System Overview

This chapter provides an overview of Cisco Systems switching systems. The switches are intelligent digital telecommunications peripherals that provide an interface to the public network. The systems take actions based on events occurring on its switched network interfaces, commands issued by an optional host computer, and internal configurations. These actions and events are reported in system files.

Cisco switching systems are available in three hardware configurations: VCO/4K, VCO/20, VCO/80; and two software configurations: standard operational mode and extended operational mode. All VCO systems can operate in either mode.

The extended operational mode refers to the extended host application programming interface (API). The extended host API is designed for messages to handle the 4,096 address range and tone plan identification. The extended host API is required for the switch to operate in extended operational mode. Refer to *Cisco VCO/4K Software Installation Guide* for detailed information about setting up your system for extended operational mode.

The difference between 2K and 4K hardware configurations is the backplane assembly of the switch. The backplane is the high-speed communications line to which all individual cards are connected. The backplane (bus) runs at a very high speed because it must carry many conversations, address information, and considerable signaling.

VCO/4K system software V5.x can run on VCO/Series or SDS switches, but only VCO/Series switches can use all 4,096 time slots. The C-bus hardware is installed on VCO/4K systems at the time of manufacture; VCO/20 and VCO/80 systems may be upgraded with an optional upgrade kit. Table 1-1 describes the feature compatibilities of the switching systems.

Table 1-1   System Feature Compatibility

System Feature	VCO/20	VCO/4K	VCO/80	SDS
2,048 ports	Yes	Yes	Yes	Yes
4,096 ports[1]	Yes[2]	Yes	Yes[1]	No
Standard operational mode	Yes	Yes	Yes	Yes
Extended operational mode	Yes	Yes	Yes	Yes
A- and B-bus	Yes	Yes	Yes	Yes
C-bus	Yes[1]	Yes	Yes[1]	No

1. To take advantage of the 4,096 ports, both the Extended Operational Mode and C-bus Enabled System Feature flags must be enabled.

2. With optional upgrade kit.

The following hardware components comprise the basic Cisco switching system:

- VCO/Series switch
- Optional host computer
- Master console
- Optional printer

The master console provides access to system administration menus and screens. Configure the components of the switch from the master console.

The host computer houses the host application. The switch houses the operating system, switch system software, and database information. It is also the storage cabinet for the control circuit, port interface, and service circuit cards. These cards are installed in the card slots of the cabinet, and are controlled by switch system software. If your host is configured with an Ethernet connection, you can access the switch remotely via Telnet.

Redundancy preserves configuration and database information if a card or system fails. Redundant systems maintain traffic if the main system fails.

The Cisco switch is a highly flexible call processing system that can use a digit matching process of dialed digits when the optional TeleRouter software is used. The main components of a Cisco switching system include a switch and a master console. The master console is where you access the switch to locally configure, change and add cards, and program new applications. If an optional host is connected to the system, the switch and host communicate via Cisco's open API messages.

The switch receives incoming digits (in most cases, the ANI and dialed number) from a CO (central office). The system is informed that digits have been received, and processes the digits based on how they are configured in the various databases within the switch. The digits are then outpulsed to the far end CO. The CO transfers the digits to the called party (dialed number).

Each Cisco switching system is unique in that it can be configured based on how you want to receive the incoming digits and send the outgoing digits. Incoming and outgoing digits are described as follows:

- Incoming Digits—The digits/signals sent by the telephone company are recognized by the inpulse type. The inpulse type defines the signaling protocol used on the incoming calls for a particular trunk, and consist of inpulse rules. Inpulse rules define the digit collection method.

  Examples of digit collection tokens supported are DTMF, MF, and MFCR2.

- Outgoing Digits—After the digits are received, they must be configured for signaling and outpulsing to the far end on an outgoing call. The outpulse rule and answer supervision template handle this process.

  Examples of digit tokens supported are DTMF, MF, and MFCR2. Answer supervision includes dial tone, busy, reorder, wink, ringback, and voice detection.

