

## Corrective Maintenance

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The chapter reviews basic corrective maintenance procedures for the VCO/4K system. It covers the hierarchy of possible causes for system malfunctions and the diagnostic tools available. It also includes system reset procedures for nonredundant and redundant systems. The chapter discusses Cisco Systems' repair-by-replacement policy and the concept of field replaceable units. The chapter ends with flowcharts that aid in resolving host communications issues.

## Fault Isolation

Fault isolation involves identifying a problem, analyzing its cause, and applying the appropriate solution. VCO/4K systems incorporate extensive error messaging and logging facilities which help in the identification process. Problems tend to have multiple causes which must be identified, individually analyzed, tested, and confirmed. Repair attempts that simply replace components on a hit-or-miss basis usually mask rather than resolve actual causes of system malfunctions.

## Host Computer Applications

Because the VCO/4K functions as a server to a host computer, fault isolation must also take into account the state of the host computer and its application software at the time a fault is discovered. Troubleshooting thus requires knowledge of the host computer system, the diagnostic capabilities of the application software, the error logging and diagnostic capabilities of the VCO/4K, and basic telephone network test and service procedures.

This manual describes how to use the diagnostic tools and procedures supported by the VCO/4K itself. Application developers must provide service technicians with details of the diagnostic capabilities of the host computer system and its application package.

## System Log

The "Maintenance Aids" section on page 1-2 briefly describes the system log of error and status messages, available through the VCO/4K system administration menus. Daily review of system logs reveals clues as to possible system problems. However, a true indication of overall system performance requires a history of system performance.

Cisco recommends that you keep the daily printed output of error and status logs for a month. The logs record all system error and status messages output by the system. They provide an excellent history of performance problems and maintenance activities requiring system reinitialization.

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To assure that a continuous hard copy record of the system error log is always available, Cisco recommends not turning off (deselecting or powering off) the system printer except for maintenance purposes. You can also write system log files to either floppy or hard disk for later use depending on the File System Configuration screen selections you make (refer to the *Cisco VCO/4K System Administrator's Guide* for more information).

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## Hierarchy of the Causes of Malfunctions

When performance monitoring indicates a system problem, you should compare the symptoms of the problem against a possible hierarchy of causes. Except for the human error factor, the causes of a system malfunction are either external or internal.

External causes of malfunctions include:

- Central Office (CO) services
- Host computer, its application, and/or its communications software
- Peripheral equipment
- Specialized communications equipment
- Power and ground irregularities

Internal causes of malfunctions include:

- Database errors
- Bus errors
- CPU and memory
- Mass storage
- Interface and service circuit hardware problems
- Software/firmware incompatibility

## Diagnostic Tools and Fault Isolation

VCO/4K software includes diagnostic tools to help isolate the possible causes of a problem. These tools include: error logs, status LEDs, alarm conditions, and administrative maintenance and diagnostic routines.

The diagnostic tools must be complemented by diagnostic routines incorporated into the host application software. The VCO/4K command set includes support for the development of host-controlled diagnostics, including the ability to remove ports from service, monitor card status, and initiate alarms. Thus, the host can trigger events in the VCO/4K that can have the effect of placing portions of the system out of service. Replacing cards and performing other corrective maintenance procedures does not cure a fault caused by the host application.

## Human Factor

The most likely cause of a system malfunction remains the human factor. Failure to follow recommended procedures for installing, programming, and maintaining the system, results in problems which can sometimes be very difficult to trace.

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The VCO/4K is a system of integrated components. Its operation depends on office data entered into the system database. It is coupled to external CO facilities through a main distribution frame that should be carefully mapped and updated as changes are made to the system configuration.

The technical documentation set contains information about, and organizational tools for, installing and maintaining a VCO/4K system. Technicians responsible for maintaining the system should be thoroughly familiar with the following documents:

- *Cisco VCO/4K Hardware Planning Guide*
- *Cisco VCO/4K Site Preparation Guide*
- *Cisco VCO/4K Hardware Installation Guide*
- *Cisco VCO/4K Card Technical Descriptions*
- *Cisco VCO/4K Mechanical Assemblies*
- *Cisco VCO/4K System Release Notes*
- *Cisco VCO/4K System Administrator's Guide*
- OEM manuals supplied with peripheral equipment installed as part of the system configuration

Technicians should also obtain copies of the documentation set for the host computer system and its application software package. Knowledge of communication protocols and the I/O interface to the VCO/4K is also important.

