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WHITE PAPER

The Cost of Retaining Aging IT Infrastructure

Sponsored by: Lenovo

Jed Scaramella
John Daly
Matthew Marden
Randy Perry

February 2014

EXECUTIVE SUMMARY

Many organizations, when faced with budget challenges, put off capital expenditures (capex) and seek alternatives to acquiring new hardware platforms, such as lengthening server life cycles and extending software licenses. This pattern of stretching the useful life cycle of servers has a number of near-term benefits for customers in terms of depreciating assets over a long period of time or prolonging an existing lease. But if a transition to new technologies has been deferred too long, then the time comes when the system has fallen far behind the performance and cost-efficiency levels being offered by multiple vendors in the marketplace today. This has been especially true in recent years, as the performance of processors has more than doubled each year, based on the emergence of multicore, multiprocessor system designs with improved system speeds.

This white paper demonstrates that a buy-and-hold strategy can actually add costs to the datacenter, for a number of reasons, as systems age in place:

- Hardware maintenance costs rise over time, and performance lags behind more current server offerings.
- Energy efficiency is not as advanced in older server models, leading to rising power/cooling costs in the latter years of the server's usable life cycle.
- Applications software and systems software fall behind the current versions available in the marketplace, and security may require frequent updates. If system software is end of life, security patches may no longer be provided leaving systems vulnerable. After five years of use, the cost of replacement climbs.

To understand more about server replacement cycles and ongoing operational costs, IDC studied many sites that remained on an existing platform long after its initial implementation, and then upgraded. IDC's customer-based research found that failure rates began to climb as servers aged into their fourth year — and beyond. It found that upgrading resulted in a return on investment (ROI) of more than 150% over three years. Importantly, savings from the technology transition covered the initial investment (payback period) after less than a year (11.7 months).

In this context, this white paper describes Lenovo ThinkServer servers, the technology on which the servers are based, and the way the servers address many of the causes of operational cost increases found at customer sites. The hardware and software capabilities of the Lenovo servers were designed to be proactive, reducing the effort and knowledge required to run the server systems and leveraging automation to reduce maintenance costs and IT staff costs.

Global Headquarters: 5 Speen Street Framingham, MA 01701 USA P.508.872.8200 F.508.935.4015 www.idc.com

SITUATION OVERVIEW

Saving Money by Leveraging Technology Refresh: How Current Accounting Misses

Most organizations continue to purchase their servers and IT equipment and then, following the initial investment, use a "standard" financially derived amortization period — often five years. Typically, this has led to a useful server life cycle of three to seven years, depending on the type of platform, operating system, and workloads being used. Most IT shops replace their x86 systems every three to five years, but some keep them longer.

After acquiring and capitalizing equipment and then initiating the amortization period, most IT managers avoid making further changes, resulting in a delay in updating the systems or providing a technology refresh. Often, IT managers do not replace the equipment before its normal depreciation cycle runs its course, as long as the system is performing adequately and meeting availability requirements. This approach to server replacement/renewal cycles misses an important assessment of the actual conditions and cost factors experienced. Instead, it relies on the calendar to determine when the server should be replaced or refreshed with new technology.

During this time, system administrators may work to repeatedly upgrade and reconfigure servers in support of workloads rather than to consider a fully burdened cost assessment, highlighting the cost reductions that could be gained by replacing the servers sooner. In many cases, a cycle of repeated upgrades, security patches, and rising maintenance and management costs can accelerate, over time, if the life cycle of the server is extended to four years or more.

Current Capital Constraints Contribute to Lengthened Server Life Cycles

IDC's supply-side data for the worldwide server market showed patterns of lengthened server life cycles. The data documented the delay and deferral of many midrange and high-end servers during the economic downturn. Of late IDC has seen in recent quarters an uptick in midrange and high-end server sales that was fed by a wave of technology upgrades across server classes. At the same time, the level of investments in x86 server technology has grown, now generating more than 95% of server unit shipments per year and more than 65% of server market revenue per year.

