How Cisco IT Migrated 34 TB Oracle RAC Database from HP Superdome to Cisco Unified Data Center Platform: Unified Computing, Unified Fabric, and Unified Management

EXECUTIVE SUMMARY
CHALLENGE
• Scale mission-critical Oracle RAC database
• Eliminate downtime requirement to perform server maintenance
• Execute flawless migration to avoid disruption to customer service
SOLUTION
• Migrated 34 TB Oracle RAC database from 3 HP Superdome servers to 12 Cisco UCS B440 Blade Servers
• Minimized downtime through rigorous testing and planning
RESULTS
• Completed migration of all ERP applications to standard server platform
• Gained ability to scale vertically (more powerful servers) and horizontally (more server nodes)
• Eliminated application disruption due to node failures
• Lowered TCO by 60 percent
• Reduced runtime for batch processing by 22 percent
LESSONS LEARNED
• Develop comprehensive test cases, and measure end-to-end performance
• Obtain the latest Oracle patches before testing
NEXT STEPS
• Add C3 environment to resiliency architecture in Texas metro virtual data center (MVDC)

Migration overcame scalability limits, lowered TCO by 60 percent, increased resiliency, and improved user experience.

Background

As part of the Global Data Center Program, Cisco IT embarked on the journey to a private cloud in 2009, systematically migrating enterprise resource planning (ERP) and business intelligence applications from HP-UX to the X86-based Linux operating system on the Cisco® Unified Data Center Platform.

The effort began with less-critical applications and culminated with the largest Oracle RAC database with the biggest impact on the customer experience. The Cisco Customer Care Center (C3) is the world's first 12-node Oracle RAC implementation on Cisco Unified Data Center Platform**.** "Moving Cisco IT's complete ERP stack from HP to Cisco Unified Data Center Platform increased resiliency and scalability, lowered total cost of ownership, and improved performance for a better user experience," says John Manville, vice president of Global Infrastructure Services for Cisco.

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Challenge

The Cisco Technical Assistance Center (TAC) and Cisco Services sales organization both rely on Cisco Customer Care Center (C3), a set of 220 applications based on Oracle E-Business Suite, accessing an Oracle 10g RAC

database. Cisco Services uses C3 to manage customer engagements, store services agreements, and manage installed base. Approximately 5000 Cisco Technical Services personnel access and update the database during processes such as service delivery, parts fulfillment, and return-merchandise authorization. "C3's capabilities are the face of Cisco to many customers," says Charles Baker, senior manager of operations, Cisco Services. "Not being able to ship a replacement part because of a server issue is unacceptable."

The C3 database previously resided on an HP Superdome platform with three Oracle 10g nodes (Figure 1). Load balancing and failover of applications across nodes required manual processes.

