CHAPTER 1

Switch Overview

The Cisco Systems VCO/4K switch is an intelligent digital telecommunications peripheral that provides an interface to the public network. The unique functions and signaling requirements of that interface are handled by the system in much the same way a data switch handles the detailed requirements of its interface.

The system takes action based on: (1) events occurring on its switched network interfaces and (2) commands issued by a host computer. These actions and events are reported back to the host. No call routing decisions or call completions are made by the VCO/4K system software without direct host control.

This document provides information about the command and report structure the host uses to control the system. This overview introduces some of the software concepts you need to understand the interaction between the host and the system.

System Resources

The circuits that allow the system to function within the switched public network are called resources. System resources are divided into two types: port circuits, which are also called network interface circuits, and internal service circuits.

Network Interface Circuits

The system requires network interface circuits (ports), to connect to and interact with, the public telephone network, telecommunication peripherals, and voice storage/retrieval equipment. The type of circuit used depends upon the equipment to which the system is connected.

System network interface circuit cards include:

- SLIC-2 (Domestic) and SLIC-INT (International)
- DID-2 (Domestic) and DDI (International)
- UTC-2
- E+M and E+M (DC5) (UK only)
- T1 Interface (Domestic) and E1 Interface (International)
- T1-E (Japan only)
- Programmable Four Span T1 (Domestic) and Programmable Four Span E1 (International)
- PRI/N (Optional)

- E1-PRI (International)
- MVDC

Refer to the *Cisco VCO/4K Hardware Planning Guide*, and *Cisco VCO/4K Card Technical Descriptions* for information on the physical characteristics of these cards.

Virtual Call Generation Ports

The system software can originate a call from the system without requiring a physical incoming port. This process makes use of an internal resource type called a Virtual Call Generation Port, or virtual port.

A virtual port is a logical entity maintained by system internal processing. There are 999 virtual ports, with a port address range of $80 00 through $83 E6. A single internal resource group, $FE, contains all virtual ports. No physical resources are associated with a virtual port; virtual port software addresses represent internal memory locations. Physical operations such as seize, wink, and digit collections, are not allowed for virtual ports. Within these restrictions, the system can use a virtual port in place of a physical incoming port in most system commands.

Internal Service Circuits

For call processing to occur, the system must detect, interpret, and present tones. Additional requirements depend upon the type of calls, and can include presenting voice prompts or providing conference features. These functions are provided by internal service circuits, also called ports. System internal service circuit cards include:

- Digital Tone Generator (DTG)
- DTMF Receiver Card (DRC)
- DTMF Receiver Card 24/48 Ports (DRC 24/48)
- MF Receiver Card (MRC)
- MF Transceiver Card with Compelled R2 Signaling (MFCR2 Register)
- Digital Conference Card (DCC)
- Call Progress Analyzer (CPA)
- Integrated Prompt and Record Card (IPRC)
- Digital Tone Generator 2 Mezzanine Card (DTG-2)
- Subrate Switch Card (SSC)

UTC-2, SLIC-2, and DID-2 cards are equipped with DTMF receivers on board, on a per port basis. Firmware on the SLIC-2 and DID-2 cards allows ports on these cards to interpret dial pulse (DP) digits. CPA cards detect call progress tone events such as dial tone, busy tone, reorder tone, special information tones (SIT), ring back presence/cessation and voice presence/cessation. Refer to the *Cisco VCO/4K Hardware Planning Guide* and the *Cisco VCO/4K Card Technical Descriptions* for information on the physical characteristics of these cards.

General Call Flow

A typical call involves a switched connection between two network interface circuits. One or more internal service circuit types receive or transmit information necessary to complete this connection. This general call flow is illustrated in Figure 1-1 and is described in the following text.

When the system detects an incoming call, it checks its database to determine whether there are any actions it must perform before informing the host of the call. These actions are contained in an inpulse rule, a list of call processing instructions for use with ports. Application designers define the inpulse rules, which are then stored in the system. If the database points to an inpulse rule for a port, the instructions are executed by the system and the results reported to the host as defined by that rule. The system then waits for further instructions from the host. Inpulse rules are discussed in Chapter 2, "Inpulse and Outpulse Rules."

