CHAPTER 5

Software and System Capacity

System Configurations

Performance is most critical in heavily loaded and fully configured systems; this chapter deals primarily with systems that have these types of configurations.

This information is derived from testing that closely simulates real-world system configurations. Your system may, because of the many variables involved, need some further tuning to achieve desired results. The guidelines presented in Chapter 6 apply to all systems and will ensure the most effective results.

Software Functionality

When the information in this chapter is influenced by the VCO/4K system software, functional downloads to hardware, or chosen protocols, specific information is provided. The effect of host application software is beyond the scope of this information. Cisco recommends that you closely coordinate your system hardware configuration with your host application developer.

Scalability

Performance, configuration, and system scaling are all closely interrelated. Refer to this guide if you are adding hardware or functionality to an existing system. System expansion is easier and more efficient if the system was configured from the beginning with consideration for future performance as well as for initial needs.

Current Performance Capacities

Many factors contribute to total system performance. This chapter identifies those factors that are influenced by the VCO system design. Several call models based on real-world customer installations are also presented to illustrate how systems have been configured to meet specific needs.

Overview of Performance Limits

All VCO systems have an A bus and a B bus, which together allow access to approximately 2,000 ports (2K systems). Only VCO systems that are equipped with a C-bus hardware kit are capable of accessing approximately 4,000 ports (4K systems).

Note All VCO/4K chassis have the C-bus kit installed at the factory. The C-bus kit must be installed, if needed, in the VCO/20 chassis.

The extended mode API for 4K systems supports increased addressing capability as a result of the C-bus. Both 2K and 4K systems can use the extended mode API, but only 4K systems have access to 4,000 ports.

Often it is best to develop an application in extended mode API even for 2K systems. Frequently 4K systems are later added to an installed base; thus applications written for 4K mode will run in either system.

Table 5-1 describes the interoperability between the two modes and the two APIs.

Table 5-1 Relationship Between 2K Mode and 4K Mode Systems and the Standard and Extended API

	API	
Operating Mode	**Standard**	**Extended**
2K mode (no C-bus)	Yes	Yes
4K mode (C-bus)	No	Yes

System performance, as measured by call rate, depends on the following:

- The call models that are being used
- The protocols employed
- Individual card hardware design limits
- Interactions between cards (especially the SPC/ICC relationship in 4K systems, at present)
- The host hardware (and the application software on the host)
- The complexity of the call handling, and other functionality choices particular to the installation
- Network traffic on a host-controlled system

A 2K system is limited to two internal time division multiplexing (TDM) buses, identified as the A and B buses. The addressing capacity for each bus is 1024 time slots, or 2048 time slots in total. Of this total, some time slots are used by the system. If a 2K switch is properly configured and takes into account the limits of other resource capacities, it can support up to 1936 nonblocking ports (see Table 5-2).

Table 5-2 Time Slots Available—No C-Bus

Time Slots	T1 Spans	E1 Spans
Total	2048	
Reserved	112	
DTG	128	
Available for use	1808	
Used by network interfaces	1800	1760
Available for services	8	48

A 4K system has an additional TDM bus called the C-bus. Systems with this bus enabled are considered 4K systems. When the C-bus is enabled, it adds 2048 time slots to the switch capacity. A properly configured 4K system, operating within the limits of other system resources, can support a total of up to 4088 nonblocking ports (see Table 5-3).

Table 5-3 Spans Supported—With C-Bus

Bus / Total Spans	T1 Spans	E1 Spans
C-bus	85	64
B-bus	37	28
A-bus	42	31
Total spans supported	164	123

Design Limits

The VCO system places fixed limits on many resources as a part of its design. These limits are listed in Table 5-4.

Note The resource limits shown in Table 5-4 are the maximum design limits supported by the system. Under certain load conditions these limits may not be achieved. In addition, capacities are not cumulative—not all maximums may be supported at the same time.

Table 5-4 Fixed Resources

Resource	Unit of Measure	Limit/Value (with ICC/SPC cards only)	
		2K mode	4K mode
Total inpulse rules	per system	30	255
Total outpulse rules	per system	30	255
Max tokens per rule	per system	16	16
Resource groups	per system	63	224
Members of a group	per system	999	1920

Table 5-4 Fixed Resources (continued)

