Cisco UCS:
A Real-World TCO Analysis

An ENTERPRISE MANAGEMENT ASSOCIATES® (EMA™) White Paper
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IT & DATA MANAGEMENT RESEARCH,
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Introduction

Continuing economic challenges, combined with ever-increasing competitive forces, have created a business climate unlike any other in history. Businesses today must maintain a laser-like focus on containing costs and increasing efficiencies in every possible way in order to generate profits and maintain competitiveness. IT, of course, is no exception, and the goal of a truly automated data center is finally within grasp thanks to the maturation and convergence of key technologies.

The drive toward the automated data center has been a long one. Over the past decade, a seemingly endless stream of data center management technologies were launched to the tune of "on demand," "autonomic," and "utility" computing, all of which promised data centers the ability to deliver highly available and enhanced business application performance at the lowest cost. The cornerstone of the automated data center concept is virtualization. The ability to combine compute, networking and storage resources into common pools which an overarching management platform can bring to bear on delivering business services is a powerful concept.

Until recently, however, most of these attempts were only partially successful. This was primarily due to a lack of integration between major data center "silos" including virtualization, compute, network, storage, and management. While investment in individual silos does provide business value, cross-silo integration and orchestration is required through a common management platform in order to fully deliver on the business potential of data center automation.

From a Total Cost of Ownership (TCO) perspective, the primary ways for organizations to reduce data center costs are through increased administrative efficiencies (reducing IT labor costs); decreased power, heating and cooling requirements; reduced hardware and cabling overhead; and decreased server hardware costs and physical footprint.

Cisco has been a force in the data center for years, pioneering many key network virtualization technologies, and is now a growing force in the server virtualization market, launching its Unified Computing vision in mid-2009. Cisco capitalized on market trends and needs by designing the Cisco Unified Computing System (UCS) from the ground up, learning from mistakes made by early entrants into the blade market. This entrance enabled Cisco to design from a "clean slate" perspective. UCS delivers on the data center automation promise by implementing the cross-silo management, maximizing flexibility and business agility with true "stateless computing," as well as delivering on the virtualization capabilities required by modern data center initiatives.

Cisco engaged Enterprise Management Associates (EMA) to take a hard look at the total cost of UCS ownership, showing how combining the three "legs" of UCS (compute, storage and network), combined with a high degree of virtualization and a single, central manager provide a lower TCO and substantial ROI compared to legacy competitive solutions.

This EMA white paper begins with a brief UCS overview and then dives into an in-depth TCO analysis, focusing on the primary areas where IT Directors can derive significant benefits: compute, network, storage, virtualization, and management. The paper takes a pragmatic approach to evaluating TCO, which is to say it is largely based on real customer experiences with UCS in the real world. The paper then concludes with EMA's perspective on the paper's findings.

Cisco UCS Overview

Cisco introduced the Unified Computing System, or UCS, in March 2009. UCS incorporates an innovative set of network, compute, virtualization and management technologies into a single, centrally managed entity, tied together with open standards and a single common policy engine. UCS tightly integrates hardware and software components, providing a high performance, cost effective architecture that supports a wide variety of hardware which includes both Cisco and non-Cisco equipment.

From a network perspective, which is of course Cisco's traditional strength, Unified Fabric is the "secret sauce" that fuels many UCS advantages maximizing architectural flexibility. Unified Fabric is a converged network backbone that carries the traffic for all networks, including LAN, SAN and management, through low latency, 10 Gbps Ethernet connections. Traditional approaches, which required discrete network cards, cables and switch connections for each network, resulted in high operational and capital expenditures from cabling costs and network switching equipment, with an accompanying increase in complexity. Unified Fabric reduces all of this down to a single set of cables and a single protocol, significantly decreasing data center network costs. This single set of cables and protocols allows for connectivity to any type of storage array, including NAS and iSCSI, as well as Direct Attached Storage concurrently with SAN arrays. Cisco also took network virtualization to a new level of sophistication, allowing physical and logical network connections to be fully decoupled from one another. This unified approach allows multiple Cisco UCS blade chassis and the attendant servers to be treated as a single "virtual blade chassis" from a deployment and management perspective. Cisco's "virtual blade chassis" also has the ability to incorporate rack servers directly into the environment with full management and networking integration, another example of Cisco's innovation in core data center server feature functionality.

