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Network Infrastructure: Keeping the Core Up to Date

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21st CENTURY CAMPUS REFERENCE GUIDE

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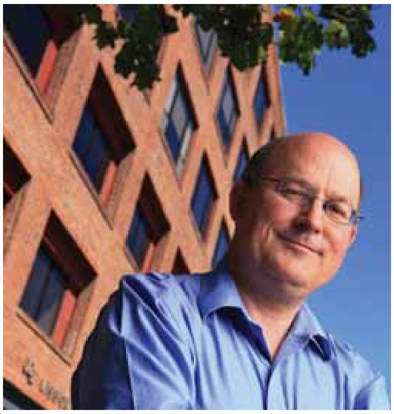

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Reporting for BootCamp

UCSF overcomes technical and logistical challenges while setting up a traffic-intensive temporary network.

Adding 350 hard-wired network connections for a day-long event would be a tall order for any IT team. When the customer making the request is one of the most visible and successful technology companies in the world, the pressure to perform amps up… just a little.

And, of course, providing the extra Ethernet nodes was only one of the challenges facing the staff at the University of California, San Francisco's Mission Bay Conference Center (MBCC) as it prepared to host Google's I/O BootCamp for developers on May 9, 2011.

"We pay a lot of attention to every customer, but this was Google," says Clifford Sacks, assistant manager for information services at UCSF's Campus Life Services. "They wanted everything to be perfect and they were happy to spend the money and the time, or ask us to spend the time, to make sure that everything was done the way they wanted it."

Held in San Francisco each spring since 2008, Google's I/O (Innovation in the Open) conference brings developers together to exchange ideas and learn how to build on the company's platforms. Last May 10-12, more than 5,000 attendees gathered in the city's Moscone Center to hear presentations mostly focused on aspects of Google's Android and Chrome operating systems.

On the day before the formal conference begins each year, the company offers BootCamp for developers who are looking for intensive technical sessions to bring them up to speed in the quickly expanding Google galaxy of products and services.

"We host a lot of technical conferences because we're a University of California campus, which gives us some cache. But this was the largest technology event we've done so far," says Sacks. "We have an excellent network and technical depth to offer, so we're a good location for it. But we knew we had to plan for technical complications because of the size and Google's requirements."

Deterring Downtime

The BootCamp event was set up in nine rooms of the MBCC, ranging from an auditorium to spaces for "office hours," where attendees could bring their individual questions for answers from Google staff or participate in small group tutorials. Each of the rooms had to be fully ready to provide high-speed connectivity, hence the 350 new Ethernet lines. In addition to the wired connections, preparations were made to provide access to UCSF's Aruba 802.11g wireless network for up to 1,200 additional devices (or, two wireless devices per user).

"The great advantage we have is that our wired network infrastructure is really good," says Sacks. "The conference center is a newer building with all CAT 6 wiring, and it's Gigabit-speed everywhere."

Still, the 600 developers signed up for BootCamp were eager to cram as much hands-on training as possible into a single day, so network downtime was not an option. Besides offering steady throughput speed, the wired Ethernet connections were planned as a way to handle the bursts of network traffic inherent in the BootCamp sessions, says Sacks.

"It was the kind of event where the person leading the session tells everyone to push a button to view a demonstration or piece of code, so hundreds of people click at once," he says. "There was no way to have wireless handle the flow without slowing it down, as we found out."

The first prep step for Sacks and the UCSF technology team was an inventory of the existing networking equipment available to support the event. They then carefully assessed the hardware needed to meet Google's requirements and moved to fill the gap between the two lists, mostly with $10,000 worth of switches and cables needed to create the hundreds of additional Ethernet connections.

Sacks and Campus Life Services computer specialist Desmond Chargualaf selected D-Link DGS 1210-48 Web Smart and D-Link DGS 1016D switches as the best choice for the project.

"For the bigger switches especially, the D-Link was best," Sacks adds. "Most of the switches on the market with the number of ports we needed are at the 100-megabit speed, rather than Gigabit speed. They might have worked, but they didn't meet our basic requirements and we were scared of bottlenecks because of the traffic."

