CHAPTER 2

Product Description

The VCO/4K consists of the following hardware and software components:

Basic VCO/4K system—The system enclosure, power subsystem, combined controller, digital switching matrix, distributed network subsystem, system generic software, and comprehensive product documentation.

Network interface circuits—A wide array of standard analog and digital line and trunk interfaces for connection to the Public Switched Telephone Network (PSTN) and specialized telecommunications equipment.

Internal service circuits—Special-purpose circuits that provide internal resource pools for application-specific call handling functions, such as voice prompt recording and playback, tone detection and generation, call progress analysis, and conferencing.

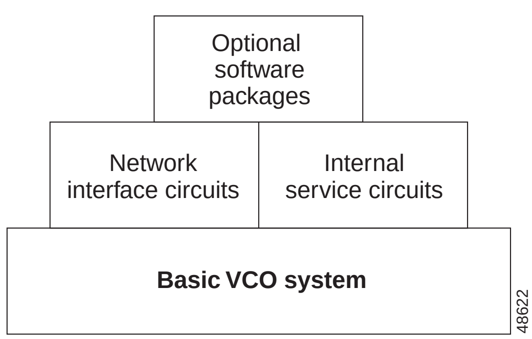
Optional software packages—Optional software packages are described in the "Optional Software/Hardware" section on page 2-12.

Note This document represents the most current information about the VCO/4K. If you need information pertaining to VCO/4K assemblies, circuit cards, or other components that are not included in this document, see the following URL on Cisco's web site for legacy VCO/4K information:

http://www.cisco.com/univercd/cc/td/doc/product/tel_pswt/index.htm

Figure 2-1 shows the layout of the VCO system.