Figure 1. Before: Manual Load Balancing and Failover, Plus Single Point of Failure for Business Unit
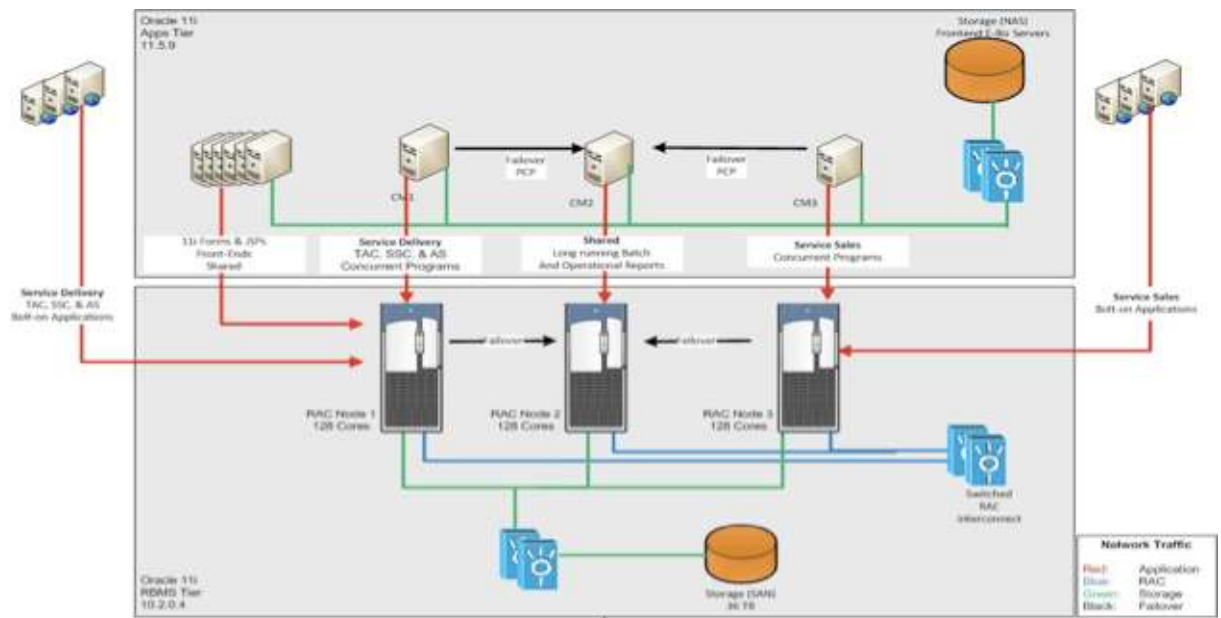
By 2011, the C3 environment had grown to 34 TB and processed more than 8000 concurrent connections from Oracle Concurrent Managers and the Java Virtual Machine. The HP Superdome had reached the limits of its vertical scalability, 128 cores, which meant accommodating projected two-year growth to 40 TB would require a new Oracle RAC node. Simply adding capacity would not address the platform's other liability: downtime resulting from server issues. "If an HP Superdome node experienced a hardware or software problem, a common occurrence, we had to schedule downtime that took one-third of all C3 applications offline, affecting the customer experience," says Jag Kahlon, Cisco IT architect. "Upgrading to newer HP servers would not improve availability." Nor would an upgrade eliminate application delays resulting from Oracle RAC Global Cache Services (GCS) waits on the HP platform. Troubleshooting and tuning Oracle RAC GCS required an ongoing effort.

Cisco IT sought a new architecture that could scale both vertically (with more powerful processors) and horizontally (with more server nodes), and would protect application availability in the event of server issues. Lengthy downtime during migration was unacceptable, because the C3 database supports vital Cisco Services activities that help customers keep their businesses operating.

"Cisco Services is one of the fastest growing businesses at Cisco," says Guillermo Diaz, vice president of Connected IT Services at Cisco. "To keep up with demands, we needed an infrastructure that could scale, improve

resiliency, and increase agility."

Solution

Cisco IT built a scalable, resilient environment for the mission-critical C3 database by migrating it from the HP Superdome Platform in the San Jose, California data center to Cisco Unified Data Center Platform in the Richardson, Texas data center, in March 2012 (Figure 2). Oracle has certified the Cisco Unified Data Center Platform for Oracle RAC 10g, 11g, and the Oracle e-Business Suite.

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"While the old platform imposed barriers to business growth, the Cisco Unified Data Center Platform simplifies growth by scaling vertically as well as horizontally," says Shaw-Jen Chang, vice president of Data Center and Platform Services for Cisco. Additional advantages of the Cisco Unified Data Center Platform for Cisco IT's Oracle RAC database include:

- 12-gigabyte-per-second (GBps) I/O throughput, double the current requirement.
- Significantly lower latency: The node-to-node latency of the unified fabric is measured in microseconds, compared to milliseconds in the HP environment.
- Rapid recovery from a node failure: If a node experiences performance issues, Cisco IT can provision any other available blade server in any chassis by clicking to apply a predefined service profile. The host is ready in seven minutes, compared to hours on other platforms.
- Wire-once architecture, lowering the time and costs of adding a new server: All servers in Cisco Unified Computing System™ (UCS®) chassis access storage arrays through a single pair of Cisco UCS 6100 Series Fabric Interconnects. Cisco IT connected the system to storage only once, and will not need to repeat the process for additional Oracle RAC nodes. With an HP Superdome, by contrast, Cisco IT would have had to individually cable each new node for data and storage connectivity, increasing port costs and operational overhead.

