ACHIEVING SUSTAINABILITY, SECURITY AND SCALABILITY WITH IBM LINUXONE 4

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EXECUTIVE SUMMARY

In this research paper, Moor Insights & Strategy (MI&S) explores the challenges organizations of all sizes face as they try to achieve the seemingly contradictory goals of digitally transforming business operations while reducing their carbon footprint, security vulnerabilities, and, ultimately, costs. This paper will demonstrate how IBM LinuxONE helps such organizations find success on their digital transformation journey.

SITUATION ANALYSIS

Many established businesses across industries need to transform. Business processes and operations that led to market leadership decades ago are outdated relative to today's digitally native competitors that can deliver products and services faster and respond to market needs with the agility and precision required for survival in the modern economy.

This market dynamic has led to seemingly every business engaging in digital transformation projects. While each company is unique in its approach to transforming the business, the goals are universal – respond to the market's needs with the speed of these digital upstarts while reducing costs.

In parallel and ostensibly