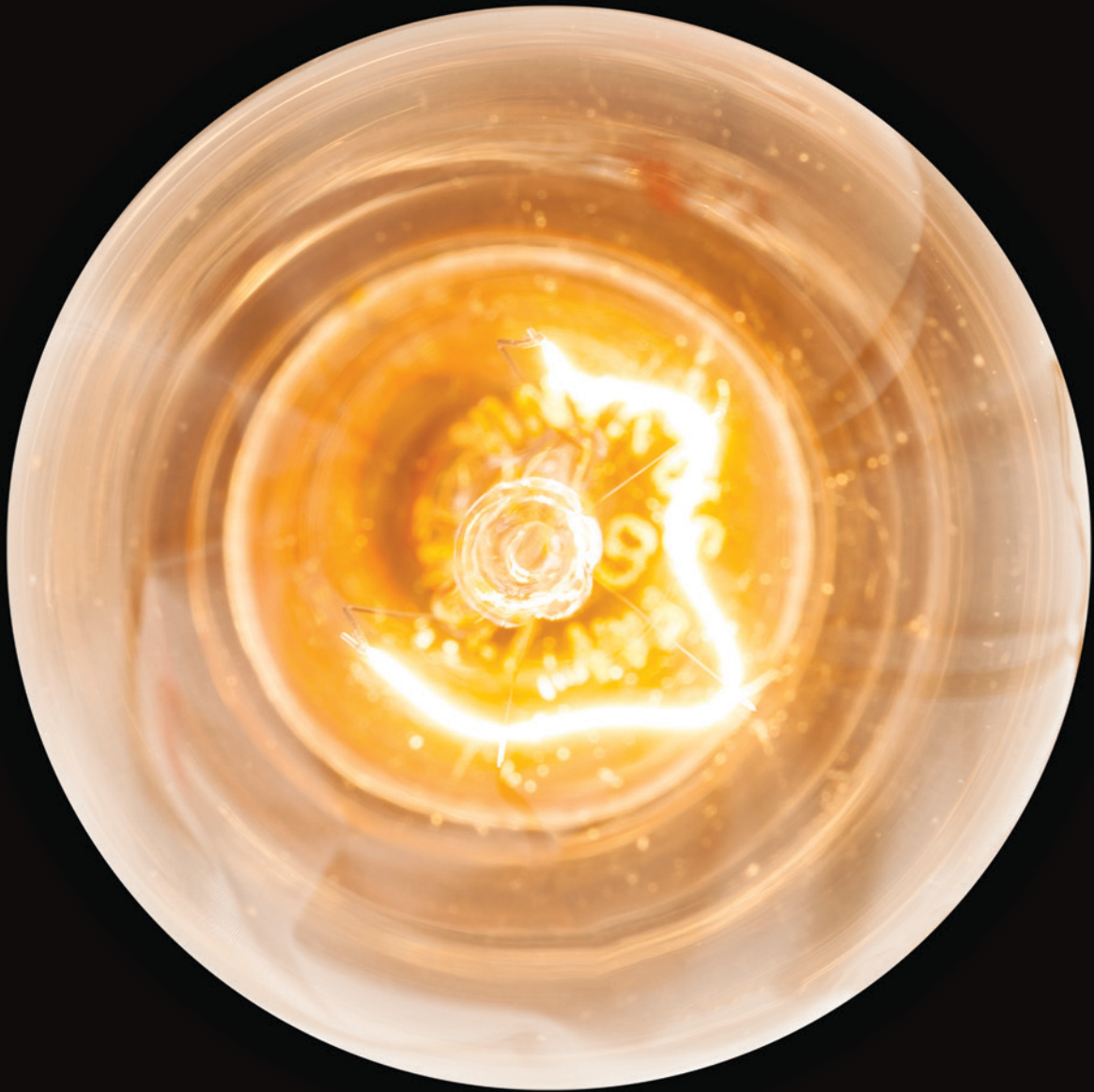


Deloitte.



