

# **Cisco IT Data Center and Operations Control Center Tour**



Overheating, Fire, and Earthquake Protection

## 8. Overheating, Fire, and Earthquake Protection

### Temperature Control

**Dick:** “Another thing you get concerned about running a data center is the temperature inside the data center. Hosts are sensitive to heat, and need to be kept cool. But our standard temperature control system in the data center only measured the heat in the room at one place—inside the air conditioning unit, on the intake side. That’s fine, it tells you when it’s hot in the room, but it only lets you know the temperature of the entire mix of air in the room.

“We still monitor that because if the entire room gets up to pretty high temperatures we want to know. If the air conditioner intake area is hot, the whole room is really hot. But it doesn’t let you know if a single host, or a group of hosts, is overheating in one small area of the room. Another option is to use temperature sensors inside the boxes and the CPUs, but that doesn’t tell you about the temperature of the whole environment in each enclosure.”

**Ian:** “We’ve done a lot of work refining our data center temperature sensing network. Our Workplace Resources facilities group – they’re responsible for maintaining the buildings – has always monitored temperature, power, and other environmental measures, but they do it from a “facilities” point of view, from the view of the whole room, the whole floor, and the whole building. IT needed to develop a different strategy about things like temperature because we’re concerned with temperature at the frame and at the host.”

**Figure 1. Temperature Sensors in a Rack**



**Dick:** “Our Data Center IT (DCIT) team came up with a nifty concept, which is ‘let’s test the environment where the equipment is, not from just one place.’ So we put temperature sensors inside some cases, near the top, plug them into the network, and monitor them periodically. That allows us to monitor temperatures at remote data centers around the world from one location. We set a range for normal temperature, and when the temperature in any case goes outside that range, an alert is sent to us on a Webpage that we monitor, and lets us know that something is wrong so we can investigate. It costs about \$150.00 for each IP-enabled temperature sensor that you can connect into the network to test the entire environment. We’ve put it in 5 to 10 different slots in the data center to give us localized feedback about the temperature.

**Ian:** “When the temperature at any of these units goes past a threshold, an alert is sent to our operations command center team. The team will see the floor plan of the data center and a map of the temperature sensors’ data, updating every five minutes. If all the sensors are high, they know it’s a systemic problem related to the air conditioning in the data center. On the other hand if only one of them is high, it could be a local system overheating or some other local problem with air flow, like a floor tile that was pulled up and not replaced, because cooled air flows under the floor.

“Without the temperature sensor network we would never have known about local overheating until one or more resources in a data center started failing. This has really helped us, because we’ve had instances where the air conditioning systems in remote data centers would start to overheat and sometimes the only thing we’d know was that our systems would start failing. We now coordinate better with Workplace Resources and they with us. That has saved us from having temperature-related system problems about two or three times a year, for the last two or three years.