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UCS also introduced several advances in server technology. Working closely with Intel, VMware and BMC, Cisco developed an innovative set of blade and rack-mount servers designed to support a high degree of virtualization and management, including rapid provisioning. Since today's servers tend to run memory-intensive, 64-bit applications including virtual machines, operating systems, databases and business applications, server upgrades in order to increase memory may be necessary long before CPU headroom runs out.

Cisco Extended Memory Technology, developed in partnership with Intel, enables two-socket UCS servers to support up to 384 GB of RAM via 48 DIMMs—more than twice the memory supported by traditional servers. Cisco's memory architecture is unique in that it also enables the use of faster performing 1333 MHz chips across all 48 DIMMs, whereas most other vendor's servers drop to 800 MHz at higher total RAM capacities due to memory architectural restrictions.

Cisco's technology delivers up to 27% faster memory access speeds at high memory densities. This higher access speed is critical for high performance databases requiring not just large memory footprints, but low latency as well. There is also a new (April 2011) UCS C260 2RU rack server, which uses the two Intel® Xeon® E7 2800 series processors, enabling two sockets to support up to 1TB of memory across 64 DIMMs leveraging Cisco's Extended Memory Technology. Organizations can now host applications using less expensive two-socket servers when they would otherwise be required to utilize four-socket servers due to memory and performance constraints.

The convergence of extended memory technology, rapid increases in processor design, maturation of virtualization technologies, advanced network fabric and management technologies that have been underway for the past ten years or so have finally resulted in the ability to deliver on the vision of Cloud computing at a price point that makes it affordable for organizations of virtually any size. Cisco has been at the forefront of this wave, and UCS is one of the first integrated approaches to combine all of these advances into a single IT service delivery platform. With Cisco UCS, true "stateless computing" with maximum flexibility can now be utilized in data centers.

Without the ability to prove that technologies like UCS are cost justified, however, they will never reach the mainstream. The balance of this paper is devoted to examining just that. EMA examined the benefits received by a number of UCS customers from a total cost of ownership perspective.

Examining UCS Total Cost of Ownership

As indicated previously, the balance of this paper examines the TCO of Cisco Unified Computing System, focusing on five key perspectives:

1. Compute – TCO advantages gained from the combination of Cisco high density processor/memory configurations and extended memory technology, coupled with Intel Xeon processor technology.

2. Network – TCO advantages realized from converged networking, including Fiber Channel over Ethernet (FCoE) and Cisco Unified Fabric, including reduced cabling, switching and management costs.

3. Virtualization – Savings gained from server hardware and software virtualization, enabling business applications to be easily moved from server to server. This includes deploying virtual machines and hypervisors that can be managed directly from UCS.

4. Storage – Advantages realized from the ability to easily incorporate existing and emerging storage technologies into a fully virtualized, UCS-based data center. UCS also provides the ability to leverage virtualized, on-board UCS storage to defer purchases of SAN technologies.

5. Management – Cost reductions gained from the convergence of compute, network, virtualization and storage management efficiencies using the Cisco UCS Manager, including integration of legacy and customized user management tools into UCS using open XML/API interfaces.