Figure 2-1 The VCO/4K

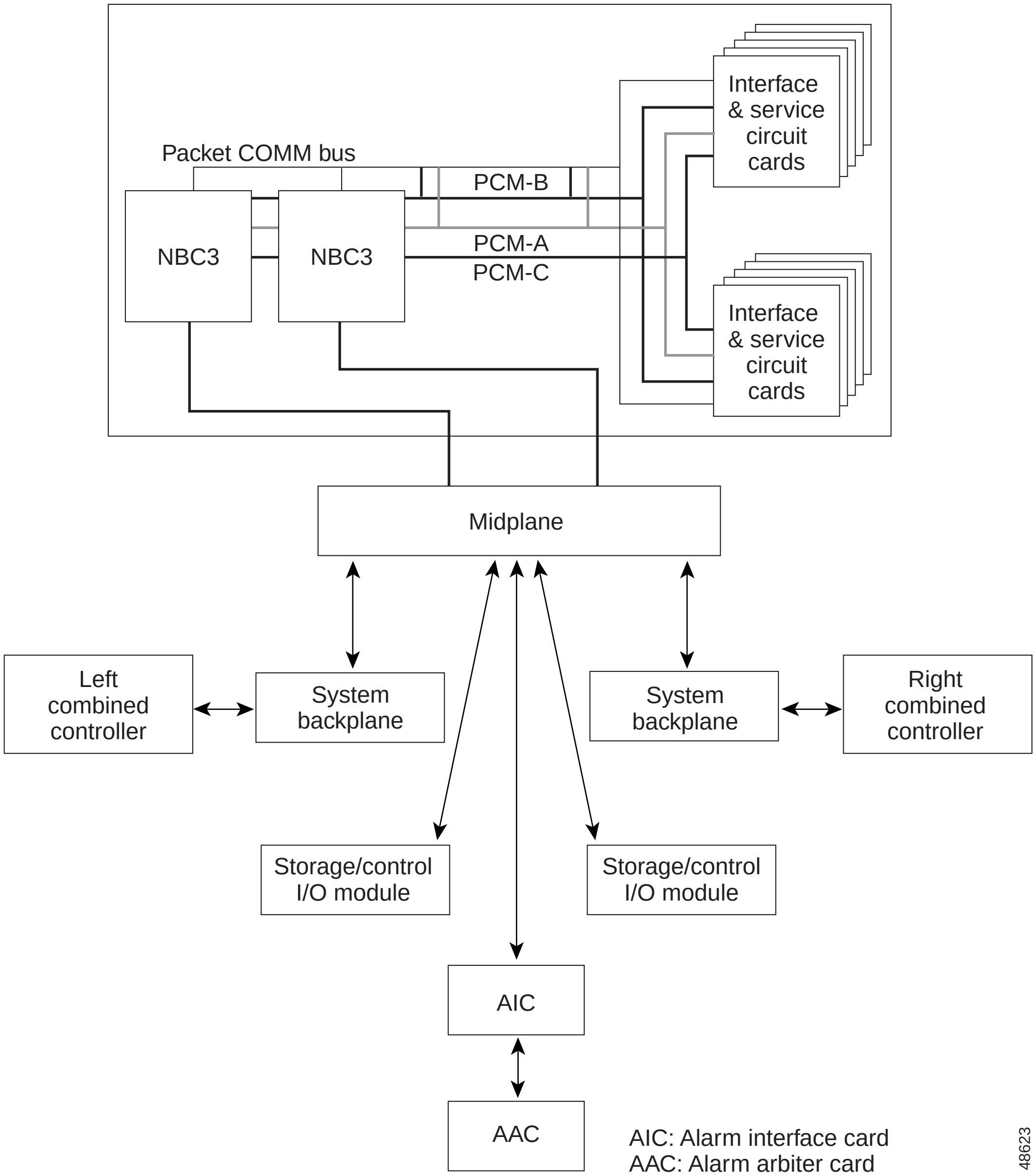


Each VCO component is discussed in the following sections.

VCO/4K System Overview

The VCO/4K open architecture digital switch can be used in a wide range of telecommunications applications. Regardless of the application, all system configurations include common hardware and software. Figure 2-2 shows a logical representation of the VCO/4K architecture.

Figure 2-2 VCO/4K System Architecture



Distributed Processing

A hierarchical distribution of system control optimizes system performance. Microprocessors on each network interface and internal service circuit card perform a portion of the event processing. This distribution of system control reduces the chance of performance degradation due to a single-point failure.

The switching matrix comprising the distributed network subsystem also uses a distributed architecture. The VCO/4K switches digital data-streams between logical port addresses, with analog-to-digital and digital-to-analog conversions performed on the network interface cards. The switching matrix accommodates nonblocking network interface and service circuit ports through a PCM voice bus switching architecture.

Switching Matrix and Distributed Network Subsystem

The VCO/4K network subsystem's interface capacity depends on the number of service circuit ports required for the desired level of system performance. Contact Cisco Systems Technical Assistance Center (TAC) for detailed system performance information.

The VCO/4K does not incorporate a central switching network. Instead, each port interface or service circuit card carries, on-board, all required analog-to-digital conversion circuitry and the portion of the nonblocking PCM network required for the number of port or service circuits on the card.

Interface port, tone generator, tone receiver, digital conferencing, call progress analyzer (CPA), and voice prompt and record cards, mount in a universal backplane bus structure.

You can mount any service circuit or port interface card in any unreserved card slot on this backplane bus, subject to main distribution frame (MDF) adapter constraints. (The first six slots are reserved.) All control information is referenced to port addresses rather than physical addresses. Call processing software reads port assignments for line/trunk interfaces and system services from the database. For example, the software reads tones, voice announcements, CPAs, conference ports, dual tone multifrequency (DTMF), and multifrequency (MF) receivers. System administration utilities let you add, move, and change lines and trunks.

Port Addressing

When a port-oriented card is placed in the port subrack and configured via the system administration tables, the controller acknowledges it and assigns it a range of port addresses, as defined in the database. Each port is associated with a time slot, during which a write/read sequence is performed.