## External Causes of System Malfunctions

This section presents a hierarchy of external causes of malfunctions. Causes appear in the order they are most likely to occur.

### CO Facilities

Lines, trunks, and channel banks connect the VCO/4K to the local central office (CO) or to specialized telecommunications equipment. Problems associated with CO facilities include:

- Loss of, or degraded transmission over, incoming direct connect lines from stations
- Loss of, or degraded transmission over, dialup trunks or incoming digital trunks
- Loss of, or degraded transmission over, outgoing analog or digital trunks
- Improper or missing answer supervision on outgoing lines
- Failure to complete routing of incoming calls to VCO/4K over dialup lines
- Failure to complete routing of outgoing calls to terminating numbers
- Failure to complete CO access to InterLATA Carriers
- Hardware damage to interface cards

When individual CO interface circuits fail, calls are blocked from obtaining service or completing a connection to the terminating number. Traffic reports log the loss of service.

When a block of interface circuits fails, the problem is usually the failure of a VCO/4K interface card. The exception to this general rule is the failure of a digital span, which causes the loss of up to 24 channels. A digital span can be lost at the channel bank, the digital switch, or at its interface point with the VCO/4K.

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## Host Computer System

Because the VCO/4K acts as a peripheral device connected to the host, any hardware or software problems occurring at the host translate into problems with the VCO/4K. Such problems can manifest themselves in the following ways:

- Failure to complete calls through the system due to:
  - Timeouts
  - Erroneous or incomplete commands
  - Mismatched database information (inpulse/outpulse rules)
  - Host computer downtime
  - Throttling caused by improper overall system configuration
- Alarm conditions triggered by the host
- Loss of host communication link(s)
- Frequent reinitialization of the system

The host application must be able to generate its own error messages. This is particularly true whenever the host issues a command to trigger an alarm on the VCO/4K. Such alarms are usually the result of a failure (in call processing or communications) detected by the host application software. A detailed error message should indicate why the alarm was triggered so that you can quickly isolate and remedy the cause.

## Peripheral Equipment

Problems with peripheral equipment can cause the following operational failures in a VCO/4K system:

- VDT related
  - Erratic error messaging or display faults on the system console
  - Inability to access or make changes to the database
  - Inability to access error logs or maintenance and/or diagnostic menus
- Printer related
  - Garbled printout
  - Loss of error messages
  - Periodic reports
- Related to the remote maintenance modem
  - Inability to perform remote maintenance
  - Multiple login attempts due to noisy lines

The principal causes of problems related to peripheral equipment are improper installation, improper cabling, and/or loss of setup parameters. The *Cisco VCO/4K Hardware Installation Guide* specifies the cabling and setup parameters required for interface with the VCO/4K. Users must enter peripheral operating parameters in the system database through the Peripheral Configuration screen (refer to the *Cisco VCO/4K System Administrator's Guide* for instructions). These parameters must match the setup parameters defined at the peripheral (refer to the OEM documentation supplied with the peripheral for setup instructions).

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VDTs usually experience keyboard and monitor problems because of frequent use. Printer mechanisms wear out over time, and modems can be damaged by line surges over power or CO connections.

### Power Subsystem Inputs

Loss of input power to the power entry module results in failure of the VCO/4K. Intermittent power surges and sags, as well as induced noise, can produce the following problems:

- Memory and bus errors causing erratic system performance
- Frequent reinitialization attempts of controllers or individual circuit cards
- Shutdown of power supply modules

## Internal Causes of System Malfunctions

This section presents a hierarchy of internal causes of malfunctions. Causes appear in the order they are most likely to occur.

### Database

Entering and maintaining database entries that address the system configuration requires a thorough understanding of all the elements in the system. System performance degrades if a discrepancy (such as erroneous additions, moves, and changes to the database) is introduced between system elements and database entries. The *Cisco VCO/4K System Administrator's Guide* describes the procedures required to maintain the system database.