IBM LinuxONE™

A flexible core system from innovation to cost

Balancing the core

Organizations are racing to adopt new technology practices in an effort to maintain their competitive advantage, if not surpass the competition altogether, and expedite innovation. In an era demanding scalability and flexibility, plagued with restricted budgets, and that requires the utilization of core system investments, businesses have their hands tied.



How does an organization with heavy investments in core systems evolve to keep pace with data growth and processing while maintaining its budget?

Transforming systems effectively requires IT executives to balance the systems in core environments with new systems that enable their businesses to leverage data and innovate. However, budget constraints can make it challenging to keep pace with the demand on legacy systems and growing data center footprints to accommodate new workloads. One way to help cut costs has been to migrate workloads to the cloud, but many companies have mission-critical workloads that are required to remain on local servers. Regardless of alternatives, in Deloitte's Global CIO Survey, the gaps

between business expectations and IT capabilities were astonishing: 57 percent of CIOs said innovation was the business's core expectation of IT, but only 18 percent of CIOs said that their IT capabilities for supporting innovation and disruption were mature.¹

There are massive amounts of opportunities available to companies that are able to leverage data, but IT executives' constrained budgets challenge their ability to bring innovation to the business as they try to balance their trusted systems with new, flexible systems.

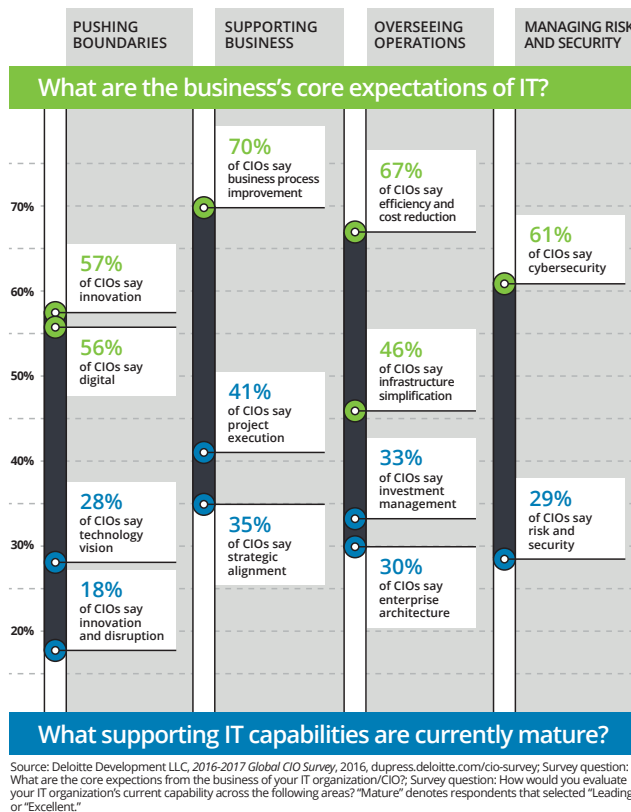
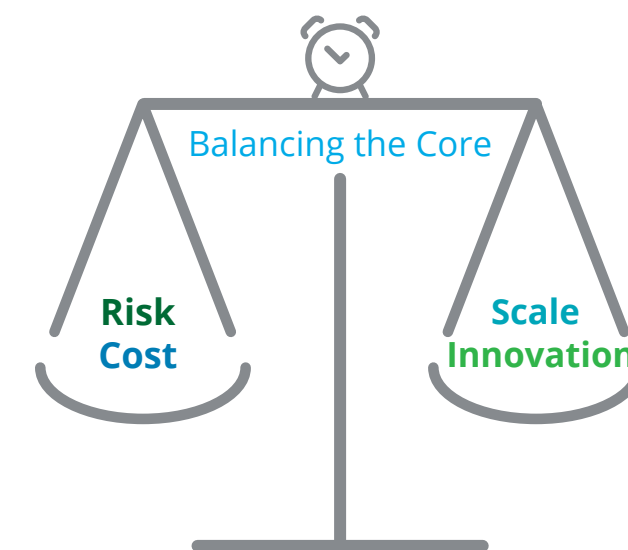