Figure 2. After: Cisco Unified Data Center Platform Delivers 50 Percent More Processing Capacity Than Previous HP Platform
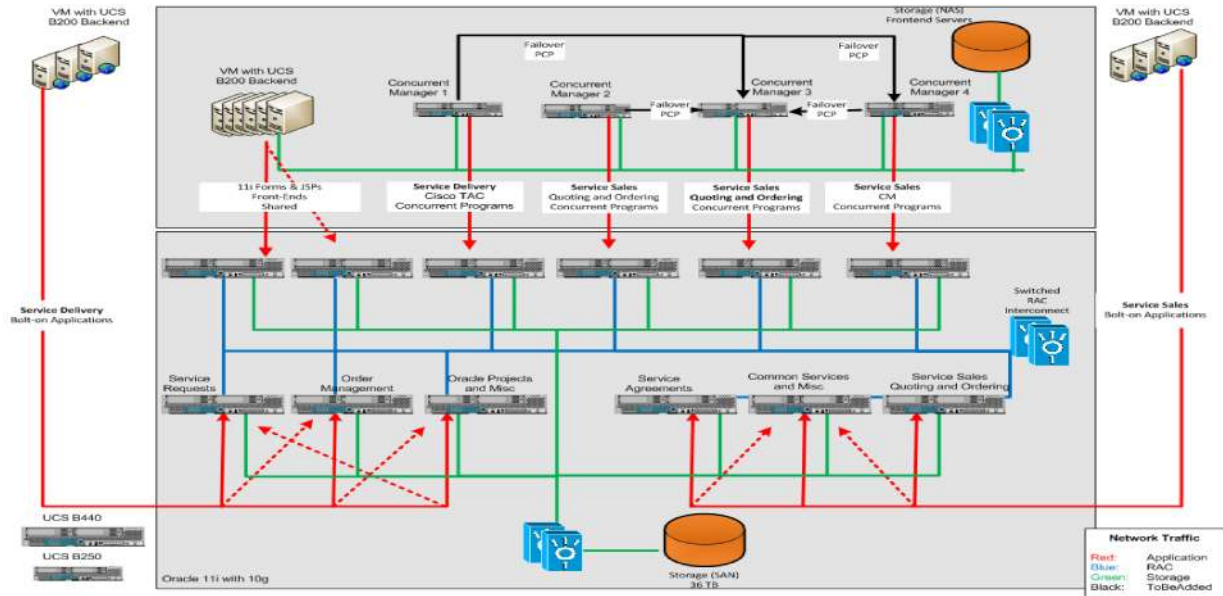
"This architecture change gives Cisco IT the scalability and agility to address the business growth for Cisco Services," says Craig Huegen, senior director of Connected IT Architecture for Cisco. "We now have the architectural foundation to support organic growth of our existing services offerings, new Smart Services for monitoring and troubleshooting customer networks, and future services."

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Sizing

Cisco IT engaged Cisco Services to help size the Cisco Unified Data Center Platform to meet expected requirements until at least 2014. Cisco Services determined that eight Oracle RAC nodes were needed for normal operation, so Cisco IT decided to implement a 12-node Oracle RAC to build an N+1 architecture. The system contains six Cisco UCS chassis, each populated with two Cisco UCS B440 Blade Servers, with room for two more (Table 1).