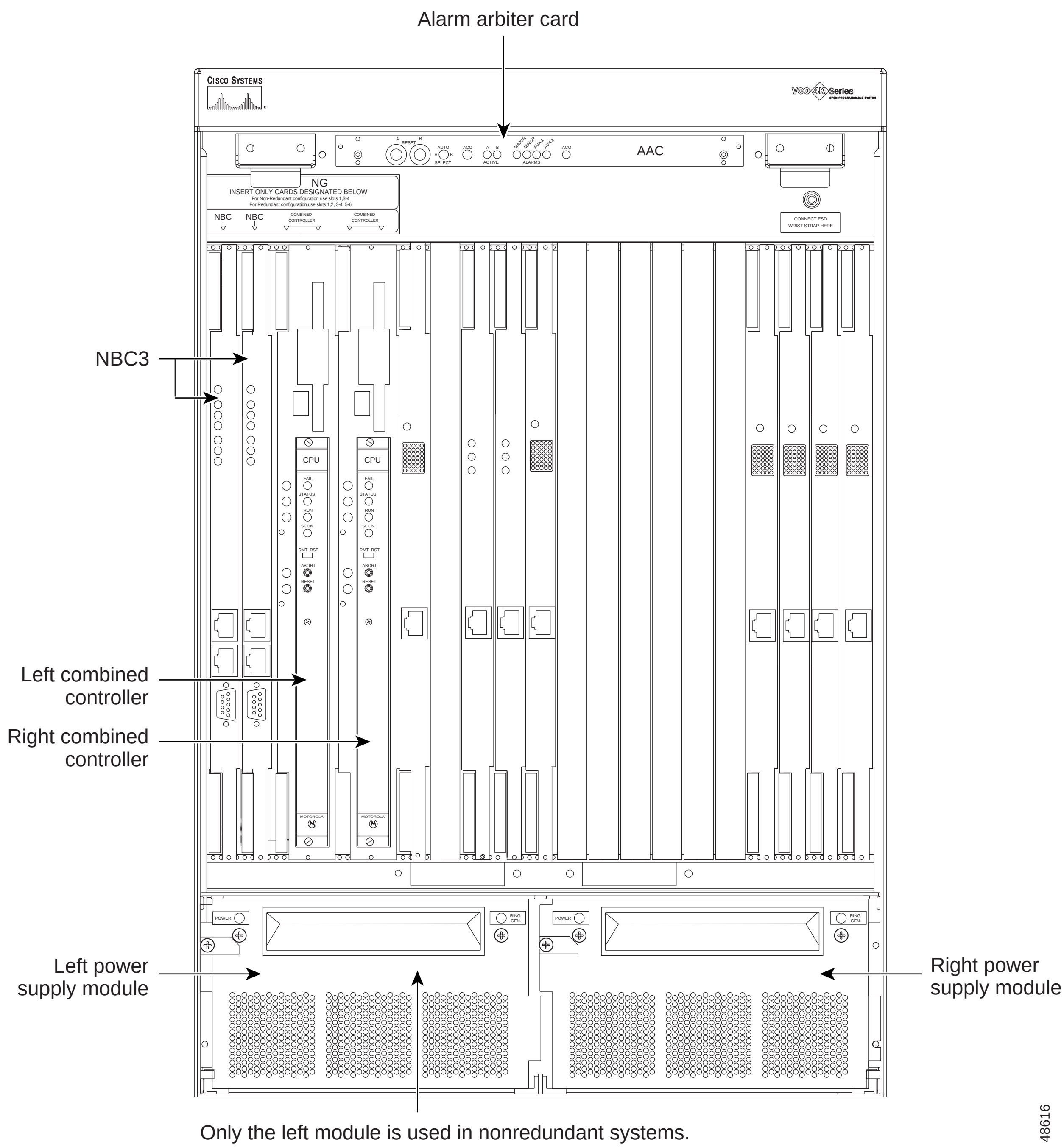
Each line, trunk, or service channel is assigned its own transmit (write) time slot address. Call processing software connects ports by dynamically assigning or mapping a receive (read) time slot for the duration of a call.

Service circuits, such as outpulse channels, voice announcement ports, call progress tone analyzers, conference ports, DTMF, and MF receivers, are similarly mapped. For example, an off hook condition may cause call processing software to map a line or trunk port to dial tone from a DTG card.

VCO/4K Architecture

The VCO/4K system enclosure meets the enclosure requirements of *UL 1459 Standard for Telephone Equipment (2nd Edition)* in customer premises installations. Redundant power supply modules and redundant combined controllers add to the reliability of the VCO/4K. The system also includes AC and DC power input options. Figure 2-3 shows a front view of the VCO/4K with the door removed.

Figure 2-3 VCO/4K Front View



Equipment Layout

A nonredundant VCO/4K system contains the following functional units:

- Control subsystem
- Storage/Control I/O module (with hard drive)
- Power subsystem
- Alarm Arbiter Card

The following subsections discuss these functional units.

Control Subsystem

The control subsystem consists of the Network Bus Controller (NBC3) and the combined controller.

Network Bus Controller

The NBC3 extends the full-duplex path from the combined controller and supports a separate communications (COMM) bus to all port-oriented cards in the port subracks. This controller includes phase lock loop (PLL) circuitry to synchronize system timing with incoming E1 or T1 bit streams.

Combined Controller

The Combined Controller consists of the following components:

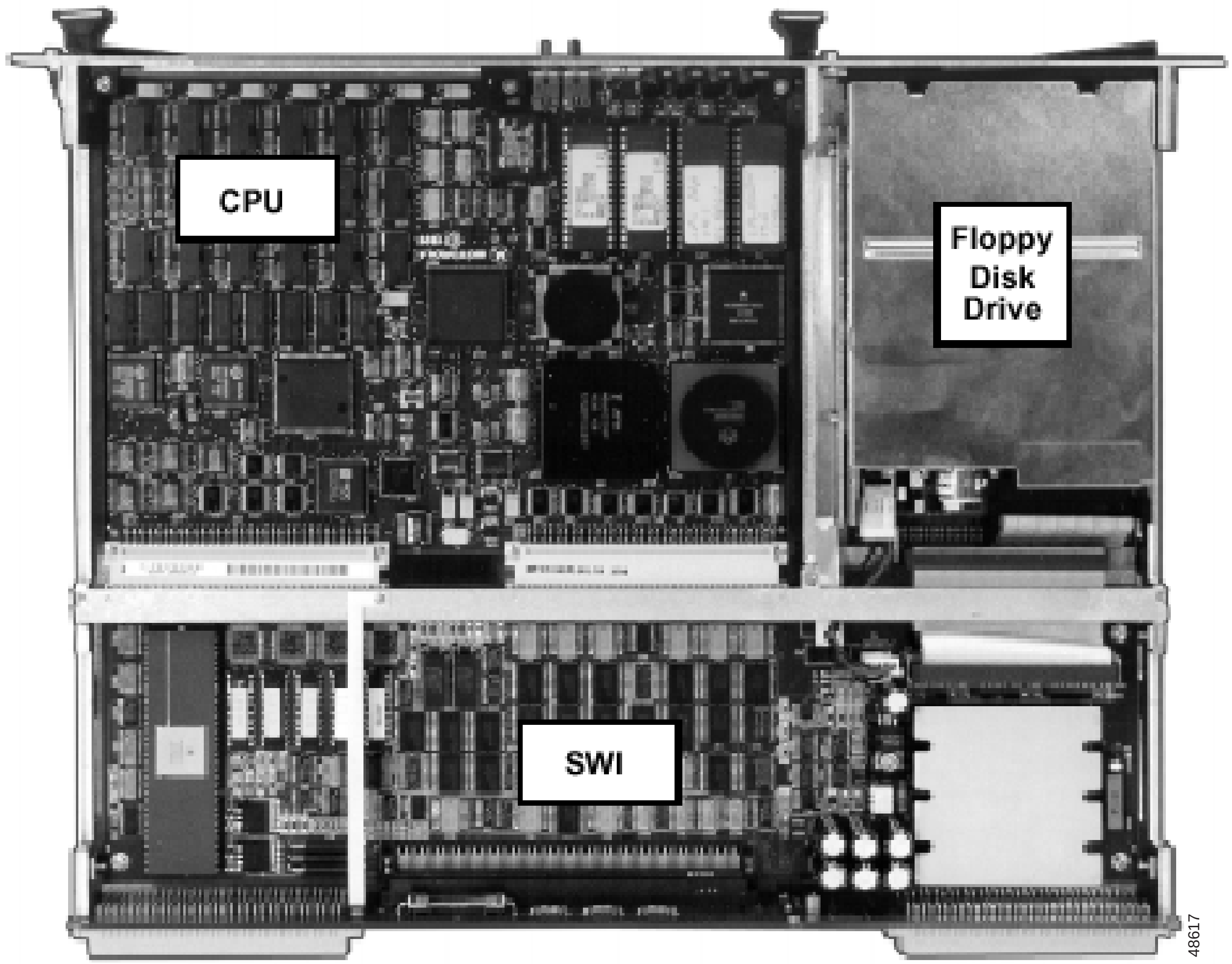
Central Processing Unit (CPU)—An MC68030-based computer with a floating-point MC68882 coprocessor, on-board Dynamic RAM (DRAM), battery-backed clock/calendar, and Small Computer Systems Interface (SCSI) bus interface.

Switch Interface (SWI) Card—Provides a full-duplex, high speed, direct memory access (DMA) controlled, parallel bus path to the NBC3. In redundant VCO/4K systems, the SWI communicates with the other controller via the update channel.

Floppy Disk Drive—A 3.5-inch, 1.44-MB floppy disk drive that allows you to make backup copies of the system database.

Figure 2-4 shows the components on the combined controller.

Figure 2-4 Combined Controller



Storage/Control I/O Module

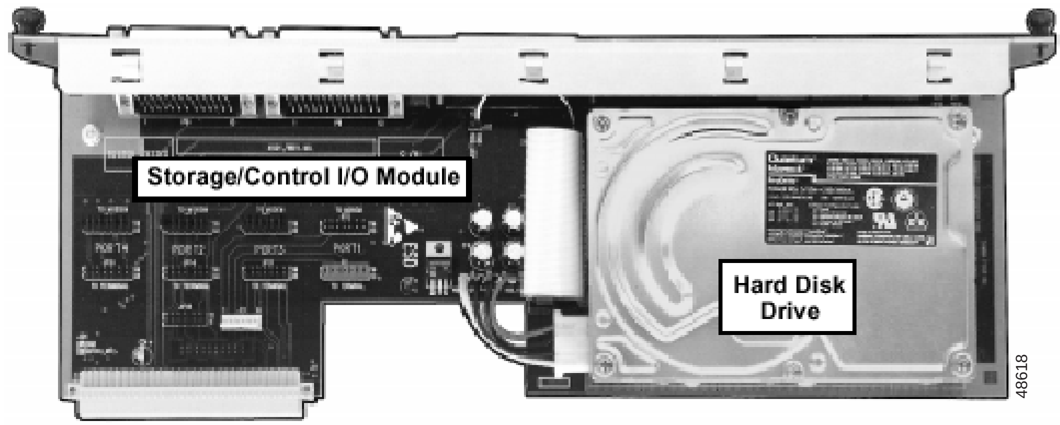
The Storage/Control I/O module provides the following interfaces, in addition to the hard disk drive:

- Serial Port 1 (DB-25 connector for system administration console)
- Serial Port 2 (DB-25 connector for remote maintenance modem)
- Serial Ports 3 and 4
- Ethernet Port (DB-15 connector for Ethernet connection)
- Printer Port (36-pin parallel (Centronics type) printer port)

The 270-MB hard disk drive provides storage for system generic, application download (i.e., NBC3, CPA, IPRC, MVDC, DRC-24/48), and system database and log files. With the Ethernet software option, you can configure log files to be passed on an Ethernet network.