Figure 1. Deloitte 2016-2017 CIO Study

The CIO wish list

Traditionally, core systems equate to mainframes. They were, and are, recognized for their reliability, durability, availability, security, and high performance. Mainframes became trusted, fault-resistant systems that supported, and still support, many of the world's largest corporations. They offer an organization dependable reporting and auditing. Core systems also take up little space on a data center floor, which reduces footprint costs by running mass numbers of workloads on a single system instead of running the same number of workloads on hundreds or thousands of smaller systems. Unfortunately, while legacy systems may excel in steadfastness and consolidation, the perception is that they often lack flexibility and have high operating costs, inhibiting businesses from achieving cost-effective innovation.

In comparison, the new systems handling flexible technologies tend to lack the steadfastness of legacy systems and can breed large data center footprints, increase risk, decrease performance, and increase executive frustration. What many decision-makers thought may be a lower-cost option for innovation led to ever-increasing server sprawl costs.



Wouldn't it be nice if there was a cost-effective system to balance core systems with new systems, provide the steadfastness of a mainframe, but operate with flexibility in mind—connectivity, open systems, open standards, virtualization, containerization, open source?

IBM has a present to deliver, and its name is LinuxONE™

In August 2015, IBM announced a three-way strategy to bring flexibility and innovation to its legacy systems by embracing open-source-based technologies and open source communities. This powerful solution combination was called LinuxONE.

LinuxONE offers a new portfolio of hardware, software, and services solutions that provides two hardware solution packages, future support for open source solutions, and a contribution to the open source community to enable greater access to the developer community.²

By combining the power of the open source community with its knowledge in reliable mission-critical systems, IBM provides a viable solution for running open source solutions at the core of organizations.

IT executives no longer need to choose between reliable and predictable, dynamic and agile, or cost because LinuxONE helps close this gap. The LinuxONE platform brings core stability to open source solutions, ultimately empowering companies to create innovative solutions at a competitive price point.

“We strongly believe that we need to leverage our strengths and invest in LinuxONE as (1) the best data serving platform in the world and (2) the most secure computing platform in the world.”

– Mark Figley
IBM LinuxONE Systems Offering Lead

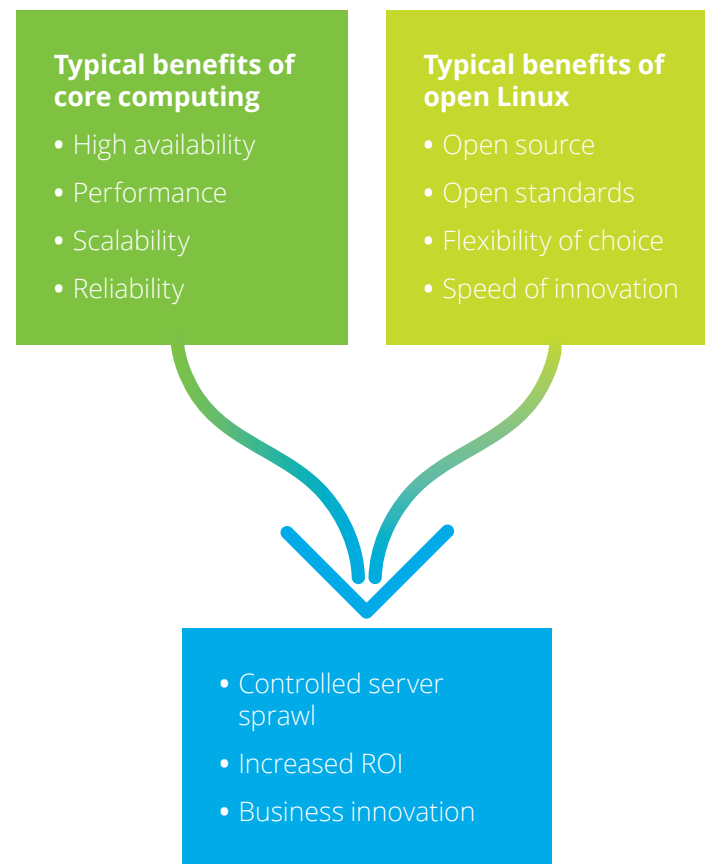


Figure 3. Typical benefits of core computing and open Linux can provide business benefits.

