



Data Center Management

How Cisco IT Operates,
Manages, and Protects Its Data
Center



A Cisco on Cisco Case Study: Inside Cisco IT

Overview

- The Cisco® IT Operations Data Center on the San Jose, California campus is one of five Cisco production data centers worldwide

Supports Cisco's intranet systems, enterprise resource planning (ERP) systems such as financials, data storage, IP telephony infrastructure, and a multitude of other employee-facing applications and databases

Houses the Operations Command Center (OCC), which monitors business-critical resources within Cisco data centers worldwide

Occupies 14,269 square feet and consists of four areas:

Cisco IT OCC

“Original” data center constructed in 1999

Build room

“Expanded” data center added in 2001

Cisco OCC

- Facilitates problem resolution for significant failures that could affect business continuity
- Tracks and responds to high-priority issues regarding priority-1 (P1) and priority-2 (P2) systems located in the five production and 41 engineering data centers worldwide
- Monitors about 8000 P1 and P2 hosts, including switches, routers, and servers across all operating systems and architectures, in addition to 374 P1 applications and 500 P2 applications

Cisco OCC (Contd.)

- San Jose OCC staff monitors network 6 a.m. to 6 p.m. Pacific Time
- Similar command center within Divyasree data center building in Bangalore, India, monitors network 6 p.m. to 6 a.m. Pacific Time

Cisco OCC



OCC Responsibilities

- San Jose building 12 OCC staff provide communication, coordination, and documentation during incidents involving a P1 or P2 host or application
- Communication — Letting the right business or support groups know about the existence of a down or degraded resource
- Coordination — Getting all duty support responders required to identify and resolve a problem to talk together to keep the resolution process active
- Documentation — Capturing every detail of the incident, from a short-term fix to a full recovery, in real time

OCC Monitoring

- OCC uses the Enterprise Management (EMAN) monitoring tool to perform resource monitoring, automatic page alerting, change management tracking, and availability measurements
- Sends out series of two “pings” every 15 seconds to 10,000+ resources it monitors 24 hours a day
- If a resource fails to respond to one of these, EMAN reports a degraded service condition

OCC Monitoring (Contd.)

- If the resource fails to respond to these pings four times consecutively, EMAN reports zero percent availability—the resource is down
- Failures associated with P1 and P2 resources are displayed in red on monitors within OCC

OCC Monitoring (Contd.)

The screenshot displays the Enterprise Monitor web interface in Microsoft Internet Explorer. The browser address bar shows the URL: <http://eman/opdata/EnterpriseMonitor/monitor.mcgi>. The page title is "Enterprise Monitor" and the breadcrumb navigation is "EMAN > OPDATA > Real-time Monitoring > Enterprise Monitor".

The interface is divided into a left-hand navigation pane and a main content area. The left pane includes sections for:

- Priority:** A set of checkboxes for priority levels (P1, P2, P3, P4, P5, P6, SO, N).
- Monitors:** A dropdown menu currently set to "ALL".
- Group By:** A dropdown menu currently set to "Hosts/Apps".
- Hosts/Applications:** A list box with "ALL" selected, and other options like "WAN", "LAN", and "HOST".
- Hostname:** An input field with a note: "use * for wildcard, comma for multiple hosts".
- Area:** A dropdown menu currently set to "ALL".
- Support Group:** A dropdown menu currently set to "ALL".
- Action:** Buttons for "DOWN", "STATUS", and "ACK MULTIPLE".

The main content area displays a list of monitoring items, grouped by category:

- DNS:**
 - [dne-sj1-33](#) (DNS) (read) P2 75% ↑ 52 ms using dne- [New Link] [Test] [Info] [Help] [Close]
- LOCATR:**
 - [tools20](#) (LOCATR) P2 75% ↑ 385 ms using dne- [New Link] [Test] [Info] [Help] [Close]
- PAL Rewrite:**
 - [tools20](#) (PAL Rewrite - Partner Access onLine) P2 75% ↑ 104 ms using dne- [New Link] [Test] [Info] [Help] [Close]
- StatusToolOrder:**
 - [ccc-sj-1-20](#) (StatusToolOrder) P1 66% ↑ 4500 ms using dne- [New Link] [Test] [Info] [Help] [Close]
- StatusToolReturn:**
 - [ccc-sj-1-20](#) (StatusToolReturn) P1 66% ↑ 5820 ms using dne- [New Link] [Test] [Info] [Help] [Close]
 - [ccc-sj-2-20](#) (StatusToolReturn) P1 66% ↑ 5769 ms using dne- [New Link] [Test] [Info] [Help] [Close]
 - [ccc-sj-3-20](#) (StatusToolReturn) P1 66% ↑ 8847 ms using dne- [New Link] [Test] [Info] [Help] [Close]
- cci tools:**
 - [ccireb-sj-bee1-admin-20](#) (cci tools) (Prod JVM for cciapp-sj-21) P1 75% ↑ 146 ms using dne- [New Link] [Test] [Info] [Help] [Close]