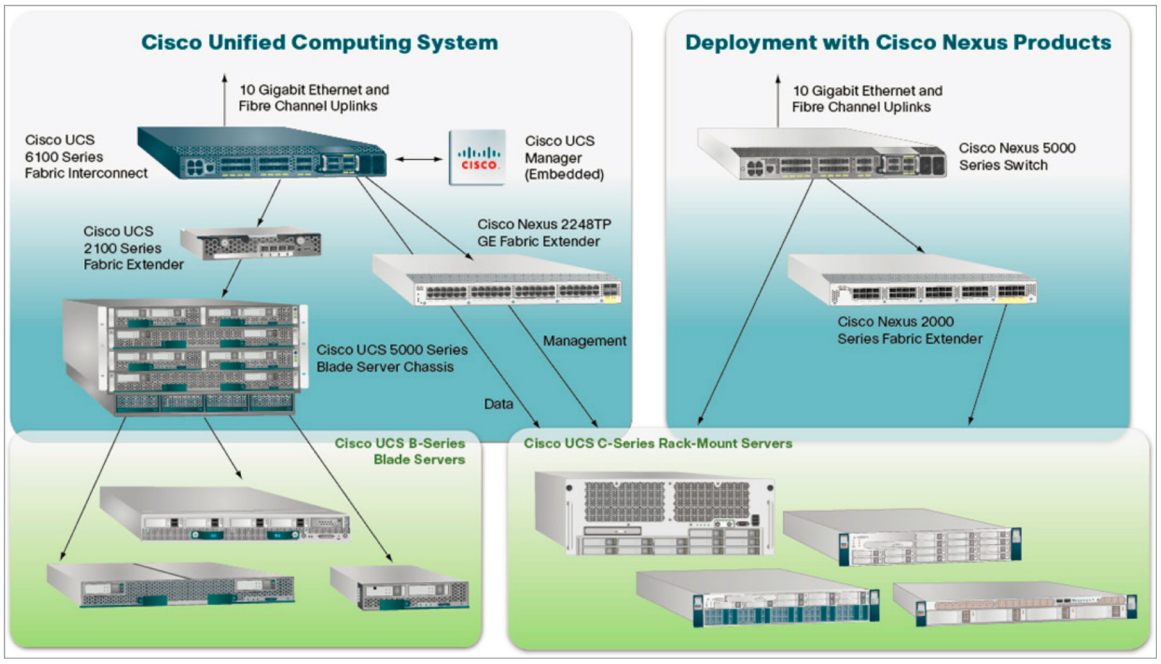

Figure 1: Cisco Unified Computing System

The balance of this paper will address the five TCO areas above in detail, examining specific TCO advantages of each and validating through analyses of current UCS customer deployments.

1. Compute

As discussed earlier, data center applications tend to become memory-bound long before they run out of other resources, including CPU and disk. Memory intensive applications include virtualization, databases, and other business applications that are designed to provide high responsiveness and performance by caching large amounts of data in memory.

Virtualization in particular is driving increased server memory requirements. Virtual machine technologies like VMware provide a clean way to package server applications inside of a portable "container" that can be easily moved from server to server in the data center as business needs dictate. They also allow multiple virtual machines to run on a single server, helping to maximize hardware utilization and decreasing costs. Add VM mobility technologies like VMware vMotion to the mix, combine them with policies, and VMs can then be moved from server to server as demand dictates.

Cisco's patented extended memory technology, which is available for its B-series blade and C-series rack mount servers, supports up to 384GB of RAM per server (two times more RAM than conventional two-socket servers). From a TCO perspective, Cisco also allows inexpensive 4GB DIMMs to be used instead of 8GB, providing the flexibility to support 384GB with 8GB DIMMs, or saving up to 20% using 4GB chips for a total of 192GB. This option provides Cisco customers a high degree of flexibility when configuring UCS servers to meet business and budgetary requirements. Cisco's B230 blade server, half-width server with two Intel Nehalem EX processors and 32 DIMM slots provides an excellent compute/memory/footprint server for users with major database requirements or wanting alternatives to RISC based architectures.

The following table illustrates the savings that may be obtained from Cisco Extended Memory:

Memory Capacity (GB)	Typical System Memory Cost (U.S.$)	Cisco Unified Computing System Memory Cost (U.S.$)	Cost Savings (U.S.$)	Savings (Percent)
96	$4,278	$4,086	$192	4%
144	$6,952	$6,129	$824	12%
192	$10,698	$8,172	$2,526	24%
512	$28,528	$22,816	$5,712	20%
1024	$64,551	$57,056	$7,495	12%

Figure 2: Cisco Extended Memory saves up to 24% over competitors' memory costs

There are a number of Cisco customers that have reported significant TCO advantages derived from the UCS Compute architectures, including the following:

- **EMC:** an information infrastructure technology vendor, migrated from a legacy Sun SPARC and Solaris infrastructure to Cisco Unified Computing System running Linux and Oracle RAC. EMC reports that the new UCS deployment performs up to 20 times better than the legacy solution, reduced end-user response times and batch runtimes by over 60%, and Oracle transaction times increased as much as 800%. EMC also estimates that UCS will save $5 to $7 million per year in reduced data center environmental costs, software licenses, software and hardware maintenance, and environmental support.
- **NetApp:** a storage vendor that built a private "engineering-as-a-service" Cloud for testing; using UCS, consolidated 51 blade server chassis and 714 servers to 15 UCS chassis and 120 servers.
- **Terremark:** a service provider that reports a 400% increase in server density after deploying UCS (compared to their previous server architecture). Their previous server vendor supported only 8 servers (64 cores) per rack, whereas UCS supports 32 servers (256 cores) per rack—with the same power and cooling requirements. Terremark also reported that UCS provides 300% greater memory capacity per rack, allowing them to run much larger virtual machines than previously.
- **Tutor Perini:** a construction firm that, due to multiple acquisitions, built a new data center to consolidate five data centers. They deployed UCS in the new data center, allowing them to consolidate 230 servers down to four UCS chassis with 22 blade servers, reducing hardware footprint 60% while consuming 38% less power than their previous data center architectures.