An innovative, flexible core system

Innovation and flexibility

LinuxONE was designed with flexibility and innovation in mind to provide businesses with an option in addressing technology demands, on time, to the organization and its customers.

Cloud

LinuxONE allows clients to use cloud and hardware environments, offering choice with consistency via Hybrid Cloud. The platform supports open source workloads, which run on Linux™, in a secure, high-performance, scalable, and available environment.

Cloud management features include IBM Wave software, which enables the simple configuration and provisioning of virtual machines, in addition to IBM's z/VM® hypervisor. For traditional Linux users, KVM virtualization and management is also available.

To aid incorporation of LinuxONE into a customer's environment, IBM offers LinuxONE platform integration with Openstack, the IBM Cloud Manager Appliance, and VMware's vRealize Automation software. The platform can also be connected through IBM's platform-as-a-service, Bluemix®, to enable the consumption of services in business applications via application programming interfaces (APIs).

Open source and open standards

In addition to commercial Linux software solutions, the LinuxONE platform is positioned to make use of open source software solutions. LinuxONE permits the deployment of many open source solutions that provide innovative and differentiated services to customers. Some example solutions include Apache Spark for real-time insights, smart city technologies, geospatial retail analytics, and financial credit management.

Virtualization

LinuxONE's virtualization capabilities allow firms to efficiently re-allocate resources between guests, using hypervisor partitioning that is built into the firmware and the platform's elastic system that combines non-disruptive horizontal and vertical scaling. The two LinuxONE hardware solutions, Rockhopper and Emperor, respectively can fit up to 1,000 VMs or 8,000 VMs in a single box.

From a virtualization toolset point-of-view, there are two options to choose from: IBM z/VM or KVM. IBM z/VM heralds from heritage, mission-critical systems and provides tight integration into the LinuxONE hardware features. To evolve z/VM, it is sometimes coupled with IBM Wave for z/VM, which is IBM's enhanced interface for managing z/VM. To be able to gain the demonstrated benefits from this virtualization layer, users with previous z/VM experience are recommended.

Open source KVM is also available and is suited for organizations that have existing skills around KVM. However, this virtualization layer is currently not as tightly coupled with the LinuxONE hardware as z/VM, which limits the number of features that are available to KVM users.

Blockchain

LinuxONE provides two major features that may be of interest to businesses looking for a platform for innovative blockchain solutions. The encryption features allow users to run blockchain at level of encryption required in many regulated industries and at a high speed.

In addition, the use of IBM's Secure Service Container, a hardened and encrypted version of its blockchain solution, allows users to run the solution, knowing that there is no administrative access without the master encryption key. This reduces the risk of impacting core business applications and is important considering 58 percent of IT ops and security managers believe organizations are granting unnecessary access to their staff.³

Retaining the core strengths

LinuxONE was created with flexibility and innovation in mind. However, it incorporates its predecessor's successes in high availability, performance, scalability, and security. Its core system has been running important workloads for generations and has demonstrated near-zero unplanned downtime. The technology is in 96 of the world's top 100 banks, 23 of the top 25 US retailers, and 9 of the top 10 biggest insurance companies,⁴ which alludes to this system's ability to maintain its steadfastness.

High availability

LinuxONE's platform provides high levels of availability—its mean-time-to-failure is measured in decades, not single-digit years. The systems are built with reliability features that include spare cores to allow additional redundancy and remove single points-of-failure. This is important when considering how memory problems can be the cause of system failures.