Resource	Unit of Measure	Limit/Value (with ICC/SPC cards only)	
		2K mode	4K mode
Virtual ports	per system	255	999
TeleRouter			
Tables	per system	10	10
Patterns	per system	1000	1000
Host Ethernet sockets	per side[1]	8	8
Start and end records	per system	3200	3200
Call capacity	per system	Call model dependent.	Call model dependent.
Conferences			
Total active conferences	per system	255	255
Maximum talk/listen legs	per conference	7 2-way-legs[2] + n 1-way-legs[3], or 8 2-way-legs[2]	7 2-way legs[2] + n 1-way legs[3], or 8 2-way legs[2]
Outpulse Channels	per DTG	63	63
NFAS (network and call model dependent)			
One NFAS Group (up to 20 spans)	number of ports	478B+2D, 479B+1D	478B+2D, 479B+1D
IPRCs (nonredundant/redundant)	per system	4/8	4/8
Minutes per IPRC	per card	35 minutes	35 minutes[4]
IPRC libraries	per system	16	16
IPRC prompts	per library	256	256
Time slots	per system	up to 1936	up to 4088
Total ISDN message templates	per system	96	96
Message template capacity (ISDN)	per system	15 tokens	15 tokens
Total supervision templates (Answer)	per system	24	24
Total host links (5-8 - host, 1 - telnet, 2 - SNMP)	per side	8	8
Ports (with SPC cards)			
CPA	per DSP	32	32
Conference	per DSP	32[5]	32[5]
DTMF	per DSP	32	32
MFR1 (displays as MFRC)	per DSP	32	32
MFCR2	per DSP	24	24

Table 5-4 Fixed Resources (continued)

Resource	Unit of Measure	Limit/Value (with ICC/SPC cards only)	
		2K mode	4K mode
OUTPL[6]	per DSP	63	63
SPC Cards			
SRM/SPC	per SPC card	4	4
DSP/SRM	per SRM	8	8
DTG/DTG-2 outpulse channels	per card	63	63
Card IDs (see Card ID Design Considerations, page 5-6)	per system	0 to 239 (240 total)	0 to 239 (240 total)
SPC-TONE	per system	64	64

[1] The number of Ethernet sockets that are enabled (and used) affects system call processing throughput.

[2] A 2-way-leg is a port (leg) that has talk and listen capability.

[3] A 1-way-leg is a port (leg) that has listen-only capability.

[4] IPRC is play-only in 4K mode.

[5] For 3-way conferences the limit is 30 (of 32) usable ports.

[6] SPC outpulse channels were not supported prior to V5.1(2).

System Capacities

This section summarizes performance guidelines that can be used to optimize your system. These guidelines are based on Cisco Systems test results and field deployments.

Existing Capabilities

This section contains recommendations and examples to illustrate changes that were implemented at field sites to improve performance.

Configuration Guidelines for VCO/4K Systems with Service Circuits

Service circuits include: SPC-DTMF, SPC-CPA, SPC-MFR1, SPC-MFCR2, SPC-CONF, SPC-TONE, and SPC-OUTP (V5.1(2) and later).

Note In VCO/4K systems having both SPC and DTG OUTP resources, do not change the status of a DTG card to out of service unless you first verify that the SPC-OUTP card is in service and is added to a resource group.

Table 5-5 lists current issues and possible solutions for systems with the SPC card.

Note The primary purpose of the SPC card configuration suggestions in Table 5-5 is to maximize throughput in high-traffic situations. This does not mean that an SPC card will not support more than two SRMs. The core idea is to evenly distribute the load across SPCs, SRMs, and DSPs.

Table 5-5 SPC Card Capabilities

Issue	Recommendations for Improving Performance
To maximize simultaneous seizures (SPC-DTMF)	Physically interleave the DSPs as you assign them to resource groups. For example: 1-1-9-1-1 1-1-10-1-1 1-1-9-1-2 1-1-10-1-2
SRM module distribution on SPC cards	Whenever possible, distribute the SRM load over the SPC cards evenly. Instead of using one SPC with four SRMs, use two SPCs with two SRMs each.
DSP algorithms	Configure the DSPs on an SRM with different resource types. Rather than configuring all DSPs on an SRM for DTMF type, for example, interleave them with CPA type (depending on the call model) from the Card Maintenance screen.

Configuration Guidelines for VCO/4K Systems with ICC Cards

Table 5-6 lists the current issue and possible solutions for systems with the ICC card.

Table 5-6 ICC Card Capabilities

Issue	Recommendations for Improving Performance
ICC Card Resource Groups	Interleave resource groups such that the same SRM/DSP within a group or same set of ICC spans do not assume most of the load. ICC resource groups should be set to cyclic hunting. For maximum performance, the load per ICC card should be limited. Ensure that the NBC3 card LP-140 is at the latest revision.[1] Physically check boards to ensure that all other cards are at the latest revision[1].

1. Refer to the Cisco VCO/4K System Software Version 5.x(x) Release notes for each release.

Card ID Design Considerations

The system is designed to permit no more than 240 card IDs (0 to 239) in total.

A card ID is assigned to every resource based on the card type. A single-span card is assigned a single ID, a multispan card is assigned an ID for each span. For example, a 4xT1 would be assigned four IDs, and an ICC card with 16 spans would be assigned 16 IDs. An SPC card is assigned an ID for each DSP

configured. Therefore, an SPC card with a full complement of SRMs and DSPs would be assigned 32 IDs. All resources require a card ID, but not all resources added to a VCO/4K take up time slots. DTMF, MF, and CPA resources do not take up time slots.