2. Network

Traditional data center networks may require up to eight discrete ports and cables for each physical server in a VMware type deployment situation. There are several new converged blade chassis I/O modules now available, but they still align with traditional architecture in that they require multiple separate and discreet Ethernet and Fibre Channel transceivers and cables leaving the chassis, unlike Cisco's unified "virtual chassis" innovative approach. Cisco pioneered converged networking through its Unified Fabric offering, which allows a single, low-latency, lossless Ethernet connection to carry the traffic for all server needs, including Fibre Channel, Fiber Channel over Ethernet, iSCSI, NAS and HPC—all via a single cable. This reduces costs in many different ways, including a marked decrease in cabling complexity and costs (and the overhead required to install and maintain all of those cables), network configuration cost savings, and lower switching costs with lower switch port consumption.

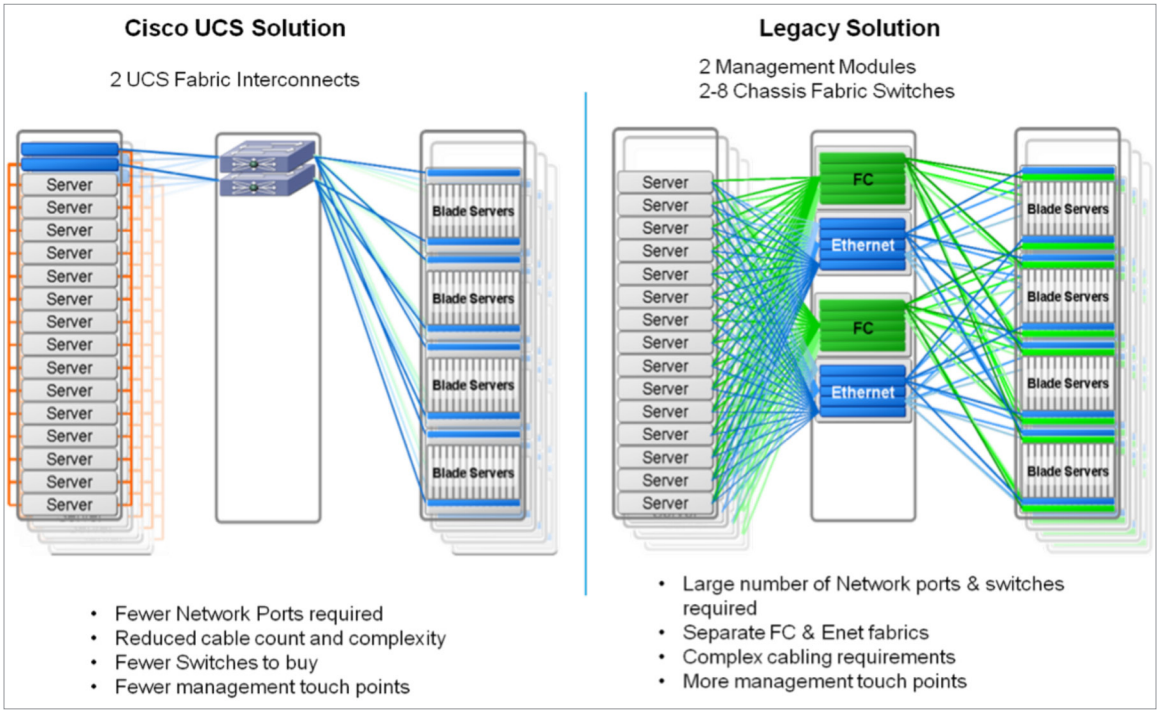

Figure 3: Cisco Unified Fabric

Cisco UCS blades do not require individual switches in the chassis, commonly required by traditional blade server architectures. Since you don't have to buy additional switches with each chassis, this significantly reduces cost and management complexity and overhead. Unified Fabric interconnects make the entire management domain appear as a single system to upstream Ethernet and Fibre Channel switches, simplifying layer 2 management and Fibre Channel network configuration. This is the "virtual blade chassis" concept that is a compelling architectural differentiator for Cisco UCS in the marketplace. This architecture also delivers predictable and dependable network "latency" between all servers (rack and blade) throughout the "virtual chassis," versus current competitive designs which have variable latency between blades depending on where they reside in the various multiple chassis. Converged networking results in increased network performance through the elimination of protocol

conversions between Fibre Channel and Ethernet devices in addition to predictable latency so important for critical application performance.