Table 1. C3 Database Environment, Before and After

	HP Superdome	Cisco Unified Computing System
Production Server Configuration	3 HP PA-RISC Superdomes	12 Cisco UCS B440 Blade Servers
Operating System	HP-UX Version 11.23	Red Hat Enterprise Linux Version 5.5
CPU Cores	384	384
Memory Speed	533 MHz	1333 MHz
Memory	1536 GB (512 GB x 3)	3072 GB (256 GB x 12)
Performance	Capacity for Current Workload	Capacity for 150 Percent of Current Workload
Database	3-Node Oracle RAC 10g	12-Node Oracle RAC 10g

Dual-Fabric Design for Resiliency

To increase resiliency, Cisco IT designed the Cisco Unified Data Center Platform with two fabrics (Figure 3). "Even if one fabric fails, applications continue to function on the second fabric," says Nagarajan R, Cisco IT architect. The Cisco UCS blade servers support 12 GBps throughput, exceeding the storage frames' 10 GBps throughput capacity. During testing with a smaller configuration, Cisco IT discovered congestion on the SAN fabric caused by application traffic, and resolved the issue by increasing the port count.

Figure 3. Throughput Allocations
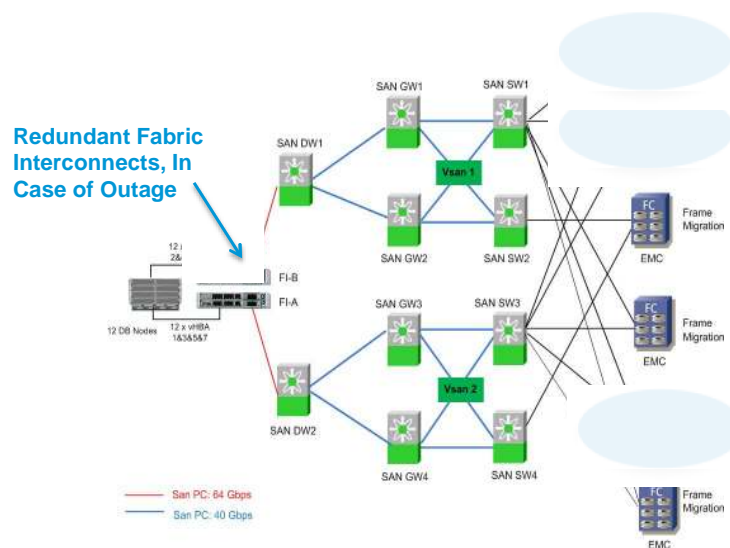
Pre-Migration Testing

As one of the C3 solution's major users, Cisco Technical Services collaborated with Cisco IT on the migration project to develop test cases, minimize downtime, and prepare users for the transition.

Cisco Technical Services performed very rigorous testing merited by a change in the underlying architecture of a critical services platform. The team conducted 15,000 tests on the 220 applications that access C3, including business acceptance testing; end-user testing; traditional QA regression and progression testing; and performance and failover testing.

Minimizing Downtime During Migration

The team minimized the impact of total downtime during migration by taking a snapshot of the database and bringing up critical customer-facing applications on a backup system. As a result, critical applications and services were available for all but eight hours of the migration process. For details about the migration process, see the case study, "How Cisco IT Migrates Critical Applications from HP Superdome to Cisco Unified Computing System."

Results

Migrating the C3 application environment to the Cisco Unified Data Center platform increased business agility and resilience while lowering TCO.

Increased Agility and Support for Business Growth

"Migrating the C3 Oracle RAC database from Superdome to the Cisco Unified Data Center Platform increased agility, because we can introduce new services without scrambling to add capacity," says Rajesh Bansal, Cisco IT manager. "The current configuration satisfies projected capacity demands for two years, and at that point we can easily scale horizontally or vertically."

Cisco Technical Services will take advantage of the increased agility in its Smart Services offerings, a new capability to proactively monitor and troubleshoot customer networks. Much of the information needed to offer these services resides on the C3 platform, such as the install base, service contract data, and business intelligence derived from service requests.