LinuxONE embeds error detection into the components and includes built-in, automated diagnostics. Automated failover increases speed to recovery and reduces system impact. Installing, upgrading, and maintaining processors is a non-disruptive process, enabling the system to run without downtime.⁵

Performance—extra cores, multi-tier cache, high I/O

Performance enables increased capacity and decreased licensing costs. The LinuxONE platform includes IBM's power systems technology and Simultaneous Multi-Threading (SMT), which allows businesses to run multiple workloads in parallel.

Additionally, unlike many other platforms that are designed for peak usage, LinuxONE can run at near 100 percent utilization, yielding less processor requirements (see Figure 4).

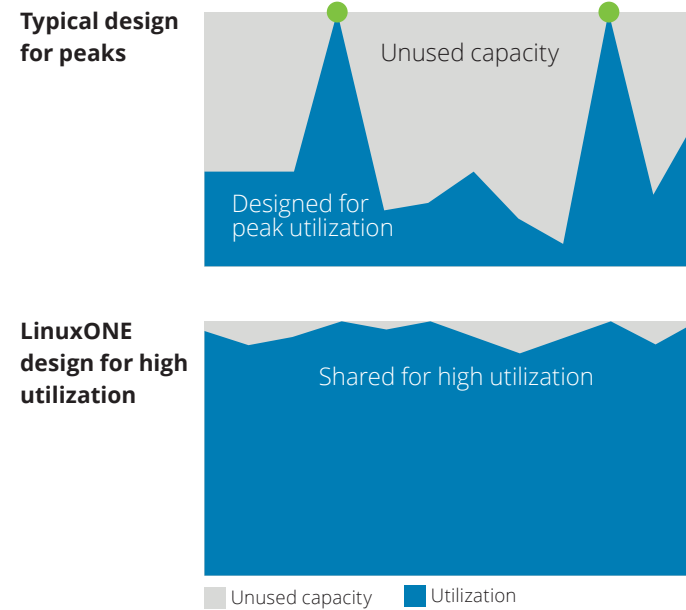


Figure 4. Example of what one may see regarding LinuxONE utilization in comparison to typical design utilization peaks.

Scalability made easy—capacity-on-demand, multiple workloads, or VMs on one system

LinuxONE is a very competitive solution for scalability. As organizations develop innovative solutions, being able to improve response times and add more capacity is crucial. LinuxONE enables scale out by adding additional Linux virtual servers, as well as scale up by adding memory and processors. The configuration of the system enables the business to scale without disruption to the running environment.

Although 8,000 and 1,000 Linux servers are the architectural limit for Emperor and Rockhopper, respectively, the amount of volume capacity may be reduced if users incorporate Secure Service Containers into the environment, and the actual number of volumes that the systems can support is likely dictated by business workload requirements.

Security

LinuxONE provides one of the most secure, commercially available platforms for Linux. The systems provide tamperproof, built-in cryptographic cards and come with firmware-based partitioning, including EAL 5+ workload isolation. Additionally, LinuxONE isolates at every level, running up to 80 LPARs to enable workload isolation and pooling of resources across partitions or dedicated to individual partitions.

The LinuxONE platform also allows users to take advantage of IBM's security solutions, including IBM QRadar®, which provides security monitoring and management. Identity management, policy-based authentication, security zones, reporting, and auditing are additional features that are available to users to enable a secure data processing environment.

The ability to consolidate workloads onto a single machine with internal high speed networks means that it is possible to decrease external network traffic, resulting in a reduced risk profile.



Linux is everywhere. It is driving an open standards revolution that is now integrating with business-critical applications.

The LinuxONE portfolio offers hardware, software, and services that combine the flexibility and agility of the open revolution for a cost-effective, enterprise-grade Linux environment.

When does Linux make sense?

- If users need an agile and effective hybrid cloud infrastructure option to address new business demands with greater efficiency and low service delivery costs
- When users need to extract insights from data faster, by removing ETL processes, and scale to meet big data and analytics demands
- When users need to secure the business, which requires system designs that provide the highest commercially available levels of security

What concerns does this address?