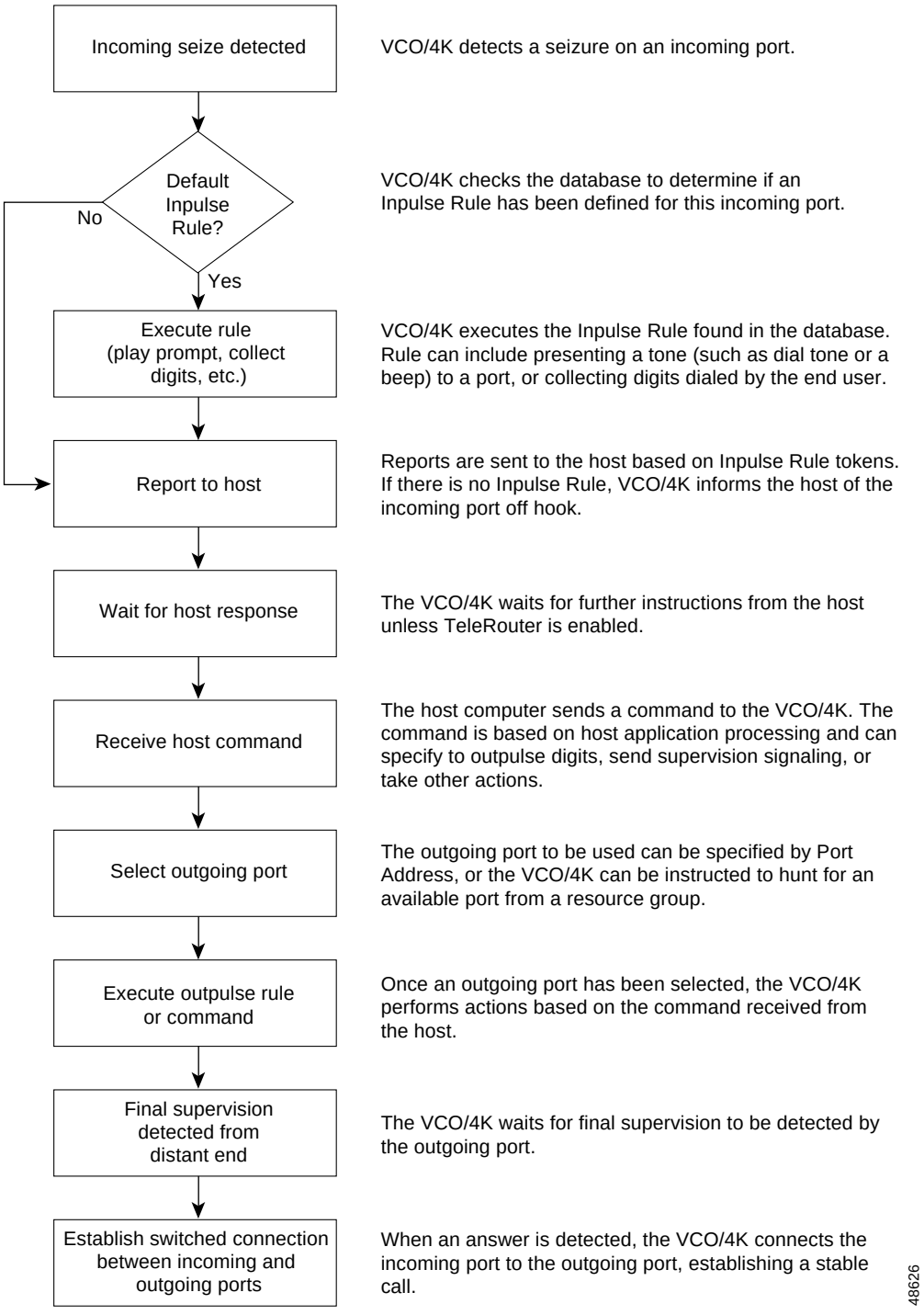
If no inpulse rule is specified for the incoming port, the system reports the incoming change of state to the host, then waits for further instructions. Reports are discussed in Chapter 5, "System Reports."