The recent rise in server market revenue reflects a technology replacement cycle now underway. There were also indications that IT organizations needed to acquire new hardware platforms while taking advantage of leveraging virtualization to consolidate workloads onto fewer server platforms for the sake of operational efficiency and reduced IT costs.

Focusing on Operational Costs

The drive to reduce capital expenditures is strong and understandably so, given the pressure on capital budgets. However, IT managers also know that the need to address operation expense (opex) within the datacenter is equally important.

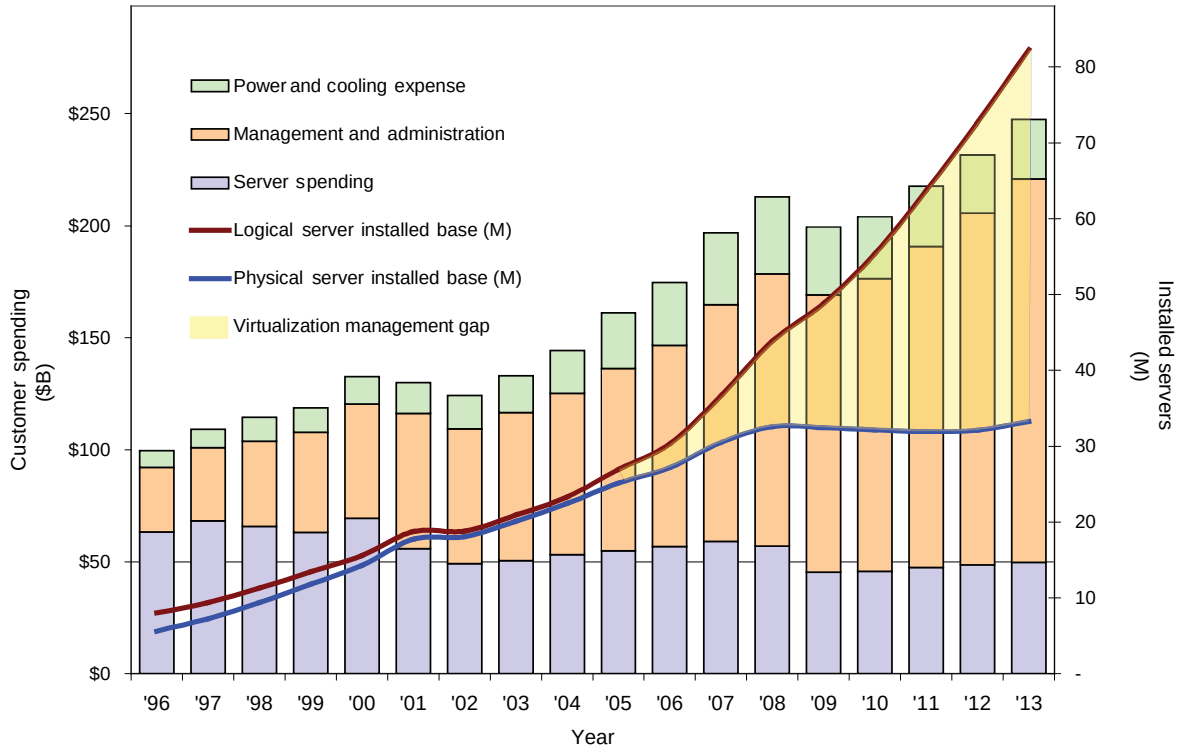
Although IT managers did a good job of capping IT spend on servers and storage in recent years, costs on the operational side of the IT organization continue to grow. Costs for maintenance and management, along with costs for power/cooling, have increased. Power/cooling costs grew eight times as fast as server acquisition costs — and costs for maintenance/management, viewed as a category, grew four times as fast as server acquisition costs.

Maintenance/Management Costs and Power/Cooling Costs Rise over Time

As Figure 1 shows, maintenance/management costs generated twice as much in total IT costs as server acquisition — and power/cooling costs grew enough to nearly equal server acquisition costs worldwide; in some sites, power/cooling costs already exceed the server acquisition costs. Meanwhile, the worldwide installed base now stands at more than 35 million units and is projected to grow even more. Fortunately, growth in logical servers (virtual servers or virtual machines [VMs]) is providing more usable capacity per physical server — and this is improving server resource utilization for each server over time.