- Running large input/output (I/O) or cache intensive workloads (i.e., database or transaction processing applications)
- Consolidating a large number of servers when a business suffers from increasing costs of server sprawl
- Gathering time-sensitive data that is driving the digital agenda
- Reducing expensive software licensing costs over time
- Providing mandatory business uptime and security

A cost-effective, flexible core system

IBM reports that Linux applications on blade servers are more than 65 percent more expensive than on those running in LinuxONE environments and that LinuxONE provides a faster return on investment at a lesser total cost of acquisition than that of blade server solutions for organizations having more than 20 Linux servers.⁶ These figures indicate LinuxONE as a viable solution for consideration for executives looking into consolidating their IT footprint and/or achieving improved performance.

IBM LinuxONE has two pricing models: outright purchase and elastic pricing. Additionally, a “try then buy” approach allows for contract cancellation after one year at no cost in many cases.

Pricing overview

Standard hardware pricing

The LinuxONE solution can be based on purchasing a set number of CPUs and memory. In addition, any required software may be bundled into a single purchase price for the solution. Software support and maintenance will be paid on normal cycles that businesses are used to. Capacity Back-Up, an optional feature, enables users to have a disaster recovery site with sufficient capacity, which can be activated in the event of a disaster. This also allows users to do disaster recovery testing at intervals as required.

Elastic pricing

Elastic, capacity-on-demand pricing allows the business to purchase the capacity that is desired and add more when it is needed. Customers can pay-for-use, pay-per-core, or rent with no upfront payment and return after one year. Companies purchase the desired number of active cores at a standard price and optionally purchase “on demand,” self-managed inactive cores at a reduced price. This likely decreases third party charges in maintaining the capacity.

Elastic, pay-by-use pricing may improve the attractiveness of the LinuxONE proposition, but organizations should consider closely monitoring solution utilization so the business budgets are not exceeded due to unplanned peak periods and utilization.

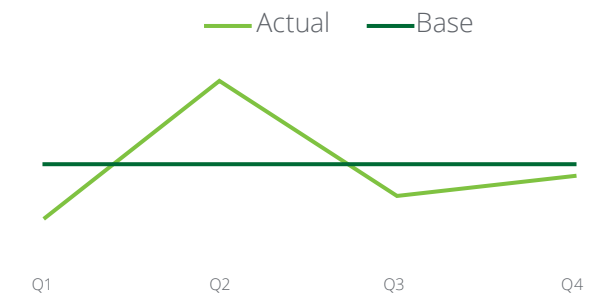


Figure 6. Example elastic pricing model over the course of four quarters.

An initial view of costs

It is anticipated that commodity-based buyers likely look at the raw cost of a server, which typically includes a lower price tag in comparison to the higher-cost LinuxONE hardware solutions. However, this should be vetted carefully with a return on investment (ROI) and total cost of ownership (TCO) analysis to make sure the correct solution for controlling future growth costs is chosen.

Costs are specific to each client that assesses the LinuxONE solution. As a starting point, the online IBM LinuxONE TCO calculator provides insights into potential cost implications⁷ and the scale of the savings that may be achieved. However, the pricing and savings presented by this tool should only be used as an indicator for potential areas of cost savings. It is recommended that the business work with IBM representatives to validate potential cost savings in the environment.

Figure 7 is an example of cost saving using a benchmark workload of 100 new servers running on blade servers. The tool indicates major savings in software costs.

When using the same tool with 100 existing servers, without databases, the savings are once again realized in application server costs. It should be noted that in this scenario, the cost comparison shows the initial price as higher, but overall cost savings are still realized.

Scaling workloads shows similar savings; when increasing an environment to 1,000 servers of mixed workloads, the savings remain consistent.

