer before it is forwarded to the next port.

Bus arbitration and hardware-based switching are shared among all ports. These features control the destination of packet transfers and access to the data switching bus. The switch uses central bus arbitration and address recognition logic for all modules. Multiple copies are not required for high-speed broadcast and multicast frame forwarding because all ports simultaneously receive the same copy of the frame when it is sent on the backplane.

The Catalyst 5500 series switches feature a 3.6-Gbps backplane; the Catalyst 5000 switch and Catalyst 5002 switch feature a 1.2-Gbps backplane. The Catalyst 5000 family media-independent backplanes support a three-level priority-request scheme. Two priorities are user-selected, and the third is backplane-based.

Buses allow each port to perform a local flush and maintain a packet retry mechanism for outbound port congestion.

Hardware-Based Switching

Hardware-based switching learns source MAC addresses and VLAN and port information automatically, saves them in a RAM address table, and uses these learned entries to forward packets to their destination addresses.

Core Switching and Layer 3 Switching

Supervisor Engine III is available with the NFFC or NFFC II daughter cards, which accommodate all the core-switching logic and allow you to perform Multilayer Switching (MLS) and other Layer 3 functions.

Supervisor Engine II G and III G have an onboard NFFC II chipset, allowing them to perform the same Layer 3 functions as the Supervisor Engine III.

Multiprotocol InterVLAN Routing

The Supervisor Engine II G and III G are available with the RSFC, an optional daughter card that performs multiprotocol interVLAN routing using Cisco IOS software.

Catalyst 5000 Family Switch Features

The Catalyst 5000 family switches have the following features:

- Catalyst 5002 switch
  - The chassis contains two fully redundant AC-input or DC-input, load-sharing power supplies. Each power supply has a separate power input.
- Catalyst 5000 switch
  - The chassis can house two fully redundant, hot-swappable, AC-input or DC-input, load-sharing power supplies. Each power supply has a separate power input.
  - The fan assembly is hot-swappable.

- Catalyst 5500 series switches
  - The chassis can house two hot-swappable supervisor engines.
  - The chassis can house two fully redundant, hot-swappable, AC-input or DC-input, load-sharing power supplies. Each power supply has a separate power input.
  - The fan assembly is hot-swappable.
  - The clock modules are redundant.

Module Hot-Swapping Support

All modules (including the supervisor engine if you have redundant supervisor engines), fans, and dual power supplies support hot swapping. Hot swapping allows you to add, replace, or remove modules without interrupting the system power or causing other software or interfaces to shut down.

The supervisor engine enables switching and controls data across the switch backplane. Therefore, one supervisor engine must be present for the system to operate, or if redundant, one must be active for the system to operate during hot swapping.

When you remove or insert a switching module, the system does the following:

1. Scans the backplane for configuration changes.
2. Initializes all newly inserted switching modules, notes any removed interfaces, and places them in the administratively shutdown state.
3. Places any previously configured interfaces on the switching module back to the state they were in when they were removed. The system puts any newly inserted interfaces in the administratively shutdown state, as if they were present (but unconfigured) at boot time. If you reinsert a similar switching module into a slot, its ports are configured and brought online up to the port count of the original switching module.

The system runs diagnostic tests on any new interface. If the tests pass, the system is operating normally. If the new switching module is faulty, the system resumes normal operation but leaves the new interfaces disabled. If the diagnostic tests fail and the system fails, remove and replace the switching module.

Caution To avoid erroneous failure messages, allow at least 15 seconds for the system to reinitialize. Note the current configuration of all interfaces before you remove or insert another switching module.

Environmental Monitoring

Environmental-monitoring functions constantly monitor the internal temperature of the chassis and the power supply voltage levels. These monitoring functions allow you to retrieve and display the present values of measured parameters and to display alarms on the console if any of the monitored parameters exceed defined thresholds.

Three status levels indicate the condition of the system:

- Normal—All monitored parameters are within normal tolerances.
- Alarm—An out-of-tolerance temperature or voltage condition exists. The system might not continue operation. If the power supply reaches an overvoltage measurement level, the power supply can shut down the system. Remove and replace the power supply.
- Critical—The power supply detects an out-of-tolerance voltage, current, or temperature condition within the power supply and shuts down. The PS1 and PS2 LEDs on the supervisor engine stay on as the power goes down. If a second power supply is still providing power, the LEDs remain red after shutdown. When both power supplies shut down in a system with redundant power, all DC-input power, including the switch fan assembly, is disabled.