FIGURE 1

Worldwide Spending on Servers, Power and Cooling, and Management/Administration



Source: IDC, 2014

Server Replacement Cycles

Figure 1 demonstrates that opex must be kept in check, or it will outpace the savings from deferred server acquisitions.

There are other signs of technology refresh: IDC's customer-based study of server workloads found that technology refresh helped address opex. The IDC server workloads study of 1,000+ IT sites found that 39% of new server acquisitions occurred as part of a routine, or planned, server refresh. New application projects drove another 33% of new server purchases, and 28% more were acquired to support additional compute capacity.

As discussed in this white paper, aging server infrastructures can play a substantial cost-adding role in datacenter cost dynamics. The trend to leverage VMs running on the hardware is key to improving resource utilization — and to providing highly granular controllability of workloads. Further, workload isolation is enforced, which preserves uptime by preventing workloads from interfering with one another — taking a "pooled resources" approach to computing resources.

IDC'S STUDY OF SERVER TRANSITION EXPERIENCE

From 2008 to 2014, IDC studied more than 50 sites that had upgraded their server infrastructure to determine the business value experienced by customers consolidating on newer servers. The continuing study highlighted the experiences at sites that had consolidated disparate server workloads on newer servers. These companies range in size from 1,500 to 175,000 employees and are located across geographies, including the United States, Western Europe, and Central Europe.

Importantly, the organizations represent a wide variety of vertical markets, including retail, financial services, manufacturing, and energy. Most of these organizations are large companies with a server infrastructure that supports tens of thousands of intra-enterprise end users — and an even larger number of extra-enterprise users, including end customers who are accessing their enterprise systems.

This study provided substantial data about the organizations' deployments as part of an IDC business value survey measuring the costs associated with deployment of new systems and the operational results, such as reductions in IT operating costs, reductions in costs related to system downtime, and employee productivity improvements associated with those deployments.

Research Methodology

This study used research interviews to determine the sources of cost — both capex and opex. By capturing these components of cost, IDC was able to calculate the impact of moving from older servers to new servers in terms of hardware acquisition costs, IT staff costs, downtime, and productivity — both for IT staff and for end users.

The interviews yielded information defining up-front investment costs in the technology, as well as deployment and ongoing maintenance costs. The interviews also elicited the companies' experiences with tangible and measurable IT and end-user business benefits over varying periods. IDC's Business Value team combined all of these factors in the synthesis of an overall cost of aging infrastructure assessment.

Key Findings

IDC's customer-based research found that failure rates began to climb as servers aged into their fourth year — and beyond. It found that upgrading resulted in a return on investment (ROI) of more than 150% over three years. Importantly, savings from the technology transition covered the initial investment (payback period) after less than a year (11.7 months).

The savings from reduced maintenance and support costs paid for the investment in the new technology. While servers have become much more powerful over time, acquisition costs and energy requirements for power and cooling have dropped dramatically. The IDC study found that, for every dollar invested in the new technology, two and a half times as much was eventually saved, over a period of three years, per 100 users using the new system.

Research consistently showed that upgrading from aged servers to newer server platforms reduced cost and increased performance. Two recurring factors appeared to directly affect these benefits of upgrading:

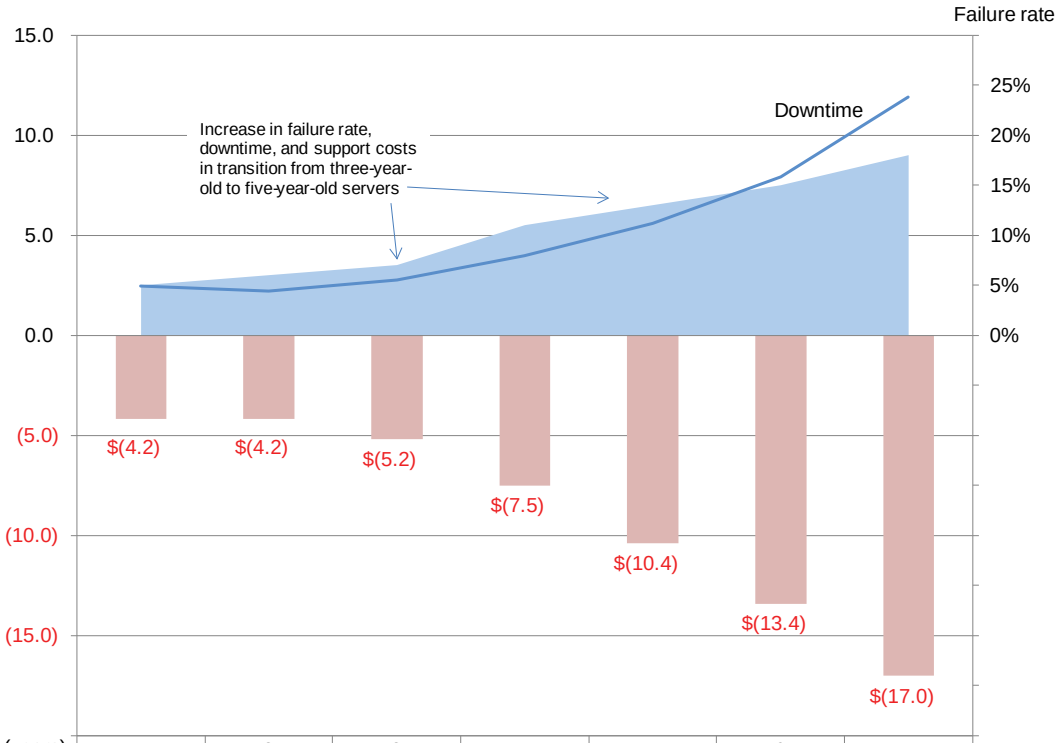
- Servers experience an optimal life span, and continued usage of servers beyond that optimal life span causes maintenance costs to spiral and downtime to increase.
- Newer platforms consistently provide the price performance increases inherent to Moore's law at lower power consumption.

As Figure 2 indicates, as servers age beyond the 3- to 3.5-year optimal replacement cycle, the cost of annual maintenance increases significantly. Multiple conditions contribute to this increase. Older systems break down more frequently as average failure rates increase from 7% to 18%. Operating system software and application software designed for three-year optimal life experience more issues. Beyond that threshold, patching becomes a more frequent activity — and most companies lose interest in keeping up with the more frequent upgrades. Migrating to newer software while running on the same hardware platform creates compatibility issues and business alignment issues of its own.

For example, Microsoft is ending support for Windows Server 2003 and will no longer provide patches for security issues that develop on that operating system. Companies that must comply with regulations, such as HIPAA and PCI, must replace Windows Server 2003. The latest operating environment, Microsoft Windows Server 2012, leverages the security hardware features of Intel Xeon processors, used in Lenovo ThinkServer servers, to speed encryption and improve security overall.

FIGURE 2

Effects of Time on IT Infrastructure (Server) Costs



Server age (years):	1	2	3	4	5	6	7
Failure rate	5%	6%	7%	11%	13%	15%	18%
Support cost	$(4.2)	$(4.2)	$(5.2)	$(7.5)	$(10.4)	$(13.4)	$(17.0)
Downtime	2.5	2.2	2.8	4.0	5.6	7.9	11.9

Notes:

Support cost values equal annual cost in US$ per 10 users.

Failure rate refers to the frequency of failure per year and per server based on the age of the server.

Downtime refers to hours of downtime per year.

Source: IDC's Business Value Research, 2014

To understand the reasons these upgrade changes become so pronounced, one needs to look at the technology changes between generations of servers, which are discussed in the sections that follow.

Innovations in Lenovo ThinkServer

For several years, IDC has been discussing how the true cost of running an x86 infrastructure lies not in the capital expense but in the operation expense. Therefore, the greatest cost savings new x86 servers can deliver include efficiencies gained through the consolidation of physical hardware, the ability to increase the use of virtualization, and the improvements to server energy efficiency. At the same time, as more applications move to a virtual environment on x86 architectures, the individual x86 systems will be hosting an increased proportion of the companies' workload. This means the reliability of these servers becomes a critical factor to ensure application availability.