VCO/Series Switch

The Cisco VCO/Series switches are programmable, nonblocking digital systems that support a wide range of telephony services. Cisco switches support a universal card slot architecture. This architecture allows for incremental expansion.

VCO/4K Switch

The VCO/4K supports up to 4,096 ports in a single rack configuration via the C-bus.

VCO/4K systems shipped from Cisco Systems display a **VCO 4K Series** label on the front of the VCO chassis and an **IV K** label on the front panel of each individual card.

To operate in 4K mode, Type 2 cards are required. Type 2 cards are compatible with the C-bus, and are designated as Type 2 by the **IV K** label on the front panel of the card. All Type 2 cards can operate in 2K mode. Refer to Table 1-2 for the attributes of all available Cisco cards.

Table 1-2   Card Type Attributes

Card	Redundancy	Diagnostics Control	Card Downloads	Card Type	Time Slot Access
2-Wire Trunk[1]	n+1 / cool	Local	Firmware	Type 1	2K
4XE1[1]	n+1 / cool	Remote	Volatile	Type 1	2K
4XT1[1]	n+1 / cool	Remote	Volatile	Type 1	2K
AAC	—	Local	Firmware	—	—
BRC[1]	1+1 / warm	Local	Firmware	Type 1	—
CPA[1]	n+1 / cool	Local	Volatile	Type 1	2K
CPU (MVME147-023)	1+1 / warm	Local	Volatile	—	—
D+I[1]	n+1 / cool	Local	Volatile	Type 2	4K
DCC[1]	n+1 / cool	Local	Firmware	Type 1	2K
DID[1]	n+1 / cool	Local	Firmware	Type 1	2K
DRC 24/48[1]	n+1 / cool	Local	Volatile	Type 1	2K
DRC 8[1]	n+1 / cool	Local	Firmware	Type 1	2K
DTG	1+1 / warm	Local	Firmware	Type 2	2K
DTG-2	1+1 / warm	Local	Firmware	Type 2	2K
E&M Trunk[1]	n+1 / cool	Local	Firmware	Type 1	2K
E1[1]	n+1 / cool	Local	Firmware	Type 1	2K
E1-PRI (NTDASS2, DPNSS)[1]	n+1 / cool	Local	Volatile	Type 1	2K
E1-PRI 120 ohms (NET5)[1]	n+1 / cool	Local	Volatile	Type 1	2K
ICC E1[2]	n+1 / cool	Remote	Flash	Type 2	4K
ICC T1[3]	n+1 / cool	Remote	Flash	Type 2	4K
IPRC 8, 64, 128 [4]	n+1 / cool	Local	Volatile	Type 2	4K
LTC-8	n+1 / cool	Local	Firmware	Type 1	2K
MRC (MF Receiver)[1]	n+1 / cool	Local	Firmware	Type 1	2K
MFCR2[1]	n+1 / cool	Local	Firmware	Type 1	2K
MVDC T1[1]	n+1 / cool	Remote	Volatile	Type 1	2K
NBC3	1+1 / warm	Remote	Volatile	Type 2	—
PRI (4ESS, 5ESS, NTI)[1]	n+1 / cool	Local	Volatile	Type 1	2K
PRI/N (4ESS, 5ESS, NTI, NI-2, NTT)[1]	n+1 / cool	Local	Volatile	Type 1	2K

Table 1-2   Card Type Attributes (continued)

Card	Redundancy	Diagnostics Control	Card Downloads	Card Type	Time Slot Access
SLIC-2[5]	n+1 / cool	Local	Firmware	Type 1	2K
SPC [6]	n+1 / cool	Remote	Flash	Type 2	4K
SSC	1+1 / hot	Remote	Volatile	Type 2	4K
SWI[1]	1+1 / warm	—	—	—	—
T1[1]	n+1 / cool	Local	Firmware	Type 1	2K
UTC[1]	n+1 / cool	Local	Firmware	Type 1	2K

1. This card type is not supported in VCO/4K system software version 5.2(0) and higher.

2. In addition to in-band signaling, the ICC-E1 supports the following ISDN variants: NET5, TS 014, and QSIG. Refer to the *Cisco VCO/4K ISDN Supplement* for more information.