Other OCC Responsibilities

- EMAN supports change management, which is tightly integrated with the EMAN alerting process and availability monitoring
- OCC monitors all approved change requests within their window of implementation—approximately 80 each day
- OCC team also involved with month-end and quarter-end data processing, a large set of batch jobs run to close the monthly financial cycle

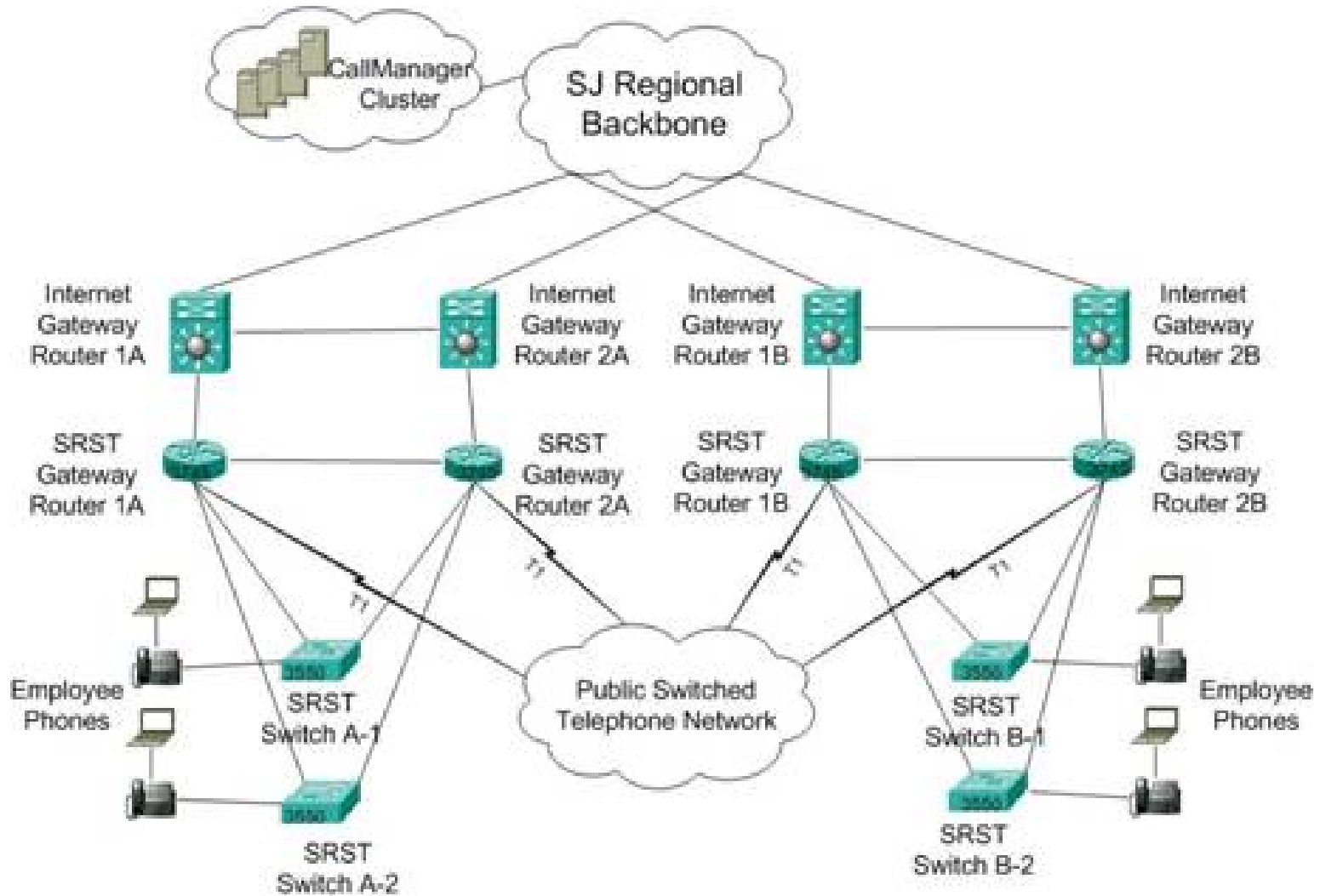
OCC Backup

- OCC redundancy and disaster recovery are in place to ensure uninterrupted monitoring and problem resolution
- During “day shift” Pacific time
 - Primary data center OCC failover to secondary data center OCC in San Jose, California
 - Secondary OCC failover to a virtual OCC out of OCC staff homes with their laptops and VPN connections
- During day shift India time
 - Primary (Bangalore) OCC failover to secondary building (Bangalore)
 - Secondary failover to virtual OCC out of OCC staff homes with their laptops and VPN connections

OCC Backup (Contd.)

- Failover capability and automatic reroute at OCC shift change made possible through IP telephony infrastructure built on Cisco® AVVID (Architecture for Voice, Video and Integrated Data) technology
- IP telephony service within the two San Jose OCCs has been equipped with Survivable Remote Site Telephony (SRST) to provide disaster recovery