Based on these reports, the host decides the action to take next and sends instructions to the system. These instructions, called commands, direct the system to perform the functions necessary to complete the call. A command may also call an inpulse rule or a similar list of instructions, called outpulse rules. Outpulse rules are discussed in Chapter 2, "Inpulse and Outpulse Rules." Command description subsections are contained in Chapter 4, "System Commands."

Other factors that affect call processing include hardware characteristics such as the physical interface type, and system database entries, such as Class of Service (COS) and resource grouping.

Note Calls that use the conference features of the Digital Conference Card (DCC) differ from the general call flow in several important areas. For a discussion of the conference call flow, refer to *Cisco VCO/4K Conferencing*.

Figure 1-1 General Call Flow



Resource Control

The system reacts to information it receives from outside the switch. The source and content of this information play a major role in determining the resources it selects to participate in a call.

The system call processing has two methods of identifying system resources: by port address and by resource group.

Port Address

A port address is a logical identifier assigned to every network interface and internal service circuit. This hexadecimal number corresponds to the PCM transmit time slot, and has no relationship to the physical location of the resource. With the exception of the system tones and outpulse channels provided by the DTG, port addresses are assigned dynamically by the system controller when a card is entered into the system database. The system controller uses the first contiguous block of available addresses.

A table of port addresses and physical locations is maintained by the system database. Use the Request Resource Allocation ($80) command and the Hardware Allocation ($81) report to transfer this information to the host.

Tone, outpulse channel, and virtual port addresses are fixed. Virtual ports are assigned port addresses $80 00 through $83 E6.

Resource Group

A resource group is a collection of like ports defined by application designers. Each group consists of a name, number, hunt type, and a list of resources. You can define up to 224 resource groups, each containing up to 999 members (ports).

The following system resources must be grouped (only one group per resource type):

- DTMF receiver ports
- MF receiver ports
- MFCR2 transceiver ports
- IPRC ports
- DCC ports
- CPA ports

The following system resources should be grouped for optimum system performance and to allow resource allocation and reporting:

- SLIC-2 ports and SLIC-INT
- DID-2 ports and DDI
- UTC-2 ports and ETC/LTC
- T1, 4xT1, and MVDC channels
- E1 channels and 4xE1 channels
- PRI/N B-channels
- E+M ports

The characteristics that help determine resource grouping include:

- Resource type
- Physical interface
- Type and location of connected equipment
- Class of Service (COS)
- Default inpulse rule assignment
- Purpose within the application
- Outpulse channels and virtual ports are already grouped internally by the system; these groups cannot be modified. System tones cannot be grouped.

Class of Service (COS)

Class of service (COS) is a set of operating characteristics the application designer assigns to a network interface circuit (line/trunk port). Once the COS mark is entered into the database, the system can determine how a port is used in a call. Table 1-1 summarizes the COS marks supported by the system.

Table 1-1 Class of Service Options

COS	Description
O	Originating—Calls originating from the system; outgoing calls initiated by host command.
T	Terminating—Calls terminating at the system; incoming calls initiated by actions outside the system.
2	2-Way—Calls originating from the system or calls terminating at the system; outgoing calls initiated by host command, incoming calls initiated by outside actions.
AO	Always Off Hook and Originating—Calls originating from the system, port goes off hook at system reset and remains off hook; outgoing calls initiated by host command.
AT	Always Off Hook and Terminating—Calls terminating at the system, port goes off hook at system reset and remains off hook; incoming calls initiated by outside actions or forced by host command.
A2	Always Off Hook and 2-Way—Calls originating from the system or calls terminating at the system, port goes off hook at system reset and remains off hook; outgoing calls initiated by host command, incoming calls initiated by outside actions or forced by host command.