Problems with the database can result in the following:

- Failure to complete calls processed through the system
- Frequent system reinitialization
- Poor grade of service performance
- Rejection of multiple messages sent by the host
- Inability of host computer to connect, or reconnect to the switch
- Frequent inpulse and outpulse aborts

Tracing database problems requires a very detailed examination of database entries across all of the individual menus associated with a potential problem.

### Bus Errors

Bus errors can occur as follows:

- During polling communications between interface and service circuit cards and the NBC3
- At the packet communications link between the NBC3 and SWI
- Along the VMEbus in the control system

These occurrences display error messages identifying the affected bus and cards.

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Intermittent bus errors can be the result of:

- Abnormal interface signals
- Power surges or sags
- Environmental problems related to operating temperature and humidity

Persistent bus errors can be a sign of:

- Circuit card failure
- Faulty midplane connections
- Interconnecting cables

## Combined Controller Assembly

CPU, memory, and peripheral interface problems can be traced to the Combined Controller Assembly (CPU and SWI). Combined Controller Assembly problems can be caused by improper jumper settings on the card, card failure, or bus faults. Problems associated with the Combined Controller include:

- Continuous system reinitialization
- Failure to completely initialize the system
- Frequent file-related errors
- Inability to update database tables
- Failure to recognize and/or complete call attempts
- Update channel failures between redundant controllers
- Communications problems with peripheral equipment
- Host communication link failures
- Message parsing errors

If the Combined Controller fails to establish communications with the NBC during initialization, the CPU performs a Phase 4 reboot. A message on the system console indicates that a reboot is beginning. If this series of events recurs, there could be a problem with SWI and NBC3 communications.

## Mass Storage

Mass storage problems are associated with read/write operations from or to the floppy or hard disk drive. The mass storage complex includes the Combined Controller, which houses the floppy drive, and the Storage/Control I/O module, where the hard drive is installed.

Mass storage problems cause the following events to occur:

- File transfer errors between system memory and the database
- Inability to open, close, read from, or write to a file
- Failure to download data from disk to downloadable cards
- Denial of access to error logs
- Inability to log in

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## Interface and Service Circuit Cards

Causes of hardware failures on individual circuit cards can be:

- Incorrect interface configuration
- Environment (operating temperature and static electricity)
- Transient power surges
- False signaling from external sources (lightning, transient or recurring overvoltage or shorts)
- Faulty midplane connections
- Discrete component failures

## Software/Firmware Incompatibility

VCO/4K circuit cards include one or more PROMs. The PROMs contain coded firmware that interacts with the VCO/4K system software to control operation. Refer to the *Cisco VCO/4K Card Technical Descriptions* for the locations of PROMs on VCO/4K circuit cards. The system software release notes lists the firmware revision levels required on all circuit cards. The system does not function properly without the correct firmware.

If you experience system problems after loading the new system software or when replacing a circuit card, check for firmware compatibility. Always refer to the configuration information contained in the **release notes**. Obtain the correct firmware PROMs from Cisco Systems and install them on all affected circuit cards, including those held as spares.

## Diagnostic Tools

The VCO/4K provides diagnostic tools to facilitate fault isolation. These tools consist of error and status logs, status LEDs, alarm conditions, and diagnostic test routines run from the system administration console.

## Error Logs

The role of error and status logs in the fault isolation process is described in the “System Log” section on page 3-1. Remote maintenance access to log files allows Cisco technical support and/or administrators of multisystem installations to quickly review the recent performance of a system.



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During periods of high traffic volume, remote maintenance by way of a modem might not be desirable. Modem access can overload the Combined Controller, causing calls to be dropped or lost.

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## Status LEDs

Status LEDs indicate the operational status of individual circuit cards and subsystems. Refer to the *Cisco VCO/4K Card Technical Descriptions* and *Cisco VCO/4K Mechanical Assemblies* for the LED patterns for all VCO/4K system components.

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**Note**

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The operational status of LEDs on peripheral and specialized telecommunications equipment varies according to manufacturer. Review OEM manuals for detailed information.

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## Alarm Conditions—System Wide

VCO/4K systems support an alarm condition scheme consistent with the alarm requirements described in Bellcore specification *OTGR: Network Maintenance: Network Element*.