**Figure 2. Server Racks Facing Each Other**

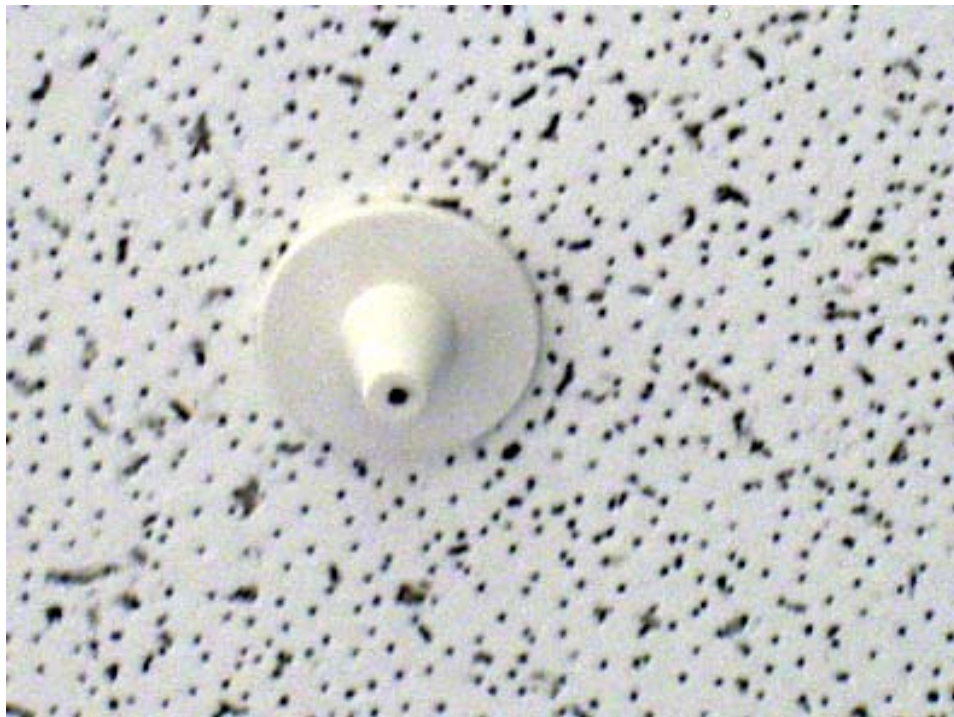


**Ian:** “The server racks face each other in pairs of rows, which helps us control temperature. Cooled air from the air conditioning units is pumped under the floor and comes up through special floor tiles. Servers pull in the cool air from the front, and push it out the back. Here in each row the backs face each other and we immediately duct the warm air up and out.

“Some people have made the mistake of having all their systems face the same way, which results in the first row getting cool air and blowing out warmer air to the back, which the next row takes in and blows even warmer air out the back, until you get a heat gradient from front to back. The air toward the back of the data center is extremely warm, and equipment in the back can fail more quickly. So we face our rows of servers front to front, and back to back, and that way it keeps the temperature relatively even throughout the data center.”

## Fire Suppression

**Figure 3.** Smoke Detector and Air Sensor on a Ceiling Tile



**Dick:** “We have smoke detectors all over the ceiling. Really, they’re not sensing the air for heat at all, they’re sensing the air for a high level of particles that would indicate smoke. We have to be careful in this room because just sweeping the floor can fill the air with particles and cause the smoke detectors to go off.”



**Figure 4. FM200 and Water Nozzles in the Ceiling**



**Dick:** “We have two forms of fire protection: FM200 and water. We have several stages of alarm, and when we get to the stage where smoke is detected, we trigger the FM200.

“FM200 is just a gigantic fire extinguisher, and works a lot like Halon. It comes in and blows out the oxygen and creates an environment that is no longer fire friendly. But it’s different from Halon because Halon takes out all the oxygen in the room, which isn’t human friendly. We were concerned that someone could be working in the far corner of the data center and not be able to make it to the doors before the Halon went off. FM200 only removes enough oxygen from the room for the fire to die off, but not enough for human beings to die too.

“We also have dry pipes for sprinklers. They don’t have water in them now. When the FM200 gets triggered, these pipes fill with water, but even then you have to have a fire beneath the sprinkler for it to drop water. The only time you’ll see water in the data center is if you get to the point where the FM200 has already gone off, you’ve got water in the pipe, and there’s a hot fire.

“We try to make sure that water is our last resort, we really don’t want to have water in the data center because water will corrode and destroy circuitry in all these machines. Unfortunately, when water gets released and there’s FM200 in the room too, the water and FM200 create a noxious mixture for the machines that is even more corrosive than water by itself. We expect that the expensive machines underneath will be entirely destroyed. But if a fire ever gets to that point, we know that the fire protection is to stop or at least slow the fire, to protect the people in the building, which is more important than the investment in the equipment.”