Figure 2-5 shows the Storage/Control I/O module.

Figure 2-5 Storage/Control I/O Module



Power Subsystem

VCO/4K systems are equipped with a power subsystem that supplies ample power, at the required voltages, for various system configurations. The system consists of three main components—power entry module, power backplane, and power supply module. The power supply module accepts one of four inputs (-48 VDC, Dual -48 VDC, 120 VAC, or 240 VAC) and provides regulated DC voltages for system operation. The VCO/4K system is configured for redundant power supply modules. Each power supply module has an LED, which indicates the status of the unit.

Alarm Arbiter Card

The Alarm Arbiter Card (AAC) provides centralized control of controllers, system status indicators, and external alarm connections.

Network Interfaces

The basic VCO/4K system can be equipped with digital network interface circuit cards in any combination, up to the system's port and power capacity. Call control support for all network interface circuit types is part of the standard VCO/4K system software. VCO/4K system administration lets you designate network interface circuits on a single card as incoming, outgoing, or two-way.

Digital Network Interfaces

Digital Network Interfaces are as follows:

Four Span Programmable T1 (4xT1) Interface Cards—Programmable at the span level, these cards support four spans of 24, 56, or 64 kbps voice and data channels and comply with Bell System DS-1 specifications for transmission at 1.544 Mbps. These cards enable incoming, outgoing, and two-way service to 24 individual nonblocking channels on a span. Additional features include D4 and ESF format, E&M, FXO, FXS, loop start, ground start, and clear signaling, law conversion, gain control, length, slip/OOF thresholds, and switch hook flash detect and send, wink detect and send, guard, off-hook minimum timing detection, and support of A-law / -law PCM coding.

Single Span T1 (T1) Interface Card—Provides a D3/D4 bipolar format, 1.544 Mbps PCM data stream to DS-1 carrier specifications; also supports wink detection and generation.

Single Span E1-CAS (E1) Card—Provides 32 x 64 kHz channels, supports A-law/ -law PCM coding or clear channel data, and uses channel associated signaling (CAS) with all bit positions of timeslot 16 in every frame reserved for bit-oriented signaling data transmission.

PRI/N Card—Provides a D3/D4 bipolar or ESF format, 24-channel (23 B+D) 1.544 Mbps digital data stream. The PRI/N card supports North American Primary Rate connectivity with D-channel protocol handling of the user side and user side symmetrical. It is compatible with Northern Telecom and AT&T implementations of CCITT Q.921 Layer 2 and Q.931 Layer 3 protocols. The NFAS option controls up to 479 B-channels using only one D-channel. D-channel backup (D-channel redundancy) is also available. Requires optional ISDN PRI and/or NFAS software packages.

Four Span Programmable E1 (4xE1) Interface Card—Programmable at the channel level, the 4xE1:

- Supports four spans of 32 channels, consisting of:
  - 30 traffic channels
  - one synchronization channel
  - one signaling channel
- Supports 64 kbps voice and data channels
- Complies with CCITT G.704 specifications for transmission at 2.048 Mbps.

The 4xE1 enables incoming, outgoing, and two-way service to 32 individual nonblocking channels on a span. Additional features include the following:

- Signaling: CAS/R1, CAS/MERC, CCS/31B
- Slip/OOF thresholds
- Hookflash send
- Detect timing
- Law conversion
- Gain control

E1-PRI Card—Transmits a 2.048-MHz, 32-channel (30 traffic channels, one synchronization channel, and one signaling channel), bipolar digital data stream. The E1-PRI card interfaces with the following:

- DPNSS
- DASS2-Network Termination
- ISDN/NET5

Switches on the card can be set for the desired card type. There are separate download software packages available for DPNSS, NT-DASS2, and ISDN/NET5.

E1-CAS Card—Provides 32 x 64-kHz channels, supports A-law/ -law PCM coding or clear channel data, and uses channel associated signaling (CAS) with all bit positions of timeslot 16 in every frame reserved for bit-oriented signaling data transmission.

Drop and Insert Card—Provides DS0 access to the switch matrix. This card supports a maximum of eight interfaces per card that operate at either 56 KB or 64 KB. It is configurable as DCE or DTE with normal or reverse bit-packing. This card supports both EIA/TIA-449 and V.35 (with user-supplied cables). The Drop and Insert card may be inserted into the system while the system is active.