## Severity Levels

System-wide alarm conditions are divided into four severity levels—fatal, critical, major, and minor. Fatal alarms cause a system switchover (in redundant systems) or a system reset (in nonredundant systems).

Critical, major, and minor alarm conditions require action to resolve the problem. Recovery from a major alarm may require component replacement and a controller reset, thus placing the system out of service. Minor alarms might require software and/or hardware changes before the condition is eliminated and the alarm is reset.

The host can set two additional auxiliary alarms by sending a Set/Reset Host Alarms (\$C0 03) command. Refer to the *Cisco VCO/4K Standard Programming Reference* and *Cisco VCO/4K Extended Programming Reference*.

## Alarm Condition Indicators

Alarm condition indicators appear:

- On the front panels of system cards
- In several system administration screen displays
- Within system log file messages
- In optional periodic alarm summary reports

The Alarm Arbiter Card (AAC) supports local and remote indications of system-wide problems by a combination of highly visible LEDs and external alarm contacts (when connected). The Major Alarm LED on the card front panel indicates fatal, critical, and major alarm conditions. You can connect the external alarm contacts to audible alarms, to alert technicians to problem conditions. An option on the system administration System Alarms Display screen allows users to disable these audible alarms.

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The Audible Cutoff (Y/N) option on the System Alarms Display screen disables the Major Alarm LED indicator on the AAC as well as the external audible alarms. It does not clear the alarm condition.

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The *Cisco VCO/4K Card Technical Descriptions* and *Cisco VCO/4K Mechanical Assemblies* describe major and minor alarm conditions for individual circuit cards and subsystems.



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### Screens for Monitoring Alarms

The following system administration screens provide indications of system alarms:

- **System Alarms Display**—Provides a general description of the alarm condition, the alarm's severity, and its number of occurrences.
- **Card Alarm Display**—Provides detailed information on alarm conditions for all network interface cards and service circuit cards.
- **System Host Configuration**—Provides detailed information on host link alarms.

### System Log File

The system log file provides information on general alarm conditions. It contains combination messages with both ALM and FRM prefix codes to indicate alarm conditions. These messages are written to the log file only at the initial occurrence of the alarm condition; similarly, messages are generated only for the clearing of the last occurrence of the alarm. In addition to these messages, an optional periodic alarm report can be written to the log file five minutes after system initialization and at 30-minute intervals thereafter. This option is activated or deactivated in the System Features screen (refer to the *Cisco VCO/4K System Administrator's Guide*).

The *Cisco VCO/4K System Administrator's Guide* discusses administration screens that display alarm conditions and system log file alarm messages.

### Alarm Condition (\$F0) Report

The Alarm Condition (\$F0) report notifies the host of alarms. This report provides the same level of information to the host as the System Alarms Display provides to the system administrator. Alarm codes within the report map to the same ALM alarm messages that appear on the System Alarms Display and in logfile messages. Refer to the *Cisco VCO/4K Standard Programming Reference* and *Cisco VCO/4K Extended Programming Reference* for a description of the \$F0 report.

### Diagnostics Menu

The Diagnostics menu offers the following options:

- *Create voice paths between ports:* You can map a receive port to a transmit port in the system. Use the Set Up Paths screen to create up to eight paths and to maintain and display all the paths.
- *Display card or port data:* The Card Display and Port Display screens show the current operating status of a service circuit or interface card without taking the card out of service. Information on the Card Display varies according to card type. Access the Port Display through the Card Display screen. The Port Display shows processing states, rule processing, links, paths, and digit collection activity.
- *Display conference data:* In systems equipped with SPC cards, the Conference Menu shows the current status of participating line, trunk, and conference ports for any conference structure. An additional screen, the Conference Display, supports multiple screens, each containing listings for up to 14 conference parties. Refer to the *Cisco VCO/4K Conferencing Guide* for additional information on the VCO/4K's conferencing capabilities.
- *Test service circuits:* The Service Circuit Test Utility allows you to initiate tests on selected service circuit cards in the system. The system displays the results of the tests on the system console screen and sends them to the system printer.