Lenovo has recognized that improving the operational efficiency and reliability of x86 environments is a priority for customers and has designed ThinkServer to address these priorities. Lenovo ThinkServer servers are built with high-quality components to ensure reliability and maximum uptime of the server systems. The systems employ enhanced power and cooling technologies and thermal designs to improve energy efficiency and lower costs. ThinkServer is designed to simplify ease of use and management of the systems, including leveraging an open design and industry standards that make Lenovo ThinkServer easy to integrate into existing IT environments.

Systems for the Next Phase of Virtualization

Virtualization has proven to be a very effective method for IT organizations to consolidate their x86 infrastructure, reducing the physical server sprawl within their environment and easing the burden on server administrators to manage a greater number of servers. In their initial adoption phase, IT organizations have been able to virtualize mostly lower-end or less complex workloads, including IT/Web infrastructure and collaborative applications; but many organizations have yet to virtualize their more complex higher-end workloads because of the memory and processor requirements of these applications. To continue to realize cost savings, IT needs to increase the virtualization penetration within its application portfolio.

Lenovo ThinkServer features increased memory capacity and processor performance that not only allow increased virtual machine density (more virtual machines per individual physical server) but also larger more robust VMs capable of running higher-end workloads. IT organizations can increase the consolidation ratio of physical to virtual servers and migrate previously hard to virtualize applications, including business processing, database, and analytics. The benefits translate into lower hardware costs and reduced IT administration costs. Further consolidating the environment through virtualization has ancillary benefits by reduces costs from rack cabling, power distribution units (PDUs), and uninterruptable power supply (UPS). The IT organization is able to make maximum use of its datacenter space, which often means avoiding costly datacenter buildouts.

Energy-Efficient Design

Server power and cooling can be a burden on IT budgets and also a limiting factor if IT is unable to expand capacity beyond its finite floor space and power envelope. By increasing energy efficiency and lowering power consumption with Lenovo ThinkServer, customers achieve savings not just from the servers but also by the reduction of power distribution units and uninterruptable power supplies, in addition to lower cooling requirements. The ThinkServer portfolio also leverages Lenovo technology, including Spread Core cooling and Smart Grid power management. In detail:

- **Spread Core cooling.** ThinkServer employs Lenovo's Spread Core cooling, which is designed to improve cooling efficiency of the system. The server's fans direct airflow through six air cooling segments (or zones), which optimizes components cooling while reducing the power consumption of fans.

- **Smart Grid power management.** The ThinkServer rack server power management tool provides processor throttling and individual or group-level power capping. Smart Grid power management tracks processor, memory utilization, and power performance. Systems administrators can enable policies, based on server utilization or power consumption trends, which set power caps for individual servers or group of servers. By enabling power caps, IT can tap into an underutilized power envelope to deploy more servers within the same rack, space, and power envelope.

Reliable Servers for IT Availability

It's never been truer that when IT goes down, the business goes down as well. IT and application availability are critical factors to any business, large or small. Unplanned downtime is disruptive to the business operations and expensive to deal with. As virtualization increases the number of workloads per physical server, a single individual server going down now has a greater impact.

Lenovo engineered the new ThinkServer line with system reliability in mind. A diagnostic panel on the front of the server provides real-time status updates. ThinkServer uses a fan system designed to absorb vibration and capacitors that have a 10- to 20-year duty cycle, not 6–7 years used by many in the industry.

Targeting Ease of Use, Ease of Integration

IDC finds that in an average IT department, 80% of the staff time is spent on simply maintaining the existing infrastructure, and only 20% is able to be to free up for innovation and value-added initiatives. At the same time, IT managers are still challenged to grow IT capacity in the face of stagnant budgets.

Creating a more efficient staff can drive significant savings and enable more funds to be reallocated to initiatives that enhance the IT environment or drive further business value. For many IT departments, additional tools would be an unwelcome sight because they only increase the complexity of IT. Lenovo engineered ThinkServer to seamlessly integrate into existing environments and work with existing IT tools.