EMA studies have shown that the Cisco Nexus 5000 Unified Fabric Switch can save 33% on hardware, support, installation and power over conventional "unconsolidated" LAN and SAN connections, plus up to 95% in inter-rack cabling costs. For example, three-year unconsolidated costs for a 500 server data center total approximately $4.5M; a consolidated network based on a Nexus 5000 would cost an estimated $3.0M—a total $1.5M savings over three years. These calculations take into account network hardware, cable installation and power costs.

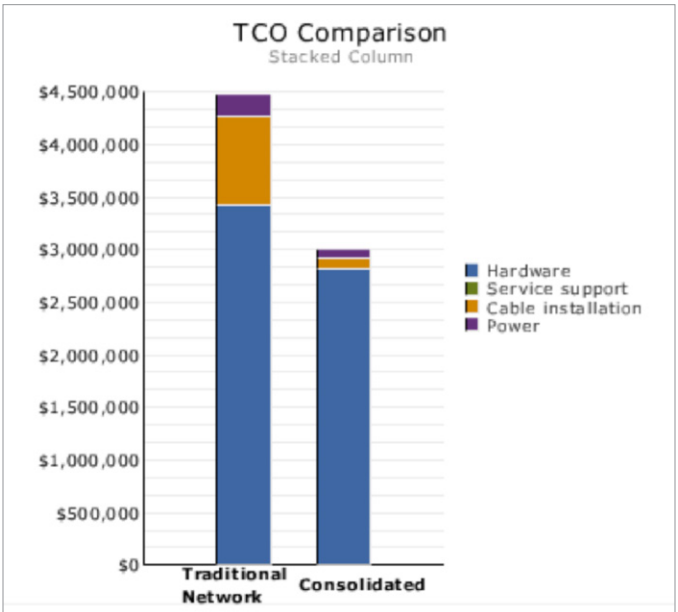

Figure 4: Comparing the Costs of Traditional vs. Consolidated Networks

The following Cisco customers experienced significant network cost reductions through the deployment of UCS:

- **ExamWorks:** a medical and legal review firm that decreased cabling requirements from 35 Gig-E connections down to eight 10-Gbps Ethernet connections using UCS.
- **NetApp:** a storage vendor that reduced cabling costs by 78% using UCS, from 1,440 cables to 250.
- **Nighthawk Radiology Services:** a healthcare provider that lowered per-chassis cabling requirements by 500% using UCS.
- **Pacific Coast Building Materials:** a construction company that decreased their per-chassis cable count from 15 to 4.

3. Virtualization

Virtualization management technologies are finally converging thanks to the emergence of key industry standards, combined with the emergence of the Virtual Machine (VM) as the atomic unit of virtualization. It is the VM, and the "hypervisors" that abstract the VM from the underlying hardware, that enable much of this to happen.

Technologies like VMware's VMotion, Microsoft Live Migration and similar offerings from other hypervisor vendors, which can move a running application *in situ* from server to server, provide the foundation of true virtualization. These technologies now promise to deliver the reality of utility-like compute services, enabling business applications to run on a variety of hardware, both inside and outside of the data center (including Cloud-based resources), seamlessly moving from server-to-server and platform-to-platform as changes in demand dictate.

While UCS was designed for both virtual and non-virtual environments, the ability to manage fully virtualized systems is a significant strength. UCS integrates security and networking into a single policy that travels with virtual machines; it supports a variety of VM vendors including VMware, Citrix and Microsoft and provides value for both server as well as desktop virtualization. Server hardware can

now be placed into resource pools, and the UCS Manager can then be leveraged to automatically balance server utilization to ensure that the cost/performance curve is maximized.

VMs are only a part of the UCS virtualization story, however. UCS Virtual Network Cards, or vNICs, are I/O devices whose type and identity are configured on-demand; dynamically provisioned network interfaces can now be connected directly to VMs and provide end-to-end visibility all the way to the VM. vNICs adhere to the VMs, allowing VMs to be moved and/or taken offline without affecting network connectivity of any other VMs running on the same server. Most importantly, interface definition and network profiles and security move between servers along with, and are attached to the VMs. UCS also supports Cisco's VN-Link architecture, which allows multiple virtual links to be configured on a single physical link. Virtual links connect vNICs inside of a VM to a virtual interface within the fabric, allowing network links within virtual machines to be managed just like physical links. This same methodology also applies to vHBAs (Virtual HBAs).