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- *Test port cards:* Use the Test Port Card function to test individual T1 Card (T1) channels or ISDN B-channels. The test sets a path over the selected channel(s) between selected DTMF or MF receiver circuit(s) and a tone channel, and then sends digits to the receiver. The system compares the digits sent with the digits received. If it detects any discrepancies, it sends an error message, the two digit test strings, and the addresses of the channel to the error log and the system printer. You can test any or all channels on the same card with a single command. Test the channels in sequential order from the start channel specified to the end channel specified.
- *Display virtual call generation port data:* The Call Generation Ports Display shows the status of all virtual call generation ports. A virtual port is a logical entity maintained by VCO/4K generic call processing as an internal resource group. You can also call up the Port Display showing the status of all ports in this special resource group.
- *Monitor call progress tones during call processing:* The Call Progress Tone Monitor screen shows the detection of call progress tones on a line or trunk port. A CPA port detects signaling events that occur during a call. The screen displays event detections, current port states, and transitions for the monitored line or trunk port and for any attached line or trunk port.

For a complete description of these functions and usage instructions, refer to the *Cisco VCO/4K System Administrator's Guide*.

## System Reset Procedures

The *Cisco VCO/4K System Administrator's Guide* and the *Cisco VCO/4K Hardware Installation Guide* provide detailed procedures for booting the system from hard or floppy disk. The following sections describe the maintenance implications of a system reset.

### Nonredundant Systems

A critical or major alarm in a nonredundant system might cause the AAC to initiate a reset (reinitialization) of the Combined Controller. (A fatal alarm condition always causes a system reset.) The CPU is cleared of all current data, thus dropping all calls in progress. Service disruption lasts until the entire reset process is complete.

Resets are not required to service the Combined Controller (where the floppy drive resides) and/or the Storage/Control I/O module (where the hard drive resides), or to replace an NBC3.

### Redundant Systems

A critical alarm in a redundant system can cause the AAC to switch over to the standby controller. (A fatal alarm condition always causes a system switchover.) Port states are maintained during switchover processing to minimize disruption of service.

An enhanced redundancy feature enables the standby controller to process the new SETUP redundancy information. Both the active and standby controllers consistently track all ports in a stable or setup state, as well as conference calls.

A standby controller can be serviced while the active controller maintains system operation.

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**Note**

To avoid an inadvertent reset or switchover between controllers, set the **Select** switch on the AAC to the active controller side—not in the AUTO position. Return the **Select** switch to the AUTO position after you have completed servicing one side.

Automatic synchronization utilities copy and restore files from the active to the standby controller prior to restoring the standby controller to service. You can reboot standby controllers from hard disk or floppy disk without disrupting system operation.

## Service Circuit and Trunk Card Downloads

The following service circuit and trunk cards require a software download from hard disk prior to being brought into service:

- NBC3
- MVDC-T1
- IPRC
- CPA
- PRI/N
- E1-PRI
- SSC (Subrate Switching Card)
- Drop and Insert Card
- DRC-24 and DRC-48
- Four Span Programmable T1 and Four Span Programmable E1

During initial system power up (cold reset), the software downloads are broadcast simultaneously to each card type. The system is restored to operation after all downloads have been completed. If an individual downloadable circuit card is removed and replaced, it is selectively downloaded when its power-up sequence is completed before being activated.

## Repair-by-Replacement

The Cisco repair-by-replacement policy provides maximum system availability with minimum downtime. The technician can remove and replace field-replaceable units (FRUs) to bring the system back to normal operation as quickly as possible. Components removed from service can be returned to the factory for quick turnaround repair.

## Spares Inventory

To maintain maximum system availability, Cisco encourages the customer to purchase spares of critical components to have on hand when a component failure is isolated and replacement is required. The *Cisco VCO/4K Hardware Planning Guide* lists spare components available from Cisco Systems.

Obtain spare parts and maintenance kits for peripheral equipment from OEM suppliers. Peripheral and host link cables are available from Cisco and computer supply sources.

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## Field-Replaceable Units

The *Cisco VCO/4K Hardware Planning Guide* lists spare components that can be replaced in the field by trained technicians. It lists the recommended spares for the VCO/4K system. Items not in the list can only be serviced or replaced by the factory or by Cisco Systems field engineers.

## Troubleshooting

For more information about troubleshooting, refer to the *Cisco VCO/4K Troubleshooting Guide*.