Sorting the Spaghetti

Choosing the right switches was important, but perhaps the toughest part of the project was figuring out where and how many of them to deploy in the various rooms designated for BootCamp, Sacks says. Decisions about the number and location of switches required for each space determined the cabling needed to make the connections.

"Before we could order any equipment, we had to diagram where all the wires would be and what types of switches we needed for each room," he adds. "Once we had a plan in place for the switches, we worked out the lengths of cabling we needed. We didn't want to have to wind 10 extra feet of cable around the base of a table."

Along with the switches, UCSF purchased 300 Belkin RJ45 CAT 6 patch cables, 188 that were 25 feet long, and 112 in 50-foot lengths. Because of other space and staff commitments, Sacks, Chargualaf and two other staffers only had the day before the BootCamp event to set up the 350 hard-wired lines — and then had just one hour on

the morning of the event to restring 100 lines to accommodate a last-minute switchover from one room to another.

Even with the correctly sized cables, wrestling the wiring into orderly submission the day before BootCamp was no small task, says Chargualaf.

"We started out with an excellent game plan, but it was difficult to execute it once we got into the rooms and worked around the way the furniture was set up, and to do it in one day," he says.

Eyes on Security and Density

The aesthetic and physical safety issues that the UCSF staff dealt with are the most obvious headaches involved in setting up temporary wired connections, says Timothy Zimmerman, analyst with the tech research firm Gartner.

"Keeping the ports and cabling in order for 350 connections can be a real mess," he says. "Then there's the issue of troubleshooting: It can be pretty hard to find your problem when you've got that many cables to find and follow from the end user to a switch port. For some older conference facilities, even providing Gigabit speed and CAT 6 wiring can be issues."

Security should also be a major concern for any institution staging an event that requires temporary network installations, Zimmerman says. Separating the additional network connections from the host network by creating a virtual local area network (VLAN), using web authentication protocols and applying specific application access control policies are all steps that can help prevent a serious breach.

Because the network segment used for BootCamp was isolated from the main UCSF network, the event raised no new security concerns for UCSF's staff, according to Sacks. They did, however, have to adjust the network's Dynamic Host Configuration Protocol (DHCP) scope release time in order to provide valid IP addresses for the large number of BootCamp participants.

"The normal release time would have been too long for the setup and rotations of the conference sessions, causing users to fill up the DHCP scope, and thus not allowing future users the ability to get a valid IP address," Sacks notes.

Once BootCamp started, technical problems with the wired connections were few and quickly solved, even when a participant accidentally kicked the power supply on one of the switches, briefly knocking out part of the temporary network, says Chargualaf.

The only systemic problem that arose was a slowing of the 802.11g wireless network, as many participants skipped the wired Ethernet lines in favor of wireless convenience, Sacks says.

"The bandwidth for all of the Ethernet ports was fine, but density was a little bit of an issue for our wireless network," he says. "There were a few more users on the wireless network than Google had estimated, so the wireless was slowed down. There was still plenty of throughput, just slower. The good thing is that our slow is better than fast at a hotel, so we noticed the slowdown but the participants really didn't."

The slowdown during the BootCamp was no surprise, especially since more participants connected wirelessly than had been expected, according to Zimmerman. Maintaining wireless performance levels depends on being able to accurately estimate transaction density, which means knowing how many users and devices will try to access the network, as well as the kind of data that will be moving over the network.

"It's important to understand the performance requirements of the users at any particular event," Zimmerman says. "A conference of engineers or developers is going to have different requirements than a gathering of HR managers."

Given proper planning, there are tools and techniques available to maintain wireless performance, such as tweaking power adjustments to accommodate the number of users, bandwidth steering and load balancing, says Zimmerman.

Listen and Plan

According to Sacks, exhaustive planning and listening very carefully to the customer were the keys to the success of BootCamp.

"There were between 10 and a dozen face-to-face meetings with people from Google, dozens of calls and conference calls, and I don't know how many e-mails," he says. "In general, you have to be open to your customer and plan around their needs. There is no cookie-cutter solution."

Communication between the technical staff working on a specific event and the university's network operation center (NOC) is also critical, adds Chargualaf.

"You have to maintain a good relationship with the NOC and give them lots of time to prepare," he says. "You have to focus on the customer but you can't forget the rest of the internal technical staff."