Lenovo does offer its own set of life-cycle tools for the ThinkServer line, including:

- **EasyStartup:** A configuration and deployment tool for RAID controller and disk array and the installation of Windows and Linux operating systems
- **EasyManage:** Remote control, monitor, and management of Lenovo servers in a LAN via a graphical interface
- **EasyUpdate:** A firmware update application to maintain up-to-date editions and avoid disruptions

Reducing Administration Costs

As we have seen in this white paper, operational costs for IT staff time, power/cooling, and responses to unplanned downtime combine to drain IT budgets. However, to the degree that any, or all, of these cost factors could be reduced, then the operational costs and the ROI to acquire the computers would be reduced (see Figure 3).

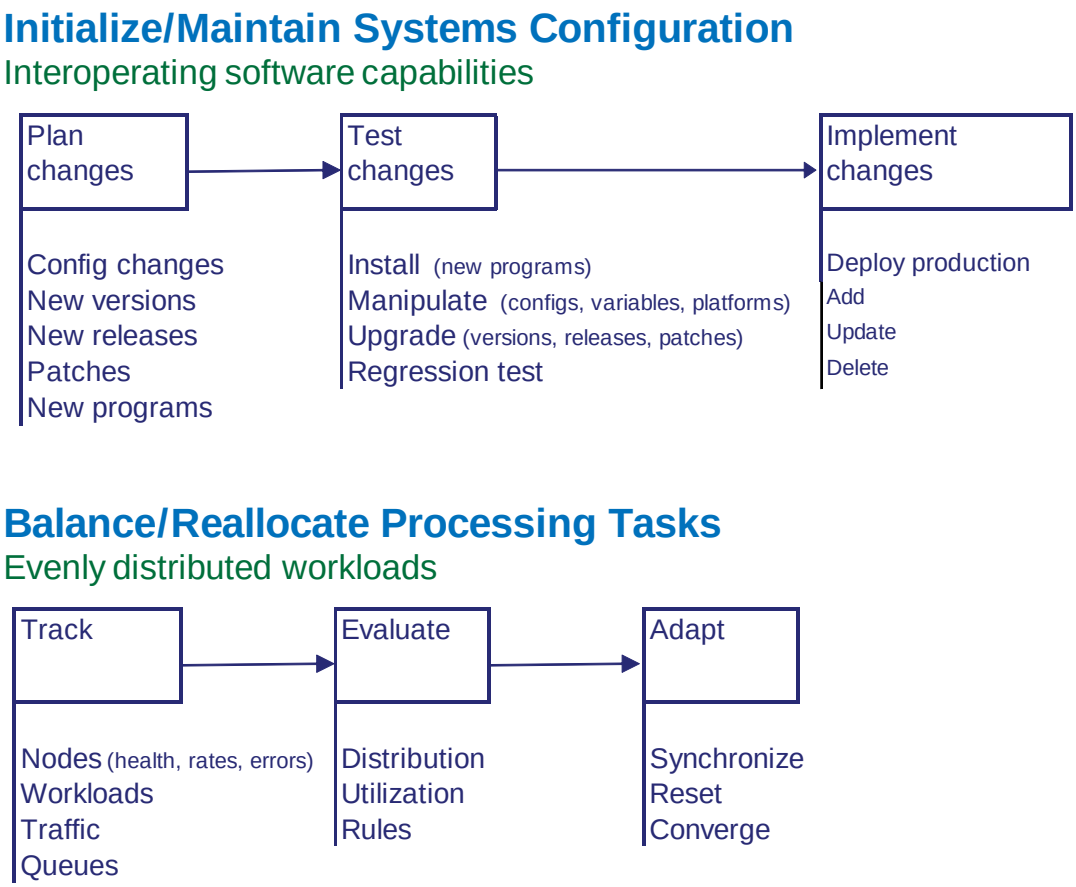
As servers age in place, the number of service incidents tends to increase over time. That means that close oversight of all of the components — and the ability to address any failing components prior to disruption of business services — is critical to maintaining business continuity.