  The DC-output power remains off until you toggle the power supply power switch and correct the problem that caused the shutdown. Typically, a critical status is caused by either condition:

  – Loss of input power. (You turned off the power supply, or the input power source failed.)

  – Power supply detects an overvoltage, overcurrent, undervoltage, or overtemperature condition within the power supply.

The processor monitors the temperature inside the module compartment, and the power supplies use the normal and critical status levels to monitor power supply voltages. If the power supply temperature exceeds a defined threshold, the power supply turns off.

The switches shut down if they contain only one power supply. However, if a switch contains redundant power supplies, the switch shuts down only if both power supplies shut off.

Note For temperature and voltage thresholds for the processor-monitored levels, refer to the *Catalyst 5000 Family Installation Guide*.

The processor uses the normal and alarm status levels to monitor the air temperature in the module compartment. Sensors on the supervisor engine monitor the temperature of the cooling air that flows through the module compartment. If the air temperature exceeds a defined threshold, the system processor indicates an alarm condition using the supervisor engine System Status LED, SNMP traps, and CLI displays. The processor stores the current alarm configuration for both the temperature and DC voltage in nonvolatile random-access memory (NVRAM). You can retrieve information about these alarms as a report of the last shutdown parameters.

Note For complete environmental and power specifications, refer to the *Catalyst 5000 Family Installation Guide*.

Module Functionality

The Catalyst 5000 family switches support different combinations of network switching modules with different maximum port densities. Refer to the *Catalyst 5000 Family Module Installation Guide* for detailed module functionality.

Each interface (or port) in the switch is designated by two types of addresses: *physical* and *MAC-layer.*

The physical interface address is the actual physical location (slot and port) of the interface connector within the chassis. The system software uses the physical interface addresses to control activity within the switch and to display status information. Physical interface addresses are not used by other devices in the network; they are specific to the individual switch and its internal components and software.

The MAC-layer address is a standardized data-link layer address that is required for every port or device that connects to a network. Other devices in the network use these addresses to locate specific ports in the network and to create and update routing tables and data structures. The switches assign and control the MAC-layer addresses on their interfaces.

Memory

The supervisor engines use the following onboard memory:

- Dynamic random-access memory (DRAM) for the default system software
- Flash memory for downloading the system software
- NVRAM for the configuration file

Refer to the *Catalyst 5000 Family Release Notes* for the minimum memory requirements for each supervisor engine.

Flash Memory

The embedded Flash memory allows you to remotely load and store system software images. You can download a new software image over the network or from a local Trivial File Transfer Protocol (TFTP) server and add the new image to Flash memory or replace an existing file.

Note Throughout this publication, the term PC card is used in place of the term PCMCIA Card.

The Supervisor Engine III supports a Flash file system. You can use a variety of commands to manage the file system (such as **cd**, **pwd**, **dir**, **delete**, and **copy**). The file system includes the following devices:

- bootflash: onboard Flash memory
- slot0: first Flash PC card slot
- slot1: second Flash PC card slot

For detailed information on the Flash PC cards, see the "Installing Flash PC Cards (Supervisor Engine III)" section on page 3-14. For detailed information on configuring the supervisor engine to boot from Flash PC card memory, refer to the *Software Configuration Guide* for your switch.

EEPROM

An electronically erasable programmable read-only memory (EEPROM) component on the supervisor engine stores module-specific information, such as the module serial number, part number, controller type, hardware revision, configuration information, and other details unique to each module. The supervisor engine EEPROM also contains an address allocator, which is a bank of 1024 *hardware* or *MAC-layer* addresses, one for each possible VLAN in the system.

Supervisor Engine Redundancy

You can install redundant supervisor engines in your switch if the following conditions are met:

- The switch must be a Catalyst 5500 series switch.
- The supervisor engines must be Supervisor Engine II, II G, III, or III G in the following configurations:
  - Two Supervisor Engine IIs
  - Two Supervisor Engine IIIs with EARL 1
  - Two Supervisor Engine IIIs with the NFFC
  - Two Supervisor Engine IIIs with the NFFC II
  - Two Supervisor Engine II Gs without the RSFC

- Two Supervisor Engine II Gs with the RSFC
- Two Supervisor Engine III Gs without the RSFC
- Two Supervisor Engine III Gs with the RSFC
- One Supervisor Engine II G with the RSFC and one Supervisor Engine II G without the RSFC
- One Supervisor Engine III G with the RSFC and one Supervisor Engine III G without the RSFC

For more information on configuring supervisor engines for redundant operation, refer to the *Software Configuration Guide* for your switch.