The customer's response and the possibility of return business are, of course, the ultimate measures of how well an event such as BootCamp goes. By that standard, UCSF gets the high mark that counts, according to Caitlin Birk, senior conference planning manager for Aramark, which manages the MBCC for UCSF.

"Google is working with MBCC to rebook for next year," says Birk. "The [Google] meeting planners were happy with the amount of support received from Aramark and the UCSF network services, as well as with the capabilities of the network." ■

MOVING UP TO N

Wireless bottlenecks will soon be a thing of the past at the Mission Bay Conference Center. By the end of the year, UCSF will join the growing number of college campuses that have upgraded to the 802.11n wireless protocol, thereby providing increased bandwidth and speed to their users.

"The [university] is upgrading the whole campus and trying to get wireless everywhere," says Clifford Sacks, assistant manager, information services, atUCSF's Campus Life Services.

With theoretical speeds of up to 540Mbps, wireless-N is up to ten times faster than the 802.11g technology in place at UCSF and provides twice the range of any previous 802.11 protocol. In addition to the switch to N, the conference center will increase the number of wireless access points (APs) in each of its rooms. Both the upgrade and the boost in AP density will help prevent bottlenecks on the wireless network during future events such as Google's BootCamp, says Sacks.

Beyond event planning, a high-speed, high-access wireless infrastructure is becoming a necessity on college campuses, says Andrew Borg, analyst with the research firm Aberdeen Group.

"For the faculty, the need for collaboration means you have to address bandwidth and latency issues," says Borg. "For the students, it's all about ubiquity. They all walk around with multiple devices these days, which creates crushing density that the network has to accommodate."

UCSF will continue to use Aruba technology for the 802.11n APs and other hardware, along with the vendor's AirWave Management Suite, with a version update to support wireless-N features.

UCSF will be operating both the existing and new 802.11n networks during the transition. The wireless-N network will have a separate service set identifier (SSID) and a new firewall setting, Sacks says. As always, the aim will be to prevent any technical hiccups from affecting users, whether they're students, faculty or attendees at an event in the conference center.

"We will be running a parallel wireless system for a while, making sure everything works," he adds.

Evolving at the Core

Increasing video and mobile device traffic is leading many institutions to upgrade their network infrastructure.

The convergence of video technologies with new forms of mobile computing has some institutions scrambling to cope. This latest technological jump continues to highlight the value of staying up to date on the network's core infrastructure.

"Although many people take the network for granted, its importance has never been greater," observes Rohit Mehra, director of enterprise communications infrastructure for the market intelligence firm IDC. "With video and mobility, its relevance only continues to increase."

According to experts such as Mehra, successfully evolving the network requires adding intelligence as well as bandwidth. "It's not just about moving traffic efficiently, but also the ability to prioritize, optimize and enforce policy-based mechanisms," he says.

Video: Streaming vs. Live

When it comes to video, an institution's priorities depend on the type of video applications it expects to deploy. Streaming video, which is a one-way interaction, comes with fewer requirements than real-time interactive video, such as conferencing or telepresence.

Streaming video primarily needs adequate bandwidth. Otherwise, buffering technologies largely minimize the impacts of Quality of Service (QoS) and device handshaking requirements.

On the other hand, with real-time video interactions, it's a different story.

"For real time, you need very high-quality video," emphasizes Gregory A. Jackson, vice president for policy and analysis at the nonprofit tech association Educause. "It must be highly interactive [handshaking-intensive] and be jitter-free. You can't solve your problems with buffering."

Other experts concur. "Jitter, latency and out-of-order packet delivery drives real-time video crazy," agrees Ken Agress, research director at Gartner. "If a video frame shows up at the wrong interval, it has a much higher impact than with VoIP [Voice over Internet Protocol] services."

To address this and similar traffic concerns, savvy network administrators are adding hardware intelligence, particularly in switches.

"High-capacity, next-generation switches support network intelligence," says Mehra. "This goes beyond simply determining which applications deserve priority. Switches can also detect who is using the application and prioritize resources to match."

While the ability to determine that an instructor who is video conferencing with remote learners takes priority over a student who is web chatting is helpful, the intelligence to distinguish between peer individuals is also essential.