- For data, a disaster in the San Jose building 12 data center would initiate a failover to Research Triangle Park, North Carolina, where all backup ERP and Cisco.com applications and data are stored

SRST in the OCC



Build Room

- Build room provides an area for equipment vendors to rack, stack, configure, and burn in new systems before they go into production and try new equipment and configurations
- Cabling and network architecture in the Build room is designed to flexibly support quick equipment changes
- Network cabinet in every half row of each of four rows makes connecting and reconnecting new equipment and moving equipment much easier by not having to pull new cable the length of the room

Build Room (Contd.)

- Cisco® Catalyst® 6500 Series Switch within network cabinet in each half-row of the Build room
- Cisco Catalyst 6500 Series used in all Cisco IT data centers to connect data center resources to the desktop LAN
- Cisco 3600 Series Router also in each network cabinet



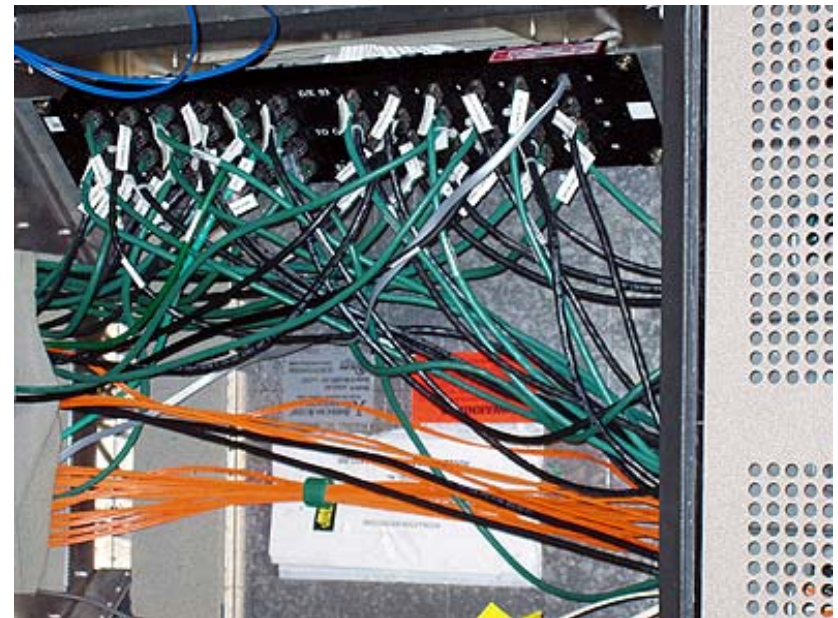
Build Room (Contd.)

- Cisco 3600 Series used to connect all server console serial ports and concentrate them
- Putting all the console ports on the network eliminates clutter of individual keyboards and monitors traditionally attached to each device