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> --Rajesh Bansal, Cisco IT Manager

Increased Resilience, Protecting Availability of Mission-Critical Applications

Failure of a single node no longer disrupts business processes as it did when the C3 environment was hosted on the previous platform. If a Cisco UCS blade server fails, Cisco IT can provision any other available server in any chassis in a few minutes by applying a Cisco UCS Manager service profile, and then use VMware tools to move the application (Figure 4). With the previous hosting platform, by contrast, Cisco IT had to call the vendor to install a new part, which took hours or sometimes days.

"I would like to congratulate the C3 program team for a successful migration of our biggest Cisco database onto the Cisco Data Center platform," says Julie Finan, senior director for Cisco IT's Global Data Center Program. "This was our first 12-node Cisco UCS implementation, which provides the required resiliency and scalability to support

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Figure 4.   Failover Architecture
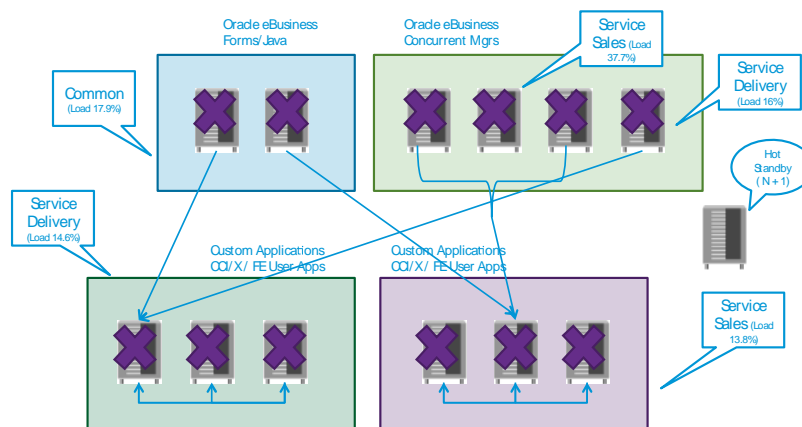
"After we migrated the C3 database to the Cisco Unified Data Center Platform, a software bug caused a database instance to crash," says Kahlon. "The processes failed over to the designated failure node, and business continued as usual, without any downtime."

60 Percent Lower TCO

Migrating the C3 environment from HP Superdome to Cisco Unified Data Center Platform lowered TCO by 60 percent, based on 81 percent less power consumption, 76 percent less data center space, and 58 percent fewer cables to manage (Figure 5). Supporting detail appears in Table 2.

Figure 5. Migrating Oracle Environment to Cisco Unified Data Center Platform Lowered TCO While Increasing Resilience Through an N+1 Architecture
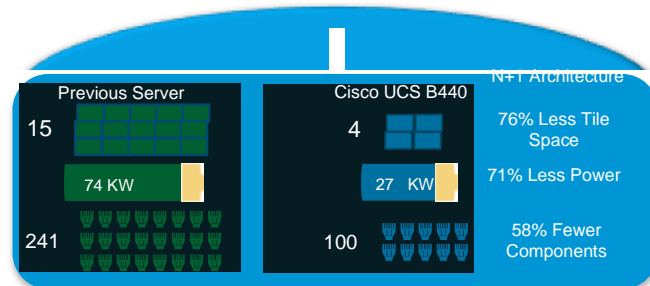
Table 2.   TCO Savings Result from Decreased Energy Consumption, Space, and Device Count

Server Function	Server Count		Energy Consumption (kW)		Data Center Tiles		Cables: Storage, Network, and Consoles	
	Cisco	HP	Cisco	HP	Cisco	HP	Cisco	HP
Production Database	12 Cisco UCS B440 (6 Chassis)	3 HP SD64 (6 SD Cabinets)	12.91	114	2	11	48	120
Database for Cisco Services Sales and Rolling Upgrade (Used to Minimize Downtime)	4 Cisco UCS B440 (1 Chassis)	1 HP Server (1 SD Cabinet)	2.78	19	.5	1.5	12	30
Backup	4 Cisco UCS C460	2 HP Integrity RX3600	7.16	4	.5	.5	28	20
Front End	8 Cisco UCS B200 M1	19 ProLiant	3.75	7.3	.5	1.5	12	71
TOTAL	28	25	26.6	144.3	3.5	14.5	100	241
Percent Gain with Cisco			**81 Percent Less Power Consumption**		**76 Percent Less Data Center Space**		**58 Percent Fewer Cables to Manage**	