"It's not only the protocol of the video, it's the context that the hardware needs to detect and enforce," Mehra says. "For example, if one student is streaming a professor's content and another is Skyping with a fellow student, it's critical that network hardware can enforce resource allocation appropriately."

Also, no matter what types of video applications an institution envisions, it will want to take every opportunity to add optical fiber. "You need lots of fiber, so keep investing in it," says Educause's Jackson, who previously served as vice president and CIO at the University of Chicago.

"Pull fiber even if you don't need it at the moment," he adds. "Remember, if you need a faster router, you can get one quickly and cost-effectively. But if you don't have enough fiber to meet an emerging need, that's an expensive challenge."

Ubiquitous Access

Today, independent wireless hotspots have given way to full-featured wireless LANs (WLANs).

Essentially, WLANs comprise wireless access points (APs) that communicate with each other as well as permit devices, such as notebooks, tablets and smartphones, to jump onto the network. Wireless APs are cabled to networking switches that connect the WLAN back to a traditional wired LAN and, through it, out to the Internet.

In the past, WLANs not only required significant capital investments, they also were management-intensive. Fortunately, equipment based on the 802.11n standard is making WLAN supervision much less hands-on.

With the N standard came next-generation wireless APs sporting capabilities such as multiple input, multiple output (MIMO), IP address filtering, intrusion prevention and the ability to operate dual radio bands, 2.4GHz and 5GHz, to reduce the impact of radio frequency (RF) interference from other technologies, such as Bluetooth. Combined, such features reduce WLAN complexity and operational costs.

Some types of wireless APs even offer self-healing functions. These include the ability to reduce congestion with load-balancing or improve signal strength by analyzing the local signal spectrum and automatically self-correct for nearby RF interference.

Additionally, today's WLANs centralize management of APs by including wireless controllers, which permit pushing out information to the APs from a management console with an intuitive graphical interface. This ability, combined with using Power over Ethernet (PoE), significantly reduces the amount of time physically required for traveling to APs to troubleshoot or restart them. (For the latest on PoE, see the sidebar *Powering Up and Chilling Down.*)

Wireless Build-out Strategies

Upgrading to new wireless equipment can even prepare a college for other technology initiatives, such as VoIP in residence halls. Some institutions are deploying new N-based equipment to ensure minimum throughputs of 15Mbps for every room in a dormitory as well as support future VoIP implementations.

Indeed, keeping VoIP in mind while developing strategies and selecting networking gear can spread the cost over multiple budgets, making deployments more cost-effective overall.

Also, many institutions are approaching WLANs in waves. Rather than blanketing an entire campus in a single project, they divide their 802.11n implementation into multiple deployments based on institutional needs.

For example, dormitory-wide wireless access now serves as a differentiator for some students when deciding which institution to attend. Therefore, many universities have put a high priority on providing widely-available wireless access throughout student housing units.

Regardless, planning for scalability and flexibility leads to cost-effectively assuring that the WLAN can handle the demands of many-to-many loads.

"Each student may have two or three devices in use simultaneously," observes IDC's Mehra. "All of these devices need to get to many destinations and many applications on your LAN and beyond."

Selective Switches

Network switches play a key role in traffic flow, either serving as enablers of quality wired and wireless traffic or acting as bottlenecks.

For traffic speed, Gartner's Agress believes 100Mbps is the sweet spot for about the next five years. "One-hundred megabits [per second] switches are now table stakes," he says.

While most enterprise switches from name-brand vendors provide all of the performance characteristics needed, granularity of control becomes the real differentiator. "Focus on how granular the control is over Quality of Service configurations," advises Agress.

One granularity characteristic is the number of physical buffers. In the past, it was common to need only two different buffers, one for high-priority traffic and the other for lower priority.

Now, institutions may want to prioritize four different types of traffic, as previously highlighted by the scenarios illustrating multiple forms of video traffic. "With only two buffers, you have to force two or more different traffic types into the same physical buffer, making it difficult to avoid latency or jitter," Agress says. "So, more buffers are better."

Additionally, investing in switches that understand differentiated services (DiffServ) can be cost-effective. DiffServ marks IP packets according to the type of service they desire. According to these markings, switches use various queuing and buffering strategies to achieve the desired QoS.