3. In addition to in-band signaling the ICC-T1 supports the following ISDN variants: 4ESS, 5ESS, NI-2, NTI, NTT, and NTT_CS. Refer to the *Cisco VCO/4K ISDN Supplement* for more information.

4. The IPRC card, with play-only capability (no record capability), is supported in a C-bus enabled switch.

5. The SLIC-2 card is supported in VCO/4K system software version 5.2(0) and higher in 2K mode only.

6. The SPC (Service Platform Card) currently supports DTMF reception, DCC - conference, MFCR2, CPA (Call Progress Analysis), and MFR1 detection.

The following list defines the headers and attributes displayed in Table 1-2.

Card

Lists, in alphabetical order, all Cisco port interface and service circuit cards.

Redundancy

Describes the action required to replace a card into a redundant system.

    n+1

    Additional resources are available, by populating the switch with one more card than is actually required. All resources are put within a common resource group, so the loss of a card does not affect the application's operation.

    1+1

    A unit/function is backed up by another identical unit/function.

    cool

    The standby redundancy configuration that means cards installed in the switch do not share any information. Upon failure, all transactions in progress are lost.

    warm

    The standby redundancy configuration that means at a certain checkpoint, the data is synchronized across a pair of facilities, such as the active facility and standby facility. Synchronization occurs only at specific points during call processing. Therefore, calls in progress may be lost (torn down) if the active facility or a manual switchover fails.

    hot

    The standby redundancy configuration that means data synchronization is based on identical real-time processing on both pairs of facilities. Upon failure of the active resource, or manual switchover of these facilities, the standby resource takes over for the active resource with no loss of calls or related functionality.

Diagnostics Control

Defines the access method available for running diagnostic testing. Some cards do not allow remote access of the information.

Local

The operating status of various system components can be tested or viewed from the switch location only.

Remote

The operating status of various system components can be tested or viewed from a remote location.

Card Downloads

Defines the upgrade method required for each card type.

Firmware

Nonvolatile. The card must be removed from the switch to replace the firmware (PROMs).

Volatile

A download is required for a cold boot or cold restart.

Flash

Live upgrade: A download is not required unless the stored card application does not match the download file on disk.

Card Type

Defines the Cisco card as Type 1 or Type 2.

Type 1

Type 1 cards are only supported by the A- and B-buses (2,000 ports), and prevent other cards in the system from supporting 4,000 ports. These cards are not physically compatible with the C-bus hardware. A system with C-bus hardware enabled does not allow Type 1 cards to be brought into service. Therefore, the 4K port configuration is not available if Type 1 cards are installed in your system.

Type 2

Type 2 cards are compatible with the C-bus hardware, that is, they can function in a 4K port switch, and are designated as Type 2 by the **IV K** label on the front panel of the card. Some Type 2 cards support only 2,000 ports but do not prevent other cards from supporting 4,000 ports; others are fully capable of handling 4,000 ports. Some Type 2 cards can be used in a 2K port configuration system configured with the A- and B-bus, but you are limited to 2,048 ports.

Time Slot Access

The card's ability to access the 2K or 4K port configuration via the C-bus.

2K is contiguous. Contiguous refers to the process of allocating individual time slots which are adjacent to one another. This method limits the number of available time slots in situations where sufficient time slots are available but, because they are fragmented, cannot be applied to a particular card.

4K is noncontiguous. Noncontiguous allows the system to allocate fragmented time slots. It is not necessary for all time slots for a card to be adjacent to one another.

VCO/20 and VCO/80 Switches

The VCO/20 supports integrated turnkey solutions or highly distributed switching requirements. The VCO/80 provides expanded card slot capacity for larger configurations. Both switches provide the same functionality, and support up to 2,048 ports.