The system call processing also uses internal COS marks for ports designated as 2-way, ports involved in a call using a virtual port, or any line/trunk port involved in a conference. These internal COS marks are summarized in Table 1-2.

Table 1-2 Internal Class of Service Options

Internal COS	Description
U	2-way trunk used for an outgoing call; assumes all characteristics of COS = O for duration of call.
T	2-way trunk used for incoming call; assumes all characteristics of COS = T for duration of call.

Table 1-2 Internal Class of Service Options (continued)

Internal COS	Description
C	Any trunk currently involved in an active conference; trunk maintains COS characteristics as defined by database.
P	Virtual port or any outgoing line/trunk port used in a call with a virtual port.

Resource Allocation, Links, and Voice Paths

The resources the system allocates to a call are determined in one of the following ways:

- An autonomous event outside the system, such as an incoming seize detected on a network interface circuit
- A command request for a resource with a specific port address
- A command or rule request specifying to use a resource from a specific group

When a resource is allocated, it is linked into a resource chain for a call. In a nonconference call, a resource chain is a serially linked list of ports that begins with the incoming port and includes all ports and channels involved in a call.

The following resources can be linked:

- Outpulse Channels
- DRC ports
- MRC ports
- MFCR2 ports
- IPRC ports
- DCC ports
- CPA ports
- SLIC-2 and SLIC-INT
- DID-2 ports and DID
- UTC-2 ports and ETC/LTC
- T1 and 4xT1 channels
- E1 and 4xE1 channels
- PRI B-channels
- E+M ports
- Virtual ports

Conference calls have several resource chains. One chain includes all DCC ports for that conference. Each DCC port also has a chain linking it to the associated line/trunk port(s).

While a resource is linked into a call's resource chain, it cannot be used for any other call. Call processing determines when a resource is dropped from a chain and made available for the next call.

A resource can be linked but not actively participating. A resource is actively participating in a call if a voice path exists (resource actively sending or receiving in-band signaling), the port is sourcing out-of-band supervision signaling, or the port is waiting for out-of-band supervision. A voice path is a physical, system-switched connection that allows the transfer of MF digits, DTMF digits, tones, prompts, or voice information. The system cannot use virtual ports to transfer information; therefore, a voice path cannot be established for a virtual port.

Call processing divides system resources into two categories: senders and receivers. Senders originate voice and in-band signaling information; receivers listen to information. Table 1-3 describes the valid senders and receivers.

Table 1-3 Valid System Resource Senders and Receivers

Senders	Receivers	Senders and Receivers
Outpulse channels	DRC ports	SLIC-2 ports and SLIC-INT
IPRC ports	MRC ports	DID-2 ports and DID
DTG/DTG2	MFCR2 ports	UTG-2 ports and ETC/LCT
—	CPA ports	T1, 4xT1, MVDC channels
—	—	E1 and 4xE1 channels
—	—	E+M ports
—	—	DCC ports
—	—	PRI/N B-channels
—	—	SSC channels

Figure 1-2 shows system voice paths. Each of these switched connections is explained in Table 1-4.

Note Virtual ports are actually memory locations which originate outgoing calls without a physical incoming port. Because of their nature, they are a resource capable of being linked, but no voice path is established when they are added to a call. For this reason, they are not represented in Figure 1-2.