In the past, the capability to utilize DiffServ was limited to Layer 3 switches, which perform numerous QoS functions because of their advanced intelligence. Today, many Layer 2 switches contain sufficient intelligence to read and respond to DiffServ tags.

"Although a Layer 2 switch can't do IP routing [like a Layer 3 device], reading DiffServ tags allows them to make priority decisions," Agress says. "In other words, they'll look a layer higher than they're actually working to help you with QoS prioritization."

Beyond Gig-E

While adding network intelligence and upgrading wireless networking are critical, evolving bandwidth capacity remains important. Institutions still relying on Fast Ethernet need to move up to Gig-E, at minimum, to implement technologies such as 802.11n. Video conferencing requires going further, to 10 Gig-E.

"Gig-E is adequate for client devices," says Mehra. "But 10 Gig-E at the core of your network is ideal for uplinks [video conferencing] and to aggregate traffic from your entire campus or for multiple campuses."

Beyond 10 Gig-E, 40 Gig-E and 100 Gig-E are on the horizon. "Many universities are already thinking about the next generation," Mehra notes. "But it'll be a couple of years before vendor products are widely available."

Completing the Picture

A few other areas for development consideration include transcoders, multipoint control units (MCUs), gateways, control systems and virtualized storage.

First, transcoders enable various IP-enabled systems to speak to each other, such as a video conferencing and a web conferencing application. "This can also prove handy for supporting different types of connections on-campus versus off," suggests Agress. "For example, perhaps you want to support high-definition broadcast-quality connections on campus but a lower-definition quality for off-campus communications."

Of course broadcast-quality connections require significantly more resources, which means quality decisions directly affect other network equipment choices. "It impacts what hardware you deploy for gateways, MCUs and control systems," Agress says.

Additionally, those planning to record video sessions must consider storage needs. "There are distinct storage requirements, depending upon how you're going to handle your recordings," says Agress. "A high-quality recording of a professor's lecture will consume hundreds of megabytes every couple of minutes."

Efficiently storing such vast amounts of content argues for a virtualized storage area network (SAN). Most virtualized SANs include powerful policy-based management tools that automatically perform otherwise-intensive chores, such as allocating space or archiving less-accessed files. ■

POWERING UP AND CHILLING DOWN

With demand for video conferencing and wireless networking heating up, new strategies are needed for powering remote gear and cooling it down. Consider these tips from the experts.

Invest in PoE+. Although the original Power over Ethernet (PoE) standard permits PoE-enabled networking switches to deliver electricity to devices through an Ethernet cable, astute organizations are moving to PoE+.

Whereas PoE delivered 15.5 watts of power per switch port, PoE+ delivers 30 watts per port. This matches the requirements of today's 802.11n wireless networking devices, security cameras and other unified communications equipment.

In addition, upgrading to PoE+ supports green initiatives.

"Because networking switches are smarter, they can power on and off PoE+-connected devices at specific times," says Rohit Mehra, director of enterprise communications infrastructure for IDC. "This ensures devices only draw power when needed, reducing carbon footprints."

Keep closets cool. With networking switches showing up in wiring closets everywhere on campus, heat must be dissipated from areas not typically served by HVAC systems.

Like any computing gear, excessive heat drastically reduces equipment lifespans and, at the extreme end of the spectrum, can start fires.

"It's absolutely crucial to do an environmental study in your wiring closets," emphasizes Ken Agress, research director at Gartner.

In addition to wiring closet ventilation devices, new compact air-conditioning (AC) units provide an ideal answer. Use such portable units as either a permanent solution or a bridge until a more extensive HVAC reroute occurs.

Depending on the design, compact AC units even include directional cooling to ensure cold air goes where it's needed the most.

Beef up reliability. Similar to cooling, campuswide switch distribution also brings new demands for backup power. Due to the ubiquity of mobile phones, some institutions are opting against powering IP phones in emergencies. However, the issues go beyond telephony.

Where switches also supply power to security cameras, provide instructions to IP-based building management systems or control other critical systems, investing in the proper electrical backup just makes good sense.

"In the event of a power outage, you need to keep the right equipment operational and ensure the cooling needs that remain are sufficiently covered," asserts Agress. "It's critical to assess uninterruptible power supply (UPS) capacity on a regular basis and make adjustments to match your reliability requirements."

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