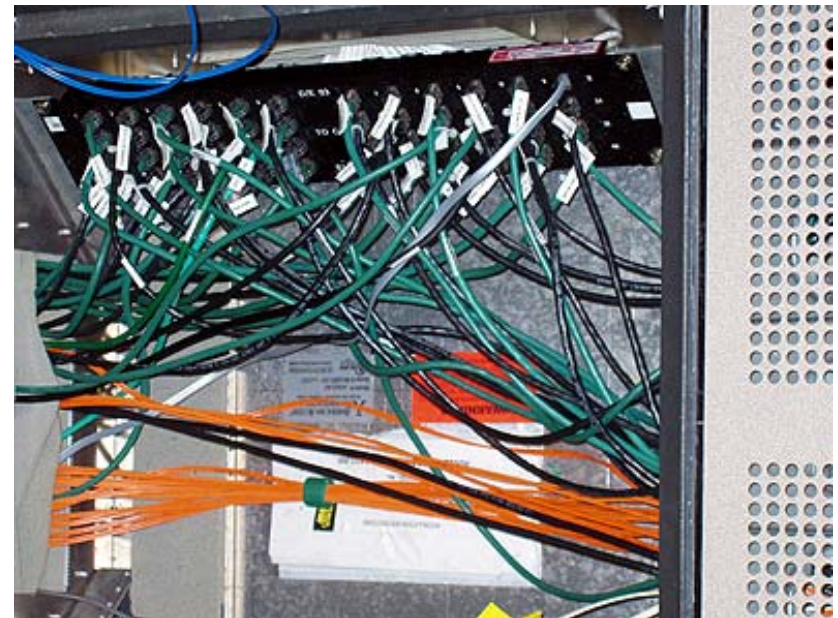
Build Room (Contd.)

- Standardized cabling system in Build room
- Cable breakout box under each floor tile connected to 12 or 24 fibers and clearly labeled with port numbers



Build Room (Contd.)

- Connecting a new device is as easy as dropping a patch cable to the breakout box, going to the zonal cabinet—which is clearly labeled with the row, breakout box, and port—and plugging that into Cisco® Catalyst® 6500 Series Switch
- Engineers no longer must pull a series of floor tiles or cables



Data Center

- Equipment within the data center, as in the other four production data centers, is largely supported directly by vendors under contract with Cisco IT
- Vendors perform upgrades, changes, and troubleshooting and repair if a problem arises with equipment
- Because support contracts stipulate that equipment is to be left in its vendor state of packaging, much of the equipment is installed with its original cabinetry rather than in standard engineering racks
- San Jose building 12 production data center uses a single rack of network equipment at the end of the data center, unlike the Build room where a network rack is situated at the end of every half-row

Data Center – Vendor Access

- Modems

Many of the storage frames have modem boxes to allow vendors to remotely monitor their equipment

If a device experiences a problem, it automatically calls the vendor

Vendor can then dial in through the same modem and diagnose the problem

Analog modems will soon be replaced by a VPN solution over the Cisco® IP network and the Internet

Data Center Storage

- Storage

San Jose building 12 data center contains about 800 terabytes of storage

Nearly all frames connected directly to each host until 2002

Connecting two or three hosts to a storage frame was inefficient, causing storage frames to be underutilized

Now, hundreds of hosts are connected to a group of storage frames through a Storage Area Network (SAN), creating a large, efficient pool of shared storage supported by Cisco® MDS 9509 multilayer director switches

San Jose building 12 data center also provides tape storage for vital records, however, backup storage for San Jose is in the RTP data center, which acts as a hot standby site

Data Center Servers

- Servers

San Jose building 12 data center houses many servers in distributed environments that can be stacked and pooled together

Most run Linux and Windows OSs

Some are large, supporting multiple e-commerce applications

Others are smaller and highly specialized, such as the five Cisco® CallManagers, taking up a quarter rack, that replaced a PBX in each of the 51 San Jose campus buildings



Data Center Cabling

- Cabling Beneath the Raised Floor

Cable layout under the raised floor in the San Jose building 12 data center and other production data centers has been standardized

Network cables rest in suspended trays closest to the raised tiles

Power cables located near the concrete floor

- Provides vertical separation from the network cabling

- Horizontal separation created by running network cabling beneath one row of tiles and power beneath another row in each aisle

Copper grounding wire closest to the concrete floor arranged in a two-foot grid pattern throughout the data center

Data Center Cabling (continued)



Data Center – Fire Suppression

- Fire Suppression

Two forms of fire protection, FM200 and water, are activated in stages within the San Jose building 12 data center



Smoke Sensor

Smoke detection by one of many sensors mounted in the ceiling throughout the data center sets off an alarm, which dispatches Cisco® security

Smoke detection by two sensors begins a 30-second countdown. FM200 will discharge throughout data center unless a technician in the area presses one of the designated panels on the wall to suspend the countdown

When FM200 is released, dry sprinkler pipes fill with water and sufficiently hot fire beneath one or more of the sprinklers will trigger the release of water in area of fire



Water and
FM200
Nozzles

Data Center – Earthquake Protection

- Earthquake Protection

Seismic isolation platforms in the main San Jose production data center allow equipment to survive an 8.3 earthquake with little or no damage

Platforms contain two parabolic plates with a large ball bearing in between them

Hosts or frames are fastened to the upper seismic plate with nylon straps, which allows the upper portion of the platform to remain relatively stationary while the lower portion and ground move side to side in an earthquake

Extra slack in cabling prevents disconnection in all but the largest tremors

Data Center – Earthquake Protection (Contd.)