Migrating the company's ERP applications, C3 and others, from HP-UX Platform to the Cisco Unified Data Center Platform has significantly decreased operational costs for Cisco IT's data center. "Standardizing the architecture in every global data center has streamlined operations, lowering operational expense by 33 percent," says Sidney Morgan, Cisco IT architect**.** "In addition, improved availability helps Cisco TAC and Cisco Services continue to provide industry-leading service-level agreements."

Faster Application Performance

Both OLTP transactions and concurrent batch programs execute faster on the Cisco Unified Data Center Platform, as shown in Figure 6. Average runtime for batch programs that previously completed in less than 30 minutes, has decreased by 15 percent. Average runtime for batch programs that previously completed in more than 30 minutes has decreased by 22 percent.

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Figure 6. C3 Transformation Results: Processes Execute Faster on Cisco Data Center Platform (Green) than Previous HP Platform (Blue)

Times Show in Seconds; Shorter Bars Represent Faster Times
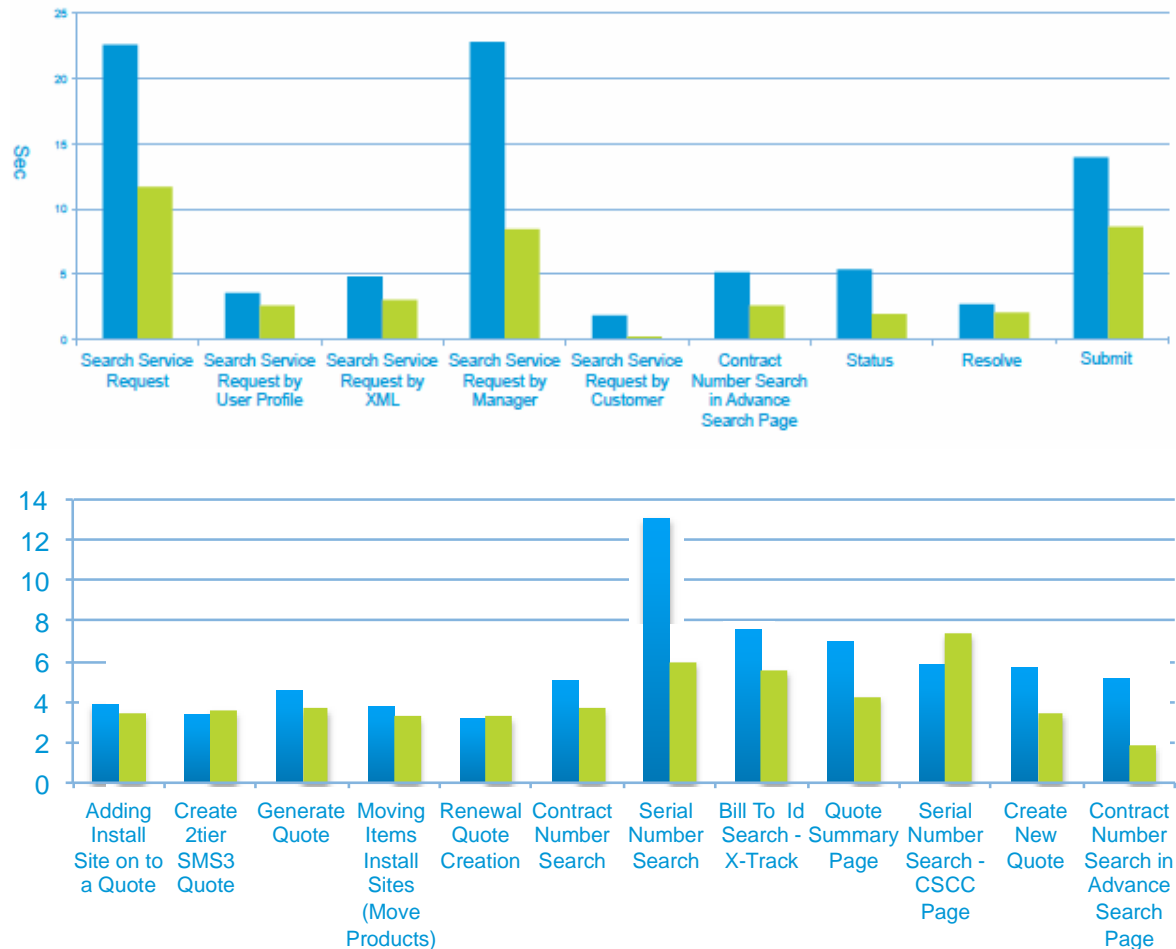
Better Customer Experience, Optimized Profitability