Administration of the card is done through the existing System Administration Console. Configuration messages are sent to the card from the generic through the NBC interface.

All digital network interface cards allow clear channel for true 64 kbps throughput.

Interface Controller Card (ICC) and the T1 or E1 I/O Modules—The Interface Controller Card (ICC) is a high-capacity network interface engine. The ICC card employs Cisco Systems mid-plane architecture which enables it to connect with a series of I/O modules specific to different network interface requirements. The mid-plane isolates the unique physical characteristics of each type of connection leaving the ICC to perform all of the signaling and protocol processing independently. There are six I/O modules supporting 4, 8, or 16 network spans. A C-bus enabled, VCO switching platform (VCO/4K Series) with a full complement of ICC cards and 16-span I/O modules will support more than 4000 ports.

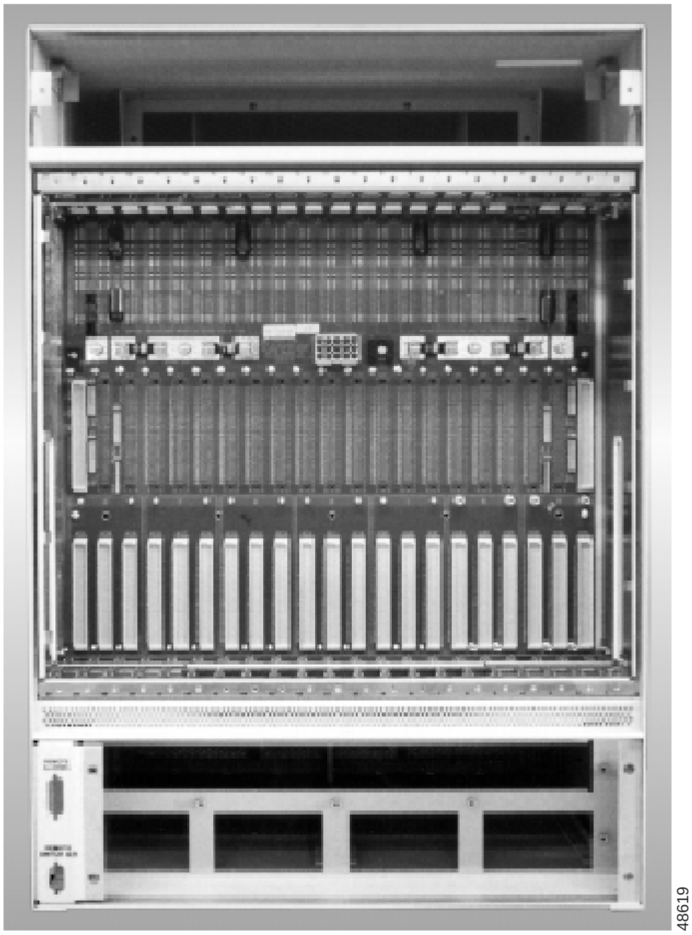
The ICC is fully programmable, enabling user control over individual channels.

Other features include on-board Flash memory for rapid configuration and boot-up time.

I/O Module Card Cage

The VCO/4K has a card cage in the front of the system and a card cage in the back. The system backplane is located in the middle. The 9U card cage in the back is used for inserting vertical I/O modules into slots with corresponding port cards. Figure 2-6 shows a back view of the VCO/4K without any I/O modules in the card cage so that the system backplane is visible.

Figure 2-6 VCO/4K Card Cage for I/O Modules



Access is at the rear of the system and slots are numbered from 1 to 21 to correspond with port subrack slots. For information about the vertical I/O modules, refer to the *Cisco VCO/4K Card Technical Descriptions.*

Service Circuits

VCO/4K service circuits provide internal pools of special-purpose resources for application-specific call handling functions. These resources are available to all network interface circuits, including PRI B-channels. You can use system administration utilities to group service circuits, except DTG tones and outpulse channels. The circuits on all service circuit cards are assigned and released by software control.

Service circuit cards are as follows:

Service Platform Card (SPC) with Service Resource Modules (SRMs)—The Service Platform Card combines the capabilities of individual service resource cards into a single card, which contains all of the functions previously provided by separate cards. The hardware design of the SPC allows the software operating within the SPC and the SPC's mezzanine card (the Service Resource Module, or SRM) the ability to exceed the older service resource function's feature set, while providing a much higher level of integration both logically and physically.

