

University of Arizona Increases Flexibility While Reducing Total Cost of Ownership with Cisco Nexus 5000 Series Switches

What You Will Learn

IT departments are moving away from expensive monolithic network and server infrastructures to flexible, dynamic architectures to reduce complexity and cost. This transition includes moving from multiple, parallel networks to one standards-based low-latency, high-bandwidth network. In mid 2009, the University of Arizona transitioned to a unified fabric supporting both data and storage traffic. Today the university is experiencing the benefits of reduced total cost of ownership (TCO), simplified purchasing, management, and network infrastructure maintenance.

Located in Tucson, Arizona, the University of Arizona is a public research university. Founded in 1885, it has more than 35,000 students in undergraduate, graduate, and professional and medical studies. The university's mission is to provide a high-quality education that engages its diverse student body in discovery through research, scholarship, and community service.

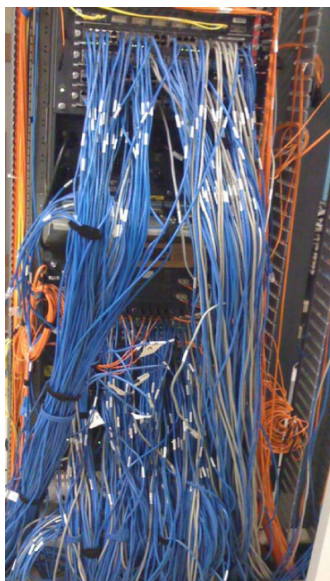
The University Information Technology Services (UITS) department facilitates and coordinates integration of technology services for the campus to enhance learning, research, and business. UITS's mission is to provide support and enhance the university's ability to fulfill its objectives through effective and efficient communications and computing solutions. UITS works collaboratively with the three communities within the University of Arizona campus: staff, faculty, and students. It provides frontline support services, infrastructure services, and enterprise application support services.

This document discusses how the infrastructure services department within UITS is transitioning to an entirely new network architecture based on the Cisco Nexus[®] Family of switches. The combination of 10 Gigabit Ethernet unified fabric and top-of-rack (ToR) architecture increases flexibility, supports the high server densities required, and simplifies operations, enabling deployment of Oracle PeopleSoft Enterprise and supporting a general and continual increase in demand for flexible, agile, centralized computing resources.

The Need to Update Applications Resulted in Modernization of the Data Center

The enterprise solutions at the University of Arizona needed updating. "Our enterprise applications had grown outdated and our planned replacements required significant new hardware. Basically, we had a lot of expansion coming down the pipe," explains Adam Michel, Senior Systems Administrator and the primary SAN administrator for UITS. The data center's network architecture was not originally designed to accommodate the server densities now available. The old model depended on large, monolithic switch chassis that aggregated all server connections in a central location, making expansion nearly impossible. "We don't have the bandwidth or port availability to add new servers, and cable management is a nightmare - we have upwards of a thousand cables and it's impossible to keep the cable map up-to-date," Michel added. In addition, the cables were run under the raised floor and were impeding airflow, causing cooling problems in some areas. Figure 1 shows the enormity of the cabling challenge of aggregating all server connections in a single networking device rack.

Figure 1. UIITS Data Center Central-Core Architecture Cabling Challenge (Photo: University of Arizona)



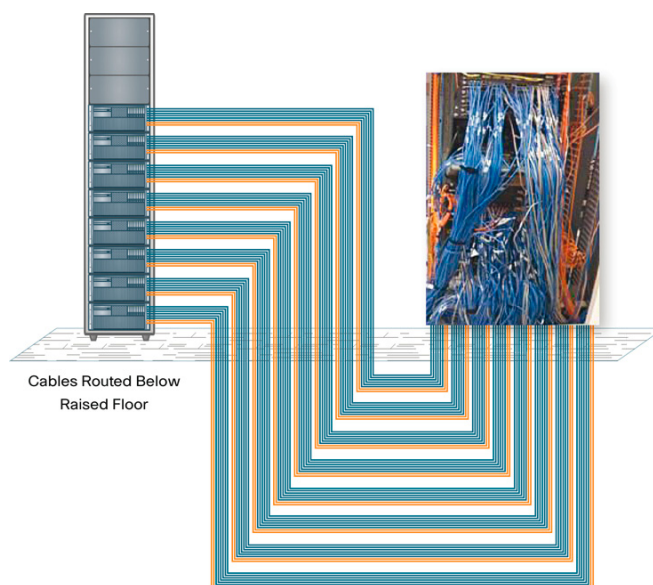
The lack of flexibility was further hampering necessary growth to support the university's constituents. Michel explains, "Our environment could not support the projected rate of growth. We were on the verge of being unable to meet our service delivery requirements with the current architecture. We just couldn't reasonably expect to meet the service delivery requirements of even the new enterprise applications, let alone the increased demand on our other central computing resources." Michel further explains, "We wanted to move to a top-of-rack architecture rather than end-of-row. Cisco Nexus, with a unified fabric, seemed like the train to be on, so we decided to get on early."