Figure 1-2 System Voice Paths

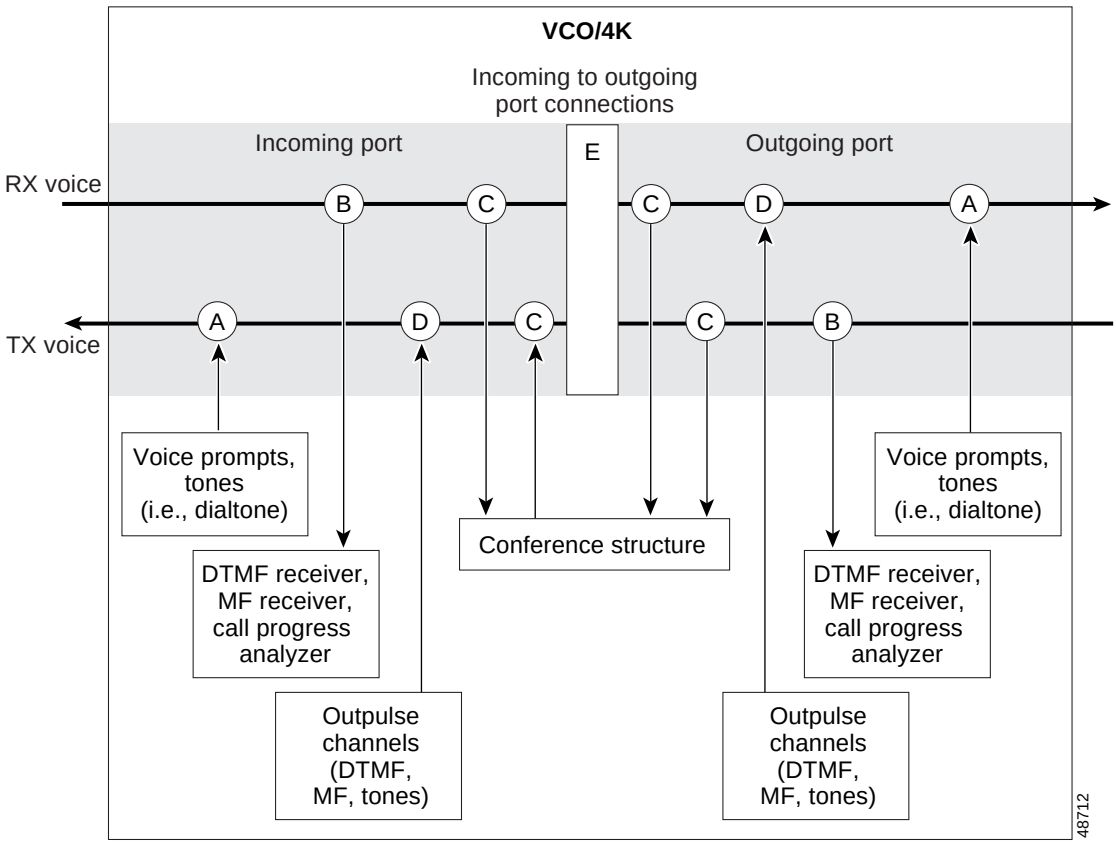


Table 1-4 Legend for Figure 1-2 Callouts

Voice Path	Description
A	Voice prompts and tones (such as dial tone or quiet) are presented to an incoming or outgoing port. The voice path is between the outpulse channel or IPRC port (sender), and the incoming port (receiver). The path is one-way only.
B	In-band signaling—such as call progress tones or DTMF, MF, or spoken (0 to 9, yes, no) digits—sent over the incoming or outgoing port are detected and interpreted by a receiver port. The voice path is between the incoming or outgoing port (sender) and the DTMF receiver port, MF receiver port, or CPA port (receiver). The path is one-way only.
C	Voice information is passed between an incoming or outgoing port and a conference structure. The voice path of this structure is between one to seven senders and an unlimited number of receivers. The path may be one-way or two-way.
D	DTMF digits, MF digits, or tones are presented to an incoming or outgoing port. The voice path is between the outpulse channel (sender) and the outgoing or incoming port (receiver). The path is one-way only.
E	Voice information is passed between an incoming port and an outgoing port (normal call in progress). The voice path is between the incoming port (sender and/or receiver) and the outgoing port (sender and/or receiver); path is normally two-way but can be altered by host via the Voice Path Control ($66) command.

Use the system administration Port Display screen to monitor the current links and voice paths for an individual port. Refer to the *Cisco VCO/4K System Administrator's Guide*. System tones cannot be linked because they are a shared resource. A voice path can be established between a tone and a receiver without a link.