The Service Platform Card architecture allows any service resource function of the VCO/4K to be performed with this card as a base platform, given a minimum of one SRM mezzanine card on the board to perform the service function(s). Mezzanine cards have the capability to perform more than one service function. Services include the following:

- **CPA**—DSP-based tone detection board that determines the status of a call. CPA detects call states such as dial tone, busy, fast-busy (re-order), audible ringback, special information tones, ring back cessation, voice, voice cessation, and pager cue tones. You can also configure the CPA to detect predefined tones. The CPA provides the unique VCO/4K capability of internetworking ISDN to non-ISDN facilities.
- Various downloads are available for country-specific tone plans. For more information about country-specific tone plans, refer to the appropriate country-specific supplement.
- **Conference**—Provides conference ports that you can use to provide conference features. Up to eight incoming and/or outgoing lines or trunks can participate as listen-and-talk ports in a single conference, or up to seven listen-and-talk ports with as many listen-only ports as desired. You can adjust input levels to the conference and output levels from the conference.
- **DTG**—Provides standard system tones (i.e., dial tone, call progress tones, and MF/DTMF digits) and outpulse channels used to outpulse digits. System tones are available to all resources.
- **DTMF Receiver**—Includes DTMF receiver circuits that perform DTMF tone detection for all VCO trunk types.
- **MF Receiver**—Includes MF receiver circuits.
- **MFCR2—**Includes MF transceiver circuits that can be assigned to calls requiring CCITT R2 forward/backward signaling.

Integrated Prompt Recording Card (IPRC)— Provides an easy-to-implement, high-quality, digital voice prompting system. The IPRC receives commands from a host application and communicates those commands to a digital voice prompt unit to produce voice messages. These messages are then routed by the IPRC card to the designated outgoing VCO/4K port. The IPRC is available with either eight playback/four record ports, 64 playback/32 record ports, or 128 playback/32 record ports. Additionally, the IPRC supports up to 16 prompt libraries of up to 256 prompts each.

Optional Software/Hardware

The following optional software is available from Cisco Systems:

- Application Software Integration Support Tools (ASIST)
- Ethernet Communications Package for the VCO-to-host interface
- Integrated Services Digital Network (ISDN) Primary Rate Interface (PRI)
- ISDN Non-Facility Associated Signaling (NFAS)
- TeleRouter call routing software
- VF-EDIT voice prompt editing software
- ISDN/NET5
- Japanese ISDN software (NIT Domestic Specification)
- ANSI and ITU Integrated SS7

The following subsections discuss these software packages.

ASIST

ASIST software aids the development of host-controlled applications. ASIST products include:

ASIST/Application Programming Interface (API)—C language representation of the VCO Standard (2K) and Extended (4K) command/report host interface. It consists of a library of software modules that builds commands to control the VCO/4K and parse reports from the VCO/4K. ASIST/API is compatible with any operating system that supports the C programming language; source code is provided for this product. The host application must be written in C.

ASIST/Ethernet—Allows a UNIX-based host to communicate with a VCO/4K over the Ethernet. ASIST provides a library of routines which allows an application developer to build a socket interface over the Ethernet, using TCP/IP, to the VCO/4K.

Ethernet Communications Package

The Ethernet communications package supports Ethernet TCP/IP communications between the VCO/4K and one or more host computers.

The VCO/4K supports a single, thick-wire, DB-15 Ethernet port located on the Storage/Control I/O module. You can use an Ethernet transceiver to convert this interface to thin wire or twisted pair.

The VCO/4K implementation uses stream-oriented TCP protocol. TCP error handling includes checksum verification of messages, sequential message delivery, and protection against message duplication. TCP is also a connection-oriented protocol, typically involving a connection between a client and a server. The VCO/4K performs the role of a server in the client/server TCP model.

Ethernet communications on the VCO/4K supports a single physical link per VCO/4K CPU, each with multiple logical connections or sockets. A socket interfaces the Ethernet communications protocol and the application. The VCO/4K Ethernet implementation supports up to eight simultaneous sockets, using the BSD 4.3 Internet Domain sockets interface.

Additionally, the Ethernet Communications package supports Network File System (NFS). With NFS, you can send alarm and trace files to the host. The host can also use NFS to download voice prompts to the VCO/4K.

You can also use Telnet to route all system administration access through Ethernet instead of the local administration console. This is especially useful in remote administration.

ISDN PRI

ISDN PRI software provides call processing and administrative support for ISDN PRI calls. User side and user side symmetrical, CCITT Q.921/931 access to AT&T 4ESS, AT&T 5ESS, and NTI can be configured for each PRI card in the system.

PRI card operation supports Layers 1, 2, and 3 of the OSI model and call control to provide an interface with the ISDN network. The generic software downloads the application software to the PRI card. ISDN PRI interacts with the call processing functions running on the controller.

Full system administration support allows PRI card configuration, alarm detection and processing, and card maintenance functions. The PRI is compatible with most system administration utilities.

The ISDN PRI Package uses templates that shield you from much of the detailed interface. ISDN Message Templates, used with rule processing, enhance programmable reporting of ISDN events and facilitate construction of D-channel messages. ISDN Supervision Templates provide control of outgoing ISDN calls.

If necessary, the VCO/4K can also provide “pass through” of ISDN data, leaving most call processing decisions to the host computer. This allows the system to use nonstandard information elements (IEs) and to handle the special signaling requirements of private networks.