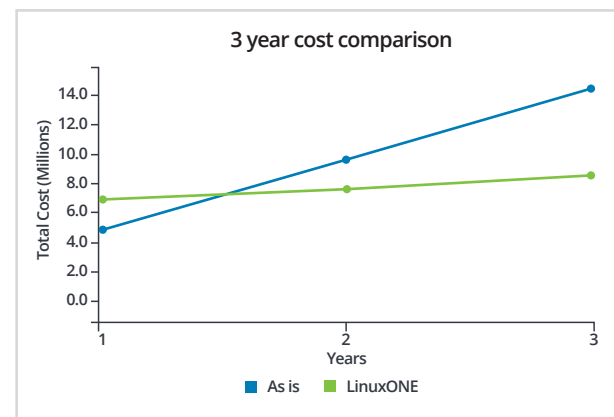
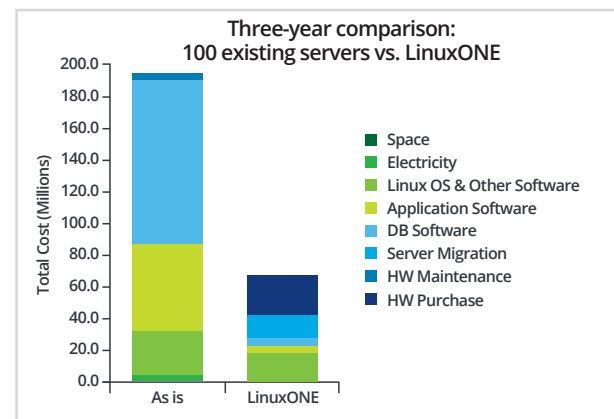
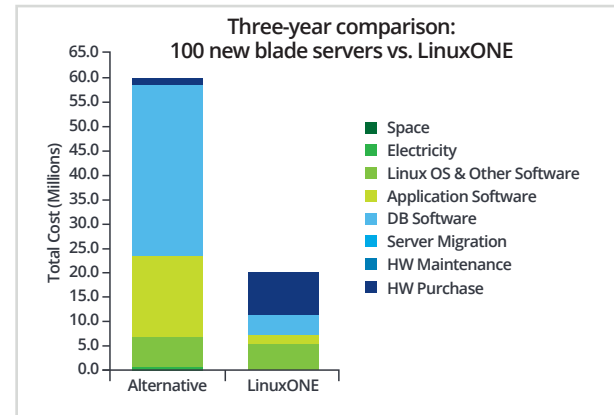


Figure 7. The top graphic depicts the comparison between a scenario of 100 new servers running on blade servers and LinuxONE™; the central graphic depicts the scenario of using 100 existing servers in comparison to LinuxONE™. The bottom graphic shows that cost benefits are still realized, even when using the environment comparison example with 100 existing servers.

Consolidation savings

Due to the nature of the technology used in the LinuxONE solution, it is not a simple one-for-one modelling exercise to determine the number of cores or amount of memory users may require. Users may experience various core consolidation ratios depending on the nature of the workload, and it is not unusual to have anywhere in the region of 20:1 to a maximum of 50:1 core consolidation ratios when comparing with traditional x86 environments.

In an environment where software may be priced on CPUs, LinuxONE is an effective solution because the number of CPUs required on the machine will be significantly less than those required in a distributed environment. Furthermore, the ability to run many elements of an application on a single platform means there are savings to be realized in the connectivity, power, space, networking, and operational support of these applications.

In an open source environment, the savings may not be as clear, as open source is not priced on a CPU basis. Potential customers are recommended to compare the total cost of the solution and the relevant savings achievable through general consolidation. This should be coupled with actual asset cycles to clearly understand when the savings may be realized.

Database savings

Reducing the number of required database licensed processors can result in significant savings. However, this is dependent on existing license agreements and the level of savings that can be realized should be considered. If users have an “Unlimited License Agreement,” there are still major savings which can be realized upon renewal of these agreements when future pricing is based on the existing utilization of products.