*Q: Has there ever been an FM200 or Halon release that you are aware of?*

**Dick:** “Not in Cisco’s environment. I’ve been in a Halon release once; a lot of data managers could tell you they’ve been in one, or at least seen a Halon or FM200 release. It looks like a whirlwind. It comes up from spouts underneath the floor all at once and with a lot of force. If you think you’ve got a clean data center, it proves you wrong. All the dust balls under the floor are blown all over the room.”

*Q: Do you ever get false alarms?*

**Ian:** “Not to my knowledge. There’s a lot of work to make sure we don’t get accidental discharges of FM200. We’ve found that what’s most important is to keep the dust level down, to prevent accidental smoke alarms going off. These alarms are very sensitive to smoke and to dust.

“One way to keep dust down is by using the Build room. We get all our boxing activities out of the way in the Build room. Unpacking boxes stirs up a lot of cardboard and plastic dust. We also hire a company that comes in twice a year or once a quarter to vacuum under our floor tiles with a HEPA filter. They clean out all the dust; otherwise, you can lift a floor tile and stir up enough dust to set off the smoke alarms.”

**Figure 5. Sticky Dust-Trapping Mats in the Doorway**



**Ian:** “And you’ll see sticky mats that you walk over in the doorway to help take the dust off your feet. There’s also more dust mitigation through the concrete floor. Concrete gets

a chalky lime layer after a few years, which is a source of dust, so we've sealed the floor and that helps control dust production."

## Earthquake Protection

**Dick:** "One thing that you'll notice here on the data center floor is that almost all the boxes are on a moveable platform. We spent about a million and a half dollars on the San Jose campus to focus on seismic isolation.

**Ian:** "We've been concerned about the impact of an earthquake on our data center here in San Jose, because this is a seismically active area."

**Dick:** "In the old days, if we had an earthquake, a big one, the boxes were either tied to the floor, bolted to the floor, or freestanding. Back then they were connected to the electrical system with heavy bussing tags so you didn't have to worry about them traveling too far but still you had to worry about them tipping over, and about whether the disk storage would be damaged.

"Because of these seismic isolation platforms, we don't worry about this in production anymore. In the engineering data center environment, they generally stay on racks that are on rollers. But with this moveable frame, they can handle an 8.2 earthquake or 8.3 Richter scale earthquake. In 1989 we had a 7.1, which was big enough. This insurance policy is basically saving us from the kind of havoc that occurs when you get a big earthquake."

**Ian:** "The earthquakes around here tend to have a horizontal displacement thrust, so the idea is the system stays still and the building moves underneath. It can move about 8 inches in any direction, which should allow us to survive an 8.3 earthquake. These platforms are just pairs of parabolic plates with a single large ball bearing placed between them. The bearing rolls around between the plates, but stays in the parabolic center."

**Figure 6. Servers on Seismic Isolation Platforms**



**Dick:** “The hosts or frames are held to the seismic plate with these nylon straps when the whole thing is moving. You want to make sure you’ve got enough cable underneath because it’s going to move a few inches in any direction and if you don’t have enough free play in the cable, they’ll get pulled out.”

**Ian:** “The idea is to help prevent the transfer of shock to the electronics. Many people bolt their systems solidly to the walls or on the floor. They’re trying to prevent things from moving, but an earthquake can still transmit a lot of shock to hard drives and other equipment, and can damage or destroy them. We’re trying to allow things to move so that we don’t transfer shock.

“Insurance will replace your sheared cables and you can plug parts and memory back in, but insurance companies cannot replace all the data you’ve lost on your disk drive. Most of our critical systems, Enterprise Resource Planning systems primarily, are being continuously mirrored to our backup data center in RTP. Every five minutes we send chunks of data over the wide area network to hot standby databases in RTP, so our most critical systems should never be more than five minutes away from our last business transaction.

“We have 800 terabytes of information stored in this data center, most of it stored as RAID 0 or RAID 1. This local backup is designed to survive single or dual disk failures. If you lose several disks in an earthquake, if you lose even a single digit percentage in your disk drive, you could end up losing whole volumes of irreplaceable data. We’re



playing a game of probabilities here, trying to reduce the number of disks that will need to be recovered from tape. Recovery can take a long time.”