ISDN PRI Package features support not only pure ISDN calls, but calls using a mixture of ISDN and non-ISDN resources. All internal resources are available for ISDN calls. These mixed-resource cases, or internetworking scenarios, allow the VCO to be used as a gateway between the ISDN and traditional services networks.

ISDN NFAS

Standard ISDN PRI consists of 23 B+D channels, where a single signaling channel (D-channel) controls the remaining 23 bearer channels (B-channels) on the interface. In VCO terms, this means that ports 1 through 23 on the PRI/N card (B-channels) are controlled by port 24 (D-channel). The NFAS option extends D-channel control to B-channels not resident on the same interface. This allows a single D-channel to control up to 20 interfaces (a maximum of 479 B-channels). Additionally, ISDN NFAS supports 23 B+D PRI/N cards, T1 voice channels, and an optional D-channel backup. ISDN NFAS requires the ISDN PRI/N software package.

TeleRouter

TeleRouter is a software overlay to the generic software that allows the VCO/4K to interpret dialed digit information and execute call routing decisions based on the information. All standard generic functions are maintained. Additional TeleRouter capabilities allow the user to design switching scenarios completely within the VCO/4K. TeleRouter can be used in conjunction with a host computer in a normal VCO/4K hosted environment, or it can independently perform routing actions on the switch in an unhosted configuration.

Screen displays within standard system administration menus provide access to TeleRouter functions. These screen displays are used to create routing instruction tables. An additional inpulse rule token initiates the instructions included in the routing tables.

ISDN/NET5

ISDN/NET5 is available through the ISDN/NET5 E1-PRI package. NET5 runs only on the 120-ohm version of the E1-PRI card.

E1-PRI card operation supports Physical, Data Link, and Network Layers (1, 2, and 3) of the Open System Interconnect (OSI) model to provide interface with NET5 D-channel protocols. Application software stored on the system hard disk is downloaded to the E1-PRI card by the generic software. This application interacts with the call processing functions running on the system controller.

Full system administration support is provided to allow E1-PRI card configuration, alarm detection and processing, and card maintenance functions. Enhancements to system call processing allow ISDN/NET5 features and capabilities to be added to an application with no effect on existing applications.

The added commands, reports, and Inpulse/Outpulse Rule tokens conform to existing standards. ISDN/NET5 Message Templates and rule processing are used to enhance programmable reporting of events and facilitate construction of outgoing D-channel message. ISDN/NET5 Supervision Templates provide control of outgoing ISDN/NET5 calls.

These features support not only pure ISDN/NET5 calls, but also calls which use a mixture of ISDN/NET5 and non-ISDN/NET5 resources. All internal resources are available for use by ISDN/NET5 calls, including Call Progress Analyzers (CPAs). These mixed-resource cases, called *interworking* scenarios, allow the switch to be used as a gateway between the ISDN/NET5 and traditional services networks.

Japanese ISDN (NIT Domestic Specification)

NTTPRI is a Japanese version of ISDN PRI, complying with the Japan Approvals Institute for Telecommunications Equipment (JATE), and is a variant of CCITT PRI standard Q.931/I.451.

Generic Support of the NTTPRI card includes the following:

- Standard PRI/N card type
- NTTPRI download
- Card Configuration: separate screen for configurable parameters
- Call Processing: existing and new Layer 3 messages and information elements
- Call Clearing: CAUSE IEs are specific to the cause event

ANSI and ITU Integrated SS7

The Integrated SS7 product serves as a gateway between Signaling System No. 7 (SS7) intelligent networks and the PSTN by integrating the SS7 network with a VCO/4K system and host computer(s). This integration can significantly improve call processing because the call setup information arrives independent of the voice traffic. Independent signaling increases the call processing rate by a minimum of 60 percent over the rates of other signaling methods. SS7 integration also reduces network congestion and deployment costs through greater port utilization and alternative routing capabilities.

The ANSI and ITU Integrated SS7 products allows the service provider to implement the following enhanced services:

- ISDN User Part (ISUP) services for call processing and switching, such as:
  - Operator Services System support
  - ISDN or Feature Group D Interworking
  - Personal Communication Services (PCS)/Enhanced Services Billing
  - Integration of full Service Switching Point (SSP) functionality
  - Wireless and wire line internetworking
- Transactions Capabilities Applications Part (TCAP) applications, such as:
  - Credit card/debit card validation
  - Personal number/“follow me” services
  - Network-based services including 800 number routing and Automatic Call Distribution (ACD)
  - Mediated access
  - Cellular roaming services

The Integrated SS7 is a system consisting of both hardware and software components that are installed in a VME shelf and connected to the VCO/4K system. An Integrated SS7 system can support one VCO/4K system, and up to eight host computers that all reside on Ethernet LAN. The Integrated SS7 system connects directly to the Ethernet LAN and SS7 network.