The main business impact of faster C3 application performance is that Cisco Services can more quickly create and update service agreements, warranty information, and install base records. These capabilities translate to faster response to customer requirements. Examples include:

- 15 percent faster quote uploading
- 84 percent faster quote validation
- 23 faster quote conversion
- 16 percent faster ordering process

In addition, faster processing of new install-base information and updated contracts contributes to profitability by facilitating timely and accurate invoicing. It also helps to eliminate situations where Cisco Services provide services to customers who are not entitled to them, as might happen if records are not up to date.

More Efficient Operations

Performance teams no longer need to spend a significant amount of time troubleshooting and tuning Oracle GCS. "We attribute the improved performance to the low-latency Cisco unified fabric, improved x86 network drivers, and use of jumbo frames on the interconnect, a recommendation from Oracle," says Kahlon.

Internal Cisco users and partners reported high satisfaction from day one, according to Baker. "Performance and resiliency have both improved," he says. "Dividing functions over 12 instead of 3 nodes reduces the stress on the system if one node fails."

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Lessons Learned

Cisco IT learned that the Oracle HugePages feature further increases database performance. The team attributes the successful migration to the following practices:

- Configure the servers to boot from SAN to accelerate recovery in the event of local disk or server failures.
- Test thoroughly before migration: Cisco IT performed two test cycles on 15,000 use cases and also performed several practice runs.
- During testing, verify end-to-end performance, not just performance within the application environment.
- Include the business user in the test process: "When you change the underlying platform supporting critical business operations, you have to acknowledge the potential for business impact," Baker says. "There is no such thing as a purely IT project, and the business needs to be directly involved or act as an advisor."
- Communicate downtime expectations to application users often and early: Cisco Technical Services began communicating six months ahead of time, and would begin nine months ahead of time if they did it again.
- Test throughput from the storage frame and SAN fabric: The Cisco Unified Data Center Platform supports up to 12 GBps, but IT teams might need to fine-tune the configuration for the SAN fabric. After testing, Cisco IT increased the number of Cisco MDS 9148 ISL ports.
- Obtain the latest Oracle patches before testing.
- Use the Oracle E-Business Suite AutoConfig tool in parallel with other migration activities. This approach reduced downtime by an estimated 8-10 hours.

Next Steps

Cisco IT plans to bring the C3 system into the Metro Virtual Data Center (MVDC) resiliency architecture, which keeps all applications available in the event of data center failure and during system upgrades. Another plan is upgrading to Oracle E-Business Suite Release 12 and Oracle RAC 11g.

For More Information

To read more about the Cisco Unified Data Center Platform Architecture, visit:
http://www.cisco.com/en/US/netsol/ns340/ns394/ns224/architecture.html.

To read additional Cisco IT case studies on a variety of business solutions, visit Cisco on Cisco: Inside Cisco IT
www.cisco.com/go/ciscoit.

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