When a virtual machine is moved from one physical server to another, the virtual interface (vNIC) that the VM's virtual link is connected to is automatically associated with a different physical port, enabling VMs to move from server to server while keeping their network characteristics (and minimizing the amount of characteristics that must change, or be manually configured, when a move occurs).

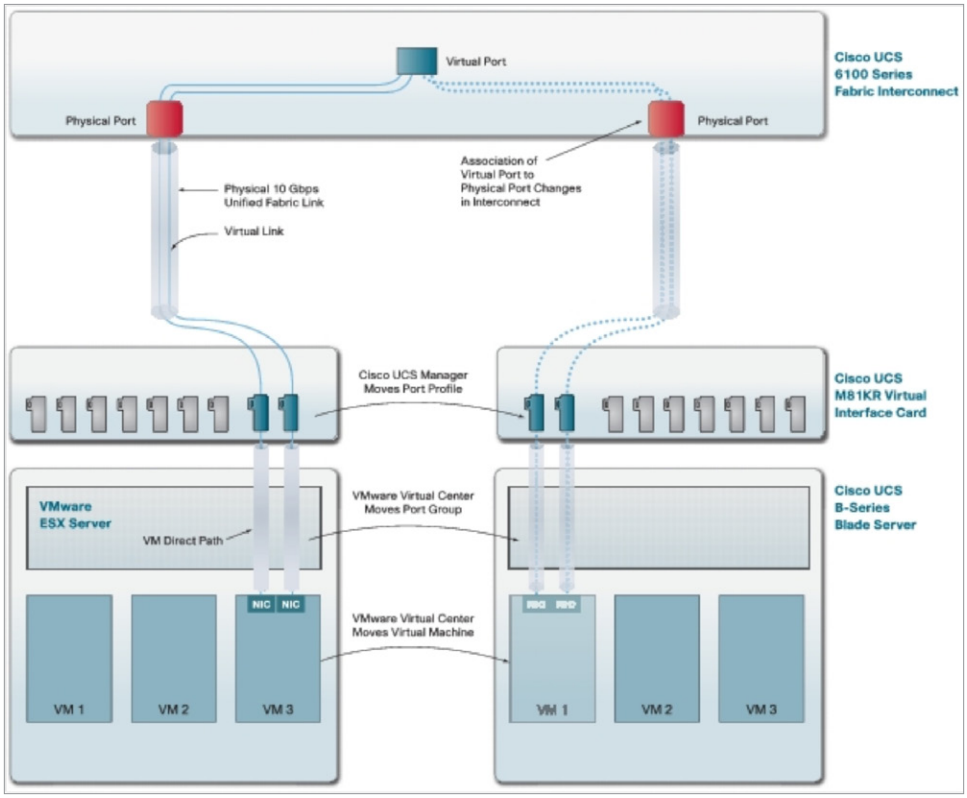

Figure 5: Cisco VN-Link Technology

In terms of reducing TCO, virtualization is truly the UCS "sweet spot," since it overlaps and accelerates the cost advantages realized from UCS and other third-party components.

The following examples illustrate the savings from increased virtualization capabilities realized by UCS customers:

- **Examworks:** a medical and legal review company that reports saving $333,000 annually by avoiding purchases of new PCs by deploying virtualized desktops on UCS servers. They report that the cost of supporting 1,000 virtual desktops using UCS is 67% less than conventional server architectures.
- **Savvis:** this multi-national IT service provider launched its "Symphony Virtual Private Data Center (VPDC)" service based on UCS. VPDC is a private Cloud that allows them to maximize hardware utilization while preserving performance and meeting customer SLAs. This not only saves Savvis money but provides a substantial competitive advantage.

4. Storage

As indicated previously, one of the key advantages of UCS is the ability to consolidate resources using a single management tool and converged network fabric. UCS allows servers to access storage over a variety of media including Ethernet, Fibre Channel, FCoE and iSCSI, protecting existing investments while allowing a flexible upgrade path as business needs warrant. Unified Fabric also supports SANs from a wide variety of vendors including Compellent, EMC, NetApp, NEC, Hitachi, HP and 3PAR, plus HBA/CNA storage adapters from Emulex and QLogic, further extending its flexibility and preserving existing storage investments. Leveraging Cisco Unified Fabric also reduces costs for Fiber Channel to Ethernet switching and interconnects.