The number of IDs assigned can become an issue in cases where, for example, a system needs to be configured with 160 T1s, (160 card IDs) and it also needs 12 SRMs (configured for DTMF, MF, and CPA—96 card IDs). This results in a total of 256 IDs for these cards, and the system is then exhausted of card IDs before all the card resources can be added.

In most system configurations, as resources are added which take up time slots, the system runs out of time slots before the card ID limit of 240 is reached. However, since DTMF, MF, and CPA do not take up time slots but they are assigned a card ID, a potential exists where adding a large number of DTMF, MF, or CPA resources could result in a configuration where a system could run out of card IDs.

If your system requires a large number of DTMF, MF, and CPA resources, then carefully plan the ID resources in accordance with the number of T1 spans in your system.

ICC-T1 Mixed Protocols

The ICC-T1 can be configured with many combinations of ISDN and non-ISDN protocols. Support is limited to a maximum of two protocols per ICC. Due to the vast number of combinations, Cisco Systems has not tested all possible span/protocol combinations. Do not configure the ICC-T1 with any combination of ISDN and non-ISDN protocols unless it has been tested by Cisco Systems.

Table 5-7 lists the mixed protocols tested by Cisco Systems.

Table 5-7 ICC-T1 Mixed Protocols Tested by Cisco Systems

	Test Combination		
Test	**Group/Span**	**Group/Span**	**Result**
1	ICC-T1, SF/AMI, E&M	ICC-T1, ESF/B8ZS, E&M	Pass
2	ICC-T1, ESF/B8ZS, Clear	ICC-T1, ESF/B8ZS, E&M	Pass
3	ICC-T1, ESF/B8ZS, Clear	ICC-T1, SF/AMI, E&M	Pass
4	ICC-ISDN, ESF/B8ZS, NTI	ICC-T1, ESF/B8ZS, E&M	Pass
5	ICC-ISDN, ESF/B8ZS, NTI	ICC-T1, SF/AMI, E&M	Pass
6	ICC-ISDN, ESF/B8ZS, NTI	ICC-T1, ESF/B8ZS, Clear	Pass
7	ICC-ISDN, ESF/B8ZS, 4ESS	ICC-T1, SF/AMI, E&M	Pass
8	ICC-ISDN, ESF/B8ZS, 4ESS	ICC-T1, ESF/B8ZS, Clear	Pass
9	ICC-ISDN, ESF/B8ZS, 4ESS	ICC-T1, SF/AMI, Clear	Pass
10	ICC-ISDN, ESF/B8ZS, NI2	ICC-T1, SF/AMI, E&M	Pass
11	ICC-ISDN, NFAS	ICC-T1, ESF/B8ZS, E&M	Pass
12	ICC-T1, SF/AMI, FXOLS	ICC-T1, SF/AMI, FXOGS	Pass
13	ICC-T1, ESF/B8ZS, FXOLS	ICC-T1, SF/AMI, FXOGS	Pass
14	ICC-T1, ESF/B8ZS, FXOLS	ICC-T1, ESF/B8ZS, FXOLS	Pass
15	ICC-T1, SF/AMI, FXOLS	ICC-T1, ESF/B8ZS, FXOLS	Pass
16	ICC-T1, SF/AMI, FXOLS	ICC-T1, SF/AMI, FXSLS	Pass
17	ICC-T1, SF/AMI, FXSLS	ICC-T1, SF/AMI, FXSGS	Pass

Table 5-7 ICC-T1 Mixed Protocols Tested by Cisco Systems (continued)

Test	Test Combination		Result
	Group/Span	Group/Span	
18	ICC-T1, ESF/B8ZS, FXSLS	ICC-T1, SF/AMI, FXSGS	Pass
19	ICC-T1, ESF/B8ZS, FXSLS	ICC-T1, ESF/B8ZS, FXSLS	Pass
20	ICC-T1, SF/AMI, FXSLS	ICC-T1, ESF/B8ZS, FXSLS	Pass