Efficient, Effective Teams

The infrastructure services department is a multifaceted group with several teams that oversee all the necessary infrastructure elements to support the computing needs of the university. The operations center team deals with the physical infrastructure: pulling cables, setting up racks with servers, and verifying that power and cooling requirements are met. The networking and infrastructure development teams handle the design and maintenance of all data fabrics and the servers and assorted devices that operate on them. Cooperation between these teams to rapidly deploy elements to support the work of the enterprise applications group is critical to their success.

Prior to the Cisco Nexus Family, when a new server was deployed, eight cables had to be pulled under the floor from the rack to the central aggregation switches (Figure 2). Each server was configured with at least two Fibre Channel host bus adapters (HBAs), dual on-board network interface cards (NICs), and one quad Gigabit Ethernet adapter, for a total of eight physical connections. The time required for this cabling and the server configuration necessary to support multiple Ethernet and Fibre Channel connections was resulting in significant overhead for service development.

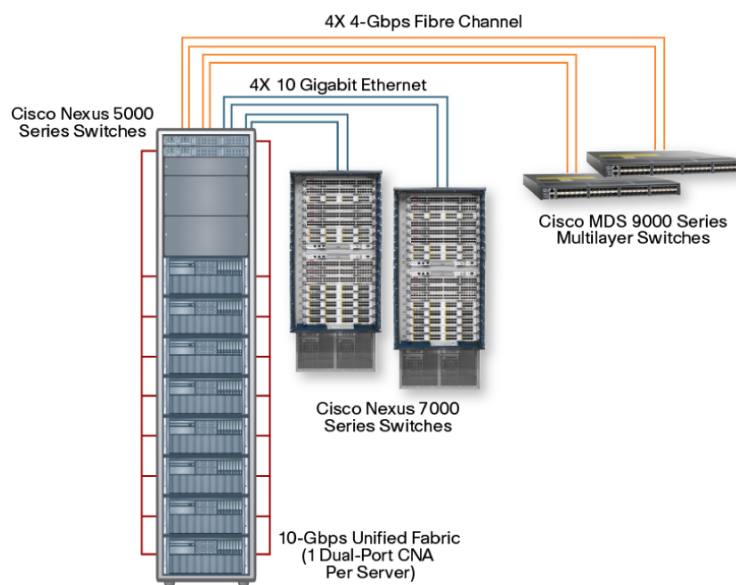
Figure 2. I/O Interface and Cabling Before Implementing ToR Cisco Nexus 5000 Series Switch Unified Fabric



To address the fabric infrastructure challenges, UITS deployed two Cisco Nexus 5000 Series Switches at the top of each rack and ran cables through ceiling cable trays rather than under the raised floor to an improved core built around Cisco Nexus 7000 Series Switches and the Cisco® MDS 9000 Series Multilayer Switches. UITS uses one QLogic 8042 or 8152 dual-attached converged network adapter (CNA) per server and the built-in Gigabit Ethernet adapter for server management. CNAs present both a physical Ethernet NIC and Fibre Channel HBA to the server's PCI Express (PCIe) bus, passing both traffic streams onto a single unified network fabric - all transparent to the operating system.

Today, instead of 8 to 10 cables per server below the floor going to a central switch, there are 2 prewired cables per server going to the ToR Cisco Nexus 5000 Series Switches, which are connected through fiber aggregation panels to the core through two six-strand fibers in ceiling trays, as shown in Figure 3. With the 10 Gigabit Ethernet infrastructure, UITS uses fewer cables and has more bandwidth and better performance to support applications than with the previous solution. In addition, cable and overall network management has been radically simplified.

Figure 3. I/O Interface and Cabling After Implementation of Cisco Nexus 5000 Series Unified Fabric



Post-Unified Fabric Implementation Experience

Moving from a central-core to a ToR architecture is straightforward. However, UITS also went from supporting the two existing parallel fabrics, Ethernet and Fibre Channel, to supporting one converged fabric that bridged the two. According to Michel, this was not difficult either. “The incremental effort to use a CNA was basically transparent to our experience with NICs and HBAs,” states Michel. “Implementing the unified fabric was effectively the same as implementing any other top-of-rack switching. Ethernet-wise, they act much like any other top-of-rack Ethernet switch. On the Fibre side, we use N-Port Virtualization (NPV) mode on the Cisco Nexus 5000 and leave the Fibre Channel configuration on the Cisco MDS, making the Cisco Nexus 5000 Fibre configuration very light.” In addition, UITS found there was no incremental management overhead associated with moving from the central-core architecture to the ToR design. The flexibility and abundance of bandwidth, according to Michel, enables very fast server deployment times. With the number of unique parts reduced, server setup also becomes easier.