UCS allows storage administrators to pre-define storage access policies that become an integral part of the standard UCS service profile, saving IT resources during server provisioning/de- and re-provisioning by removing the need for storage administrators to re-engage in the process.

Examples of customers that have derived value from the UCS storage capabilities include:

- **LaSalle Solutions:** a service provider that was able to defer the purchase of an EMC storage array by utilizing the 4TB of onboard storage provided on UCS blades, enabling them to run 15 VMs per blade. After customer needs dictate storage beyond the 4TB per blade, LaSalle can easily add a storage array while leveraging Cisco Extended Memory Technology to maximize server density.

5. Management

UCS differentiates itself in its management approach from those of other vendors, by offering a unified management that enables the entire server, network, storage access and virtualization infrastructure to be managed from one pane of glass. UCS Manager is truly the UCS "secret sauce," providing a single management point and plane for managing all UCS resources, both server and networking, as well as storage connectivity. This capability dramatically increases the flexibility and agility that data center personnel need to respond real-time to changing business needs. For UCS servers, this management functionality is "agentless," eliminating the maintenance burden required by other solutions to keep multiple firmware versions in-sync to ensure operability. Another key advantage of UCS is that it was designed from the start to provide open interfaces, including GUI, CLI and XML-based API access to manage UCS resources. This enables UCS customers to integrate existing data center management tools with UCS, preserving their existing investments as well as writing their own code to interface directly with UCS Manager.

Since all data center administrators (compute, network, virtualization or storage-focused) interact with UCS Manager through Roles Based Access and a single interface, they can dynamically collaborate to create reusable UCS 'Service Profile' templates for specific uses and applications. Service Profiles are data sets that integrate server and network state, configuration, and infrastructure policies into portable, reusable "profiles." Using templates allows administrators to deploy servers against predefined configurations very quickly in a repeatable, automated manner without needing to "tweak" settings for known application requirements. This "build once, reuse at need" methodology makes "stateless computing" a reality and has the functional benefit of very low "time to production" for new servers and makes all workloads truly portable (whether virtualized or not). UCS Manager can dramatically increase the dynamic flexibility of any data center. UCS Service Profile templates allow administrators to deploy blades as much as 47% faster with up to 67% fewer steps than other solutions.

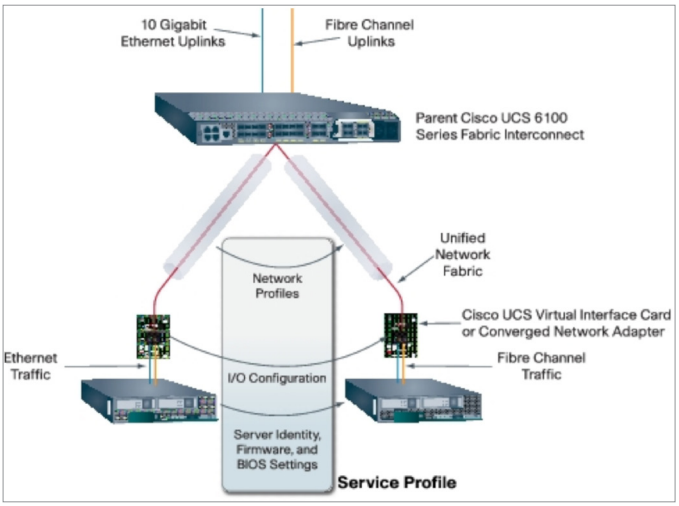

Figure 6: Cisco UCS Manager Service Profile

UCS Manager automatically discovers new resources (e.g., servers) as soon as they are plugged in, automatically provisioning them and putting them to use (or into available resource pools) based on pre-defined policies. Using UCS Service Profiles, this policy-based capability provides strong savings in terms of reducing administrative labor and maximizing hardware utilization, whether it is used in a monolithic or a virtualized environment. As business demand increases, UCS can automatically provision additional resources in order to maintain service levels. Having servers be automatically joined to resource pools reduces the need for duplicative "burst capacity" servers since these servers can now be shared across multiple application groups.