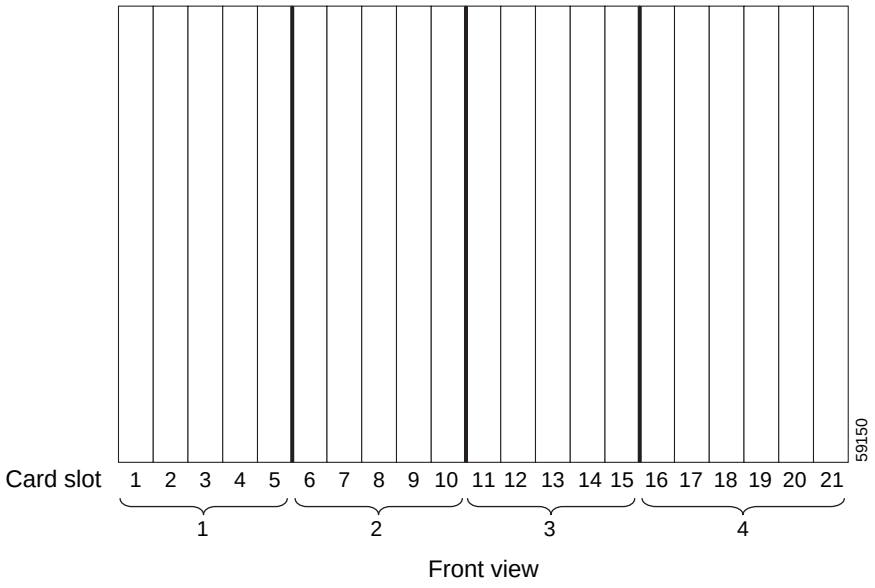
Guidelines for Matching Database and Physical Cards

System performance can be improved if you ensure that the database assignments correspond to the physical cards in the system. In particular, you should not have ICC spans defined that are not connected but which are in a maintenance state or an alarm state. The system will poll these spans as though they were active. This is unnecessary overhead.

Power Distribution Guidelines

The DC power is distributed to the midplane in four quadrants in a VCO/20 or VCO/4K system. These translate to slots 1 to 5, 6 to 10, 11 to 15, and 16 to 21. (See Figure 5-1.) If fully loaded SPC cards are installed in a single quadrant, they may draw enough current during download to compromise the midplane power distribution. Distribute SPC cards in separate quadrants to alleviate this problem. Because there are two NBC cards and two Combined Controller cards in a redundant system, only three quadrants (2, 3, and 4) are available in those systems.

Figure 5-1 Four VCO Midplane DC Power Distribution Quadrants



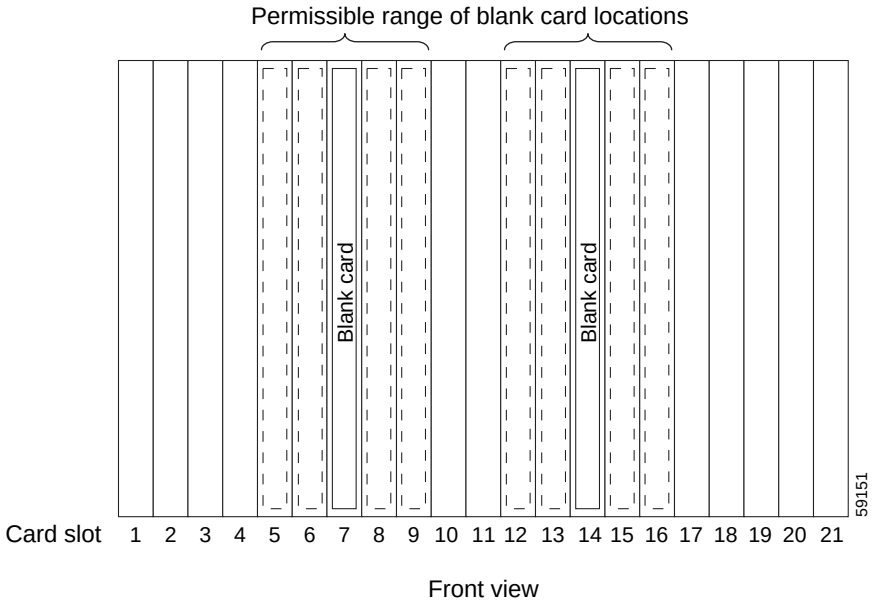
Blank Cards Required to Maintain NEBS Compliance

Depending on the system you ordered, your VCO/4K may have been shipped with two blank cards that are integral to maintaining NEBS GR-63-CORE compliance for the system. These cards have a metal blade in place of the usual PCB. The metal blade compartmentalizes the system to retard the propagation of fire within the card cage. (See Figure 5-2.)

These blank cards must remain within two slots of their original locations (normally, systems are shipped with the blank cards in slots 7 and 14). If the system is fully loaded, these cards may be replaced by functional cards.

Note The blank cards are an additional requirement to a full complement of blank faceplates on unused slots. Both are required.

Figure 5-2 Location of Blank Cards for NEBS Compliance



Scalability from Single Span and 4xE1/T1 Cards

The migration from single span and 4xE1/T1 port interface cards to ICC 8- and 16-span cards does not support a direct scaling of capacity.

The system and card limits are a result of design limitations at several points in the overall capacity. As an example, a 16-span ICC card will not carry 16 times the number of calls that a single-span card would.

The ICC card has the following advantages:

- Greater physical port density
- Reduced cost per port