ThinkServer upgrade customers can achieve significant improvements by leveraging the combination of:

- ThinkServer servers' enhanced capability
- ThinkServer tools for management — EasyStartup, EasyManage, and EasyUpdate
- Windows 2012's expanded management capabilities, including:
  - Windows Management Framework for integration
  - Windows PowerShell for automation
  - Windows Server Manager's deployment and configuration tools for managing multiple servers through a single dashboard, etc.

FIGURE 3

Server Life-Cycle Administration **Functions**, **Objectives**, and Steps



Source: IDC, 2014

Leveraging Lenovo's Software and Hardware Capabilities

In 2014, IDC interviewed two organizations — large companies with over 1,000 employees in the construction and chemical manufacturing industries — upgrading to Lenovo ThinkServer servers. Both companies maintain datacenters with hundreds of physical servers and thousands of virtual machines. One organization had moved approximately half of its server environment to Lenovo, while the other had moved a

more limited number of application servers to Lenovo. Both organizations indicated that they had benefited from upgrading to Lenovo ThinkServer. The organizations reported that the new Lenovo ThinkServer servers provided:

- Greater efficiency and enhanced software support capabilities, reducing the administration time required of their IT staffs, which in turn reduced labor opex cost — one firm estimated reductions of 30% in server administration
- More powerful throughput capabilities that allowed each server to support more virtual machines, which in turn reduces the number of servers required and thus reduced their capex
- Reduced energy and cooling opex — between 5% and 10% less — because the more powerful servers supporting more VMs per machine also consumed less power than the servers they replaced
- Reduced downtime and need for help desk support (One organization estimated downtime had dropped from an average of four instances of unplanned downtime per month to less than two. One manager estimated that, "… with newer hardware, we're losing 5-10% of calls to the help desk." In addition, he noted that his IT staff can now handle 70% of calls at Level 1, whereas it was able to handle only 50% before its server upgrade.)
- More efficient IT operations, capturing a number of business benefits across their organizations

One interviewee explained that "a lot of virtualization in the past 10 years has required new and improved processors." He reported that the company is avoiding about 20% of its annual server purchases with the Lenovo server environment because Lenovo servers support more virtual machines per physical server. The manager explained that "we might have been able to put 10 VMs onto one of the older servers, and now we can add another 3–4 on top of that." His company has leveraged these efficiencies to help it trim its hardware footprint in smaller offices, where it can now use fewer physical servers to support more VMs. According to the manager, "Where there were previously two servers at an office, we might only have one now because of increased virtualization capabilities."

Upgrade Imperative

Both organizations indicated that rapidly advancing software releases for operating systems, hypervisors, DBMS, and applications demand more capable, up-to-date servers and force the upgrade. One IT manager explained, "We needed to upgrade our control systems, and we needed new servers to do this. The need for the change was driven by the software because the old hardware could not support the new software." Another interviewee explained, "We find that if we don't replace our servers on schedule, any savings quickly evaporate …. [For example], we have a SQL Server that is long overdue for an upgrade. It's not only impacting IT but also the company as a whole because of performance reasons. People are not able to get their data, which impacts about 1,500 users." This strains the IT team because many more IT staff hours are required to manage an older server than an up-to-date server.

Keeping up to date with software releases in turn provides another benefit. It allowed these firms to keep up to date with more secure firmware and low-level security protection. One organization explained that running newer servers with "the latest version of the firmware" enhanced security because the newer firmware allowed easier installation of upgrades. According to this organization, instead of going through the difficult process of applying security updates to an older server, "it's easier and more cost effective to actually put in newer hardware with the latest version of the firmware." Another firm mentioned that the new server supports newer isolation technology that helps ensure that one compromised server cannot harm another server. This feature did not run on the older, replaced servers.

Business Impact

Both firms upgrading to new Lenovo ThinkServer servers cited the business benefit of the upgrade. One credited the new Lenovo ThinkServer with enabling "a 30–40% increase in performance" for its enterprise resource planning (ERP) system. According to the interviews, the improvement translated to "a user impact on the order of a 10% productivity improvement." One of the firms, a construction company, explained how the new Lenovo server's additional VM capability enabled it to change the way it distributed data back and forth from the central office to a field site. The added capacity of the new servers enabled the company to run an additional VM/app that handled replication of data from field to central and back. Data refreshes that formerly took three to five days took a couple of hours and greatly simplified backup and recovery.