TCO Benefits Achieved

When assessing TCO, both the capital costs associated with the purchase of the solution and the extended operating costs and savings are examined. The capital expenditures (CapEx) associated with the redesign to use the ToR infrastructure included:

- Cisco Nexus 5000 Series 10 Gigabit Ethernet unified fabric aggregation switches
- QLogic CNAs

Operating expenses (OpEx) included:

- Training for two UITS staff members
- Installation of the new equipment

OpEx and CapEx savings were achieved in numerous areas:

- Fewer cables to purchase and manage: The university went from up to six Cat6 and two fiber connections of 100 feet or more per server to one pair of Twinax interconnects of less than 10 feet
- Fewer adapters to purchase, install, and maintain (including firmware updates): The university went from three adapters to one dual-channel CNA
- Fewer device drivers to install and maintain: The university went from two drivers to one driver
- Server deployment cost savings: Instead of two people to pull cables and set up the rack with servers, the university needed only one
- Faster time for server deployment to production: The deployment took hours instead of days
- Quick and easy cable access: Cable access was easy using ToR switches and ceiling cable trays
- Support for higher server densities: UITS can now more readily consider one-rack-unit (1RU) servers in place of 2RU servers because of the reduced cable density and improved cooling performance, thus increasing the computing density per square foot of data center floor space
- Reduced costs for cooling: Fewer cables below the floor enable better airflow and lower cooling costs
- Consistent management: The new setup required no significant changes in LAN and SAN administrator tasks
- Simplified maintenance: All new servers are built to one I/O standard, with fewer, and standard, spares
- “Free SAN” in every device: SAN access is always available through the CNA, even if it was not configured initially, allowing the university to be agile when requirements shift over time
- High-performance infrastructure: 10 Gigabit Ethernet provides plenty of headroom with no need for additional adapters to increase bandwidth
- Flexibility: Adding a server or a rack of servers is a trivial task, taking hours rather than days

“Our cabling bulk is way down ... which frees up space in the raised floor, and that helps our cool air circulation,” states Michel. UITS achieved significant OpEx savings by moving to ToR Cisco Nexus 5000 Series Switches

Best Practices Recommendations

After completing the installation of the Cisco Nexus 5000 Series Switches, Michel had some advice for best practices for others who want to move to this more flexible infrastructure:

- **Training:** The same week-long training class was attended by both a LAN administrator and by Michel. As a result, the networking administrator learned more about how to manage a SAN, and Michel learned more about networking. This shared training enabled the two administrators to determine roles and responsibilities to achieve the most efficient division of labor when managing the new network switches. Both found they were able to build on previous knowledge of Cisco LAN and SAN products, especially management knowledge, making getting up to speed easy.
- **High availability:** UITS made the decision to use just one two-port CNA per server rather than two. This choice met availability requirements in a simpler and more cost-effective way.
- **Fibre Channel SAN connectivity and management:** UITS uses the NPV mode on the Cisco Nexus 5000 Series to simplify switch management at the server and rack levels. This choice allows the Cisco MDS 9000 Series to perform all SAN switching and zoning the same as it did before the upgrade. Thus, SAN management stayed consistent, with very few changes.
- **Organizational changes:** Good communications between the groups is necessary to implement an effective, efficient data center solution. Having the network administrator and the system administrator attend the same training built trust between the groups through a shared understanding of the solution. Roles were divided so that the LAN administrator allocates VLANs to the SAN administrator, enabling the SAN administrator to become a tenant of the unified fabric switch. Other than this, there were no functional changes to roles and responsibilities.
- **Evolutionary changes:** UITS started this transition with a new project and new hardware and is now implementing all new servers on this architecture, as old servers are replaced. When cables are unhooked from old servers, they are pulled out of the floor to be reused and to gain back airflow and space beneath the floor.

Future Plans

Beyond the implementation of Oracle PeopleSoft, UITS is committed to the new architecture for all new servers. Each one will be configured with a least one CNA connecting to the unified fabric and ToR Cisco Nexus 5000 Series Switches. The goal is to have the majority of applications running on virtual servers within this architecture. UITS is currently looking at the Cisco Unified Computing System™ platform to support this virtual environment.

Simplification Leads to TCO Savings

The Cisco Nexus 5000 Series 10-Gbps unified fabric switches radically simplify the network environment. The reduction in complexity leads to significant CapEx and OpEx savings through increased staff efficiency in deploying, managing, and maintaining the environment, thereby reducing TCO. At the same time, the Cisco Nexus 5000 Series Switches deliver superior flexibility and performance, providing the foundation for the University of Arizona data center of the future.

For More Information

For more information about the Cisco Nexus 5000 Series Switches, visit <http://www.cisco.com/en/US/products/ps9670/index.html> or contact your local account representative.



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