A consolidated story: Environmental analytics

An IBM client focusing on environmental analytics migrated its databases from x86 systems to IBM LinuxONE in an effort to ensure that it could scale its future business and manage large utilization peaks. By doing so, the client saw improved performance and cost reduction by reducing its CPUs from 205 on a distributed environment to a mere 17 CPUs on a LinuxONE server. It also reaps the benefits of a resilient, high-performance system that enhances the delivery of data to its clients.



Sample cost saving areas

- Inter-server connectivity and networks
- Physical space, power, and cooling
- Management costs
- Software licensing
- Hardware

March of the penguins

Expanding upon the LinuxONE hardware announcement, there are two LinuxONE hardware models available today—Emperor and Rockhopper—both aptly named in accordance to IBM's adoption to open source and Linux's famous mascot penguin, Tux.

These systems run the LinuxONE platform that enables integration with Linux distributions, which are bundled software operating systems that allow customers to interact with various LinuxONE platform features. For example, the Linux distribution of SUSE SLES with Service Pack 2 supports advanced multi-threading and data processing core technologies of the LinuxONE platform.⁸

There are many Linux distributions available to integrate with the LinuxONE platform. These include: SUSE SLES, Canonical's Ubuntu, and Red Hat Enterprise Linux (RHEL). Additionally, community versions of Debian, openSUSE, Fedora, and CentOS run on the platform.

IBM LinuxONE Rockhopper™

The Rockhopper is the smaller, entry-point LinuxONE model hardware that is optimized for high-performance, reliable, scalable, secure, and cost-efficient computing. The base machine starts at 10 processing cores and 1TB of memory, and it can scale up to 20 cores and 4TB of memory. In its largest configuration, Rockhopper can support the equivalent of 1,000 Linux servers. The Rockhopper solution tends to be better suited for entry-level enterprises or growing businesses looking to use the LinuxONE technology.

From a cost perspective, the smaller Rockhopper may appeal to those seeking a cost-effective solution. However, the two-drawer model is likely to be the most popular starting point to provide increased redundancy.

IBM LinuxONE Emperor™

The Emperor is the larger, enterprise-ready solution for large scale consolidation, capacity, and optimization. It is the first in a generation of systems that is designed for digital business and the mobile economy by delivering enterprise level performance, security, availability, virtualization, and scalability. This machine is capable of supporting up to 141 cores, 10TB of memory, and 8,000 Linux servers.

The larger Emperor is typically suited for customers requiring large-scale distributed system consolidation or those who have large memory requirements.



The last word

Technology is evolving at a rapid rate, introducing a number of opportunities for businesses to expand and deliver new capabilities. However, this evolution also introduces the threat of businesses becoming obsolete if they do not remain flexible and innovative and maintain the integrity and performance of their systems. Technology leaders should cost-effectively balance their technical environments so that they can provide the flexibility and steadfastness that the business demands to deliver internal requirements and expand client footprint.

LinuxONE provides organizations an option to leverage flexible, open source software on a stable, secure, and reliable platform at an effective cost point, satisfying the CIO's wish list that has been described. It provides a viable option to businesses wishing to combat server sprawl, regain control of their IT infrastructure footprints, and provide their users and customers with data and insights when it is needed.

IBM established an important precedence with its LinuxONE investment to help ensure businesses have the needed end-to-end capabilities to drive innovation in this constantly-evolving, digital world.

"Our embrace of Linux, open source software, and the open ecosystem ethos is critical, but it doesn't answer the 'why' question. Those open source software packages can also run on a \$6,000 server, so the value proposition cannot just be that we run that software, and it isn't..."

IBM has invested billions of dollars over many decades building a platform that is not just a little different, but radically different than other servers [around] a few focused use cases: data serving of all kinds, massive scale transaction processing, and high security computing where data privacy and regulatory compliance matter...

We continue to invest in building strengths in those areas and will be more effective at communicating that value proposition to new customers that are unfamiliar with our platform."

– Mark Figley

IBM LinuxONE Systems Offering Lead

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