Business Benefits

Today's businesses rely on hundreds of servers operating efficiently — and doing so on a 24 x 7 x 365 basis. Any prolonged disruptions in these operations, which businesses sometimes call "computer glitches," are simply unacceptable because they affect the availability of applications and databases being accessed by employees and by end customers. Therefore, any interruptions are to be avoided. In the event that processing is interrupted by an outage, it must be able to resume on other systems as quickly as possible.

Technology Transition: Before and After

As servers age in place, various cost categories show that spending gets steeper as time goes on. These categories include maintenance costs; costs for power and cooling, managing, and monitoring servers; and staff costs. However, according to a demand-side, customer-based study conducted by IDC, a server transition that takes into account all these factors offers surprising findings that contradict and challenge traditional IT depreciation cycles. Based on respondents' experiences with technology refreshes, the study shows that IT investments in new technology pay off in less than a year — and that the cost savings benefits over three years are more than three times as much as the initial amount invested.

The IDC study found that transitioning server infrastructure on pace with newer technology (e.g., every two years) can reduce multiyear server costs. This occurred not only because today's servers can handle comparable workloads at less than 40%

of the aggregate power requirements that older servers require but also because of Lenovo's advanced technologies, which in turn reduce maintenance overhead and IT labor costs.

Other cost savings benefits can be added to this list. They include administrative labor associated with physical equipment management and cabling, as well as upgrades to firmware and the associated regression testing prior to production deployment.

Because of the high cost and potentially disruptive nature of upgrades, IT organizations strive to avoid this activity. Nevertheless, as the length of the deployment increases, the cost of maintenance per server increases. Because newer servers require less of this type of maintenance and management, labor cost savings ensue. Operational expense factors can be materially reduced with newer servers.

CHALLENGES AND OPPORTUNITIES

The worldwide server market is a competitive one. Server platforms continue to compete in terms of price and performance and their capacity to support and manage virtualized workloads and their ability to provide reliability, availability, and serviceability to IT staff and end users.

For all vendors, product differentiation and a timely response to changing business conditions are key to meeting customer expectations regarding technology refresh for each product life cycle.

Lenovo recognizes that its ability to integrate functionality into the platform (e.g., hardware and software), while supporting open computing standards for software and key hardware components (e.g., I/O, software APIs), is the basis for much of its differentiation and business value as it goes to market with its server solutions. That is why Lenovo is emphasizing its role as a provider of cost-effective workload server platforms that will support business continuity and business value based on customer usage patterns and ongoing service requirements.

CONCLUSION

As we have seen, the continual increase in computing power, which is more than doubling every two years, counters the conclusion that avoiding new equipment and capital expense is the best way to reduce capex acquisition costs.

As organizations consider server transition in their datacenters, they also should consider incorporating a full accounting of all of the relevant factors — including not only capital costs but also labor, power/cooling, and electricity costs. This type of analysis, including avoidance of opex costs, may provide surprising conclusions, showing long-term cost projections over the server life cycle that challenge traditional IT depreciation cycles.

One example of this approach is replacing older server technologies that have been supporting specific workloads over many years. In-depth IDC interviews show that sites

that have updated server technology have reduced many types of operational costs, including costs of IT staff time for maintenance and management, per-workload energy costs, and facilities costs. Respondents reported that through the process of workload consolidation, they can run more workloads in less datacenter space with newer systems than they could with previous-generation systems.

Refreshing server infrastructure on pace with newer technology — including server acquisition costs, IT staff costs, and power/cooling costs — can reduce opex by as much as 33%, as discussed in this white paper. Rather than put off capital expenditures and extend server life cycles (buy-and-hold strategy), organizations that are faced with sharp budget challenges should consider selectively upgrading their servers to the latest available technology, targeting the workloads that would benefit most from workload consolidation, including demanding workloads that require high levels of availability and high levels of security.