A VCO/80 switch configured with all Type 2 cards in a single subrack can be fitted to enable C-bus and run as a 4K port switch. The SDS-500 and SDS-1000 may not run as a 4K port switch; they are restricted to approximately 2,000 ports.

If you are upgrading your existing VCO switch to a VCO/4K switch, a C-bus retrofit kit and 4K labels are included in your upgrade package.

Configuration and database information, such as card setup and inpulse/outpulse rules, is stored on the hard drive of all the switches. In a redundant system, two databases are stored—one on each hard drive.

Optional Host Computer

The host computer is the traffic director for all calls coming into the switch. When the switch detects an incoming call, it sends a report to the host. The report contains inpulse rule information. Based on the information received, the host sends a command back to the switch with call control instructions according to the application requirements, specifying how to outpulse the digits, whether to send supervision signaling, or whether to perform any other action stored in the database.

The VCO/4K can be controlled by virtually any type of host computer, from PCs to mainframes. The size and speed of the host depends on traffic volume. In most cases, a mainframe, or multiple host computers, allows for faster message handling and minimizes the possibility of a host overload and loss of traffic. The switch supports up to eight hosts and Ethernet links.

The host computer is connected to the switch via Ethernet or a serial port. If you are using an Ethernet connection (TCP/IP), the host is plugged into the ETHERNET port on the front of the CPU-TM card. If a serial cable is used, the host is connected to the SERIAL port on the front of the CPU-TM card.

Master Console

The master console is where you configure, add, or make changes to cards, and program new applications. The console is designed with VT220/320 emulation. Sunview, Xview, and PC-type keyboard layouts are also supported.

When you log in to the system from the local master console, you can perform system administration functions within the switch. As system administrator, you can log on to the master console to perform the following functions:

- Define inpulse and outpulse rules
- Change the configuration of an entire card or a single port
- Add a card to the system
- Configure system peripherals, file systems, administration access, and host communication ports
- Verify the version/revision level of system software or firmware
- View the current status of a card or port as part of the host application debugging process
- Load software onto the system
- View the overall system status
- Run diagnostic routines on trunk or receiver circuits

Software Components

Various software components are necessary for a call to be processed through the Cisco switching system. Call routing decisions or call completions cannot be made by the generic software without direct host control.

Optional software applications are available, and depend on the features your system provides and the requirement of the application.

System Software

Cisco switch system software is real-time software that controls the functionality of the Cisco switches. System software Version 5.2 is the most current system software for the VCO/4K switch. Multiple software diskettes contain the system software Version 5.2 files. These files include the executable files, database files and card download files.

Optional Host Control Software

The host control software should be created on the optional host to properly utilize the command and report structure used to control call processing.

System Log Files

The system maintains log files of all error and status messages generated by the system controller. Log files are stored by month and date. For example, the file for December 23 is identified as A-DEC23.LOG, where "A" identifies the system controller for which messages are generated. Up to 31 days of messages are stored on the system disk before being overwritten. A-DEC23.LOG, for example, is overwritten on the 23rd day of January. You can print or view the log files from the Print/Display System Log File screen, which you access from the Maintenance menu. You can also copy the files from the hard disk via the Disk Utilities screen, which you also access from the Maintenance menu.

When the Ethernet Communications option is used, you can also store log files on a remote device through the Ethernet Network File System (NFS) facility. Refer to the *Cisco VCO/4K Ethernet Guide* for more information.

Each message is preceded by a time stamp that includes the VCA for that system, the date/time the message was generated, and an identifier showing the controller and its status at the time of the message. This identifier is in the format X-SSS, where X = controller side A or B, and SSS = ACT (Active) or SBY (Standby). For example, "A-ACT" indicates that controller A was active when the message was generated.

In a redundant system, both system controllers store both sets of log files, one for each side. Log files are marked according to the system controller for which they were generated: either "A-" for the A side or "B-" for the B side. Each side sends its messages across the update channel. A sample log file printout for a redundant system is shown in Figure 1-1. Possible messages are described in *Cisco VCO/4K System Messages*.