*Q: How long would it take to recover a lot of data from tape?*

**Ian:** “It all depends on how much data is lost. If we lost multiterabyte volumes it could take days to replace, and it would be costly. If we had to replace multiterabyte volumes, we’d have to dedicate multiple teams working simultaneously to coordinate all that recovery. And because we back up to tape less frequently, the data would not be completely up to date, and some data would never be recovered.”

## **End**

### **Overheating, Fire, and Earthquake Protection**

You can go back to the Data Center Power section, move ahead to hear Dick and Ian conclude the tour, or you can go to any other part of the tour.

We hope you have enjoyed this part of the Cisco IT Data Center tour. You can contact your Cisco sales person to arrange an Executive Briefing Center visit, and request a live tour of the Cisco main production data center and operations control center.

For additional Cisco IT case studies on a variety of business solutions,  
go to Cisco IT @ Work

[www.cisco.com/go/ciscoitatwork](http://www.cisco.com/go/ciscoitatwork)

**Note:**

This publication describes how Cisco has benefited from the deployment of its own products. Many factors may have contributed to the results and benefits described; Cisco does not guarantee comparable results elsewhere.

CISCO PROVIDES THIS PUBLICATION AS IS WITHOUT WARRANTY OF ANY KIND,  
EITHER EXPRESS OR IMPLIED, INCLUDING THE IMPLIED WARRANTIES OF  
MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Some jurisdictions do not allow disclaimer of express or implied warranties, therefore this disclaimer may not apply to you.



## **Corporate Headquarters**

Cisco Systems, Inc.  
170 West Tasman Drive  
San Jose, CA 95134-1706  
USA  
[www.cisco.com](http://www.cisco.com)  
Tel: 408 526-4000  
800 553-NETS  
(6387)  
Fax: 408 526-4100

## **European Headquarters**

Cisco Systems International  
BV  
Haarlerbergpark  
Haarlerbergweg 13-19  
1101 CH Amsterdam  
The Netherlands  
[www-europe.cisco.com](http://www-europe.cisco.com)  
Tel: 31 0 20 357 1000  
Fax: 31 0 20 357 1100

## **Americas Headquarters**

Cisco Systems, Inc.  
170 West Tasman Drive  
San Jose, CA 95134-1706  
USA  
[www.cisco.com](http://www.cisco.com)  
Tel: 408 526-7660  
Fax: 408 527-0883

## **Asia Pacific Headquarters**

Cisco Systems, Inc.  
Capital Tower  
168 Robinson Road  
#22-01 to #29-01  
Singapore 068912  
[www.cisco.com](http://www.cisco.com)  
Tel: +65 317 7777  
Fax: +65 317 7799

Cisco Systems has more than 200 offices in the following countries and regions. Addresses, phone numbers, and fax numbers are listed on  
**the Cisco Website at [www.cisco.com/go/offices](http://www.cisco.com/go/offices).**

Argentina • Australia • Austria • Belgium • Brazil • Bulgaria • Canada • Chile • China PRC • Colombia • Costa Rica • Croatia • Czech Republic  
• Denmark • Dubai, UAE • Finland • France • Germany • Greece • Hong Kong SAR • Hungary • India • Indonesia • Ireland • Israel • Italy • Japan  
• Korea • Luxembourg • Malaysia • Mexico • The Netherlands • New Zealand • Norway • Peru • Philippines • Poland • Portugal • Puerto Rico •  
Romania • Russia • Saudi Arabia • Scotland • Singapore • Slovakia • Slovenia • South Africa • Spain • Sweden • Switzerland • Taiwan •  
Thailand • Turkey • Ukraine • United Kingdom • United States • Venezuela • Vietnam • Zimbabwe

Copyright © 2004 Cisco Systems, Inc. All rights reserved. Cisco, Cisco Systems, and the Cisco Systems logo are registered trademarks or 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. (0406R)