Data Center – Temperature Sensing

- Temperature Sensing System

Concerned with temperature at the frame or host, Cisco® placed temperature sensors in many of the racks and frames, distributed in a grid-like pattern

Sensors connect to an IP-based console network for remote monitoring

Alarm is sent to OCC if temperature at any sensor exceeds threshold

Sensors have eliminated two or three temperature-related system problems a year



**Temperature
Sensor**

Data Center – Power Distribution

- Power Distribution

Hosts getting smaller, increasing power drops per rack, and many require redundant power supplies, separate power drops, or both to the same device, putting strain on power distribution system

In newer section of San Jose building 12 data center, three power distribution unit (PDU) cabinets deployed

Drops run from each PDU to three circuit breaker distribution cabinets in each row

Physical circuits run under the floor to each frame, supplying ample connections for power drops and separate power sources for power redundancy where required

Data Center – Power Backup

- Power Backup and UPS

Uninterruptible power supply (UPS) system and dual backup generators provide continuous power to data center in the event of power failure

Power flows from the power grid through UPS system, providing the data center with filtered power during normal operation

If grid power lost, battery power from UPS system supports entire data center for up to 20 minutes

Cisco® maintains three UPS systems, but only two are needed to support full design load of data center, providing N+1 redundancy

Data Center – Power Backup (Contd.)

- Power Backup and Generators

When power is lost, two backup diesel generators begin to spin-up to full power within 20 seconds

When fully running and synchronized, generator power is sent through the UPS system, which also recharges the UPS batteries

One generator is sufficient to supply the load for the entire data center, but a second generator provides backup

Because it can be difficult to determine the state of the power supply (grid, UPS, or generator) two lights were installed in the data center: Red for UPS, blue for generator

An IP closed-circuit camera allows the OCC to monitor the lights remotely



To read the entire case study, or for additional Cisco IT case studies on a variety of business solutions, visit Cisco on Cisco: Inside Cisco IT

www.cisco.com/go/ciscoit



CISCO



Americas Headquarters

Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883


Asia Pacific Headquarters

Cisco Systems, Inc.
168 Robinson Road
#28-01 Capital Tower
Singapore 068912
www.cisco.com
Tel: +65 6317 7777
Fax: +65 6317 7799

Europe Headquarters

Cisco Systems International BV
Haarlerbergpark
Haarlerbergweg 13-19
1101 CH Amsterdam
The Netherlands
www-europe.cisco.com
Tel: +31 0 800 020 0791
Fax: +31 0 20 357 1100

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at www.cisco.com/go/offices.

 ©2007 Cisco Systems, Inc. All rights reserved. CCVP, the Cisco logo, and the Cisco Square Bridge logo are trademarks of Cisco Systems, Inc.; Changing the Way We Work, Live, Play, and Learn is a service mark of Cisco Systems, Inc.; and Access Registrar, Aironet, BPX, Catalyst, CCDA, CCDP, CCIE, CCIP, CCNA, CCNP, CCSP, Cisco, the Cisco Certified Internetwork Expert logo, Cisco IOS, Cisco Press, Cisco Systems, Cisco Systems Capital, the Cisco Systems logo, Cisco Unity, Enterprise/Solver, EtherChannel, EtherFast, EtherSwitch, Fast Step, Follow Me Browsing, FormShare, GigaDrive, HomeLink, Internet Quotient, IOS, iPhone, IP/TV, iQ Expertise, the iQ logo, iQ Net Readiness Scorecard, iQuick Study, LightStream, Linksys, MeetingPlace, MGX, Networking Academy, Network Registrar, Packet, PIX, ProConnect, RateMUX, ScriptShare, SlideCast, SMARTnet, StackWise, The Fastest Way to Increase Your Internet Quotient, and TransPath are registered trademarks of Cisco Systems, Inc. and/or its affiliates in the United States and certain other countries.

All other trademarks mentioned in this document or Website are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (0704R)