Figure 1-1   Typical System Log File Printout — Redundant System

```
    #01 Fri Apr 30, 1999 13:51:06 A-ACT
FRM101: CARD OOS - RLS 1,1,17 (CARD ALRM SET)
    #DF Fri Apr 30, 1999 13:51:01 B-SBY
FRM101: CARD OOS - RLS 1,1,17 (CARD ALRM SET)
    #DF Fri Apr 30, 1999 13:52:45 B-SBY
FRM095: Card Restored - RLS 1,1,17 (CARD ALRM CLRD)
    #01 Fri Apr 30, 1999 13:52:54 A-ACT
FRM095: Card Restored - RLS 1,1,17 (CARD ALRM CLRD)
```

In a nonredundant system, log file extensions are not used. Each message is preceded by a time stamp that includes the VCA for that system and the date/time the message was generated. A sample log file printout for a nonredundant system is shown in Figure 1-2. Possible messages are listed in *Cisco VCO/4K System Messages*.

Figure 1-2   System Log File Printout — Nonredundant System

```
    #00 Fri Apr 30, 1999 10:30:00
FRM504: Major Alarm Set For - ALM011: No Hosts Available
    #00 Fri Apr 30, 1999 10:30:00
FRM503: Minor Alarm Set For - ALM010: Host Communications Failure
    #00 Fri Apr 30, 1999 10:30:05
HST003: Host <ADLC-4 > Restored
    #00 Fri Apr 30, 1999 10:30:05
FRM511: Major Alarm Clear For - ALM011: No Hosts Available
    #00 Fri Apr 30, 1999 10:30:10
HST001: Host Manager Initialization Complete
    #00 Fri Apr 30, 1999 10:30:12
FRM087: NBC Status Set To Active
    #00 Fri Apr 30, 1999 10:30:12
FRM086: NBC Hardware Tests Passed
```

Available Disk Space Monitored on Switch Hard Drive

With system software V5.1 FSR00 PUN23, or greater, the system automatically monitors the 80-MB hard drive in the switch for available disk space. Disk space on the hard drive can fill up quickly due to large trace and log files. The trace and log files can grow excessively due to the following circumstances:

- The trace functionality was not turned off after a debug or maintenance session.
- A large number of messages are continuously being logged to the log file.

The system continuously monitors the trace and log files to avoid large files using excessive disk space. Trace and log files should not exceed 1 MB. If the system detects that either file has exceeded 1 MB, it generates an alarm message (ALM096 for a trace file, and ALM097 for a log file.) Refer to the *Cisco VCO/4K System Messages* for alarm messages and meanings.

In addition, each midnight, the system verifies that a minimum of 30 MB is available on the hard drive. If the system detects that available disk space has fallen below 30 MB it generates an ALM093 alarm message. This message notifies you to delete unnecessary files until available disk space exceeds 30 MB.

If the system detects that available disk space has fallen below 15 MB it generates an ALM094 alarm message. The system then automatically creates disk space by performing the following steps:

Step 1   Delete all but the last (currently being used by the system) core files.

Step 2   Delete trace files exceeding 15 days.

Step 3   Delete log files exceeding 15 days.

Step 4   Delete trace files exceeding 1 day.

Step 5   Delete log files exceeding 1 day.

After executing each step, the system verifies available disk space. If available disk space exceeds 30 MB at any point during the deletion process, subsequent steps are not performed. However, if the system fails to generate more than 30 MB of available disk space after performing all steps it generates an ALM095 alarm message.

ALM093, ALM094, and ALM095 are cleared at midnight if the condition that set these alarms no longer exists. In addition, the log files are updated, the System Alarms Display screen is updated, and the $F0 (Alarm Condition Cleared) host reports are sent. Refer to *Cisco VCO/4K System Messages* for descriptions of alarm messages ALM093 to ALM097.