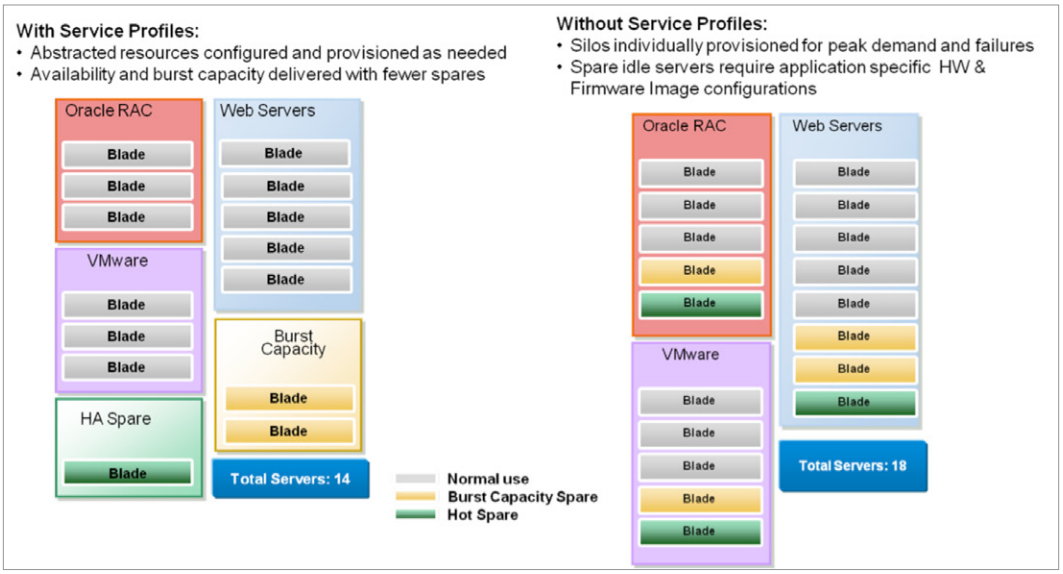

Figure 7: Benefits of Cisco UCS Service Profiles and "resource pools"

Examples of UCS customers that have derived value from the Cisco UCS Manager include:

- **Examworks:** supports 1,000 users with a four-person IT department (one admin per 250 users), compared with industry averages of 20 personnel for 1,000 users (one admin per 50 users)—a 500% reduction in OpEx and resulting in labor savings of $1.1M. They also reported that the ability to quickly convert servers from acquired companies into Virtual Machines and port them to UCS dramatically decreases integration time while increasing responsiveness, allowing systems from acquired companies to be integrated over a weekend.
- **Holmesglen TAFE:** an education provider that reduced new server provisioning time from days or weeks to minutes using UCS Manager.
- **Mediapro:** a media company that saved €250,000 (Euros) by in-sourcing content delivery using UCS. They also accelerated time-to-market for new services by 50% due to efficiencies gained from UCS Manager and virtualization while maintaining IT staffing levels during periods of substantial business growth thanks to increased administrative efficiencies.

EMA Perspective

The convergence of the key data center technologies that UCS represents portends a sea change in the way that IT delivers services to the business. The ability to package all components of a business application inside of a portable, easily managed container (such as a virtual machine), coupled with the ability to define a complete set of policies, known as service templates, enable UCS Manager to effectively map the business applications to pools of hardware resources based on resource availability and performance characteristics. Together, these provide the ability to satisfy business requirements while maximizing data center investments.

Fortunately for UCS customers, Cisco designed UCS to be deployed incrementally in order to deliver business value at each step in the process. For example, an organization may choose to initially deploy UCS servers to host conventional (non-virtualized) loads without moving to Unified Fabric, realizing business value from the servers before deploying additional UCS components. Each of the five TCO areas described earlier in this paper stand alone in terms of delivering business value, and as one might expect, combining multiple TCO areas accelerates time-to-value and return on investment.

EMA analyzed the business value realized by a large number of Cisco customers, and based on these analyses, combined with significant exposure to UCS technologies since its introduction, leads us to the conclusion that Cisco customers that choose to invest in UCS stand an excellent chance of extracting significant, quantifiable business value within a relatively short period of time while increasing overall responsiveness, performance, business agility and availability of critical business applications.

About Enterprise Management Associates, Inc.

Founded in 1996, Enterprise Management Associates (EMA) is a leading industry analyst firm that provides deep insight across the full spectrum of IT and data management technologies. EMA analysts leverage a unique combination of practical experience, insight into industry best practices, and in-depth knowledge of current and planned vendor solutions to help its clients achieve their goals. Learn more about EMA research, analysis, and consulting services for enterprise IT professionals, lines of business users, and IT vendors at www.enterprisemanagement.com or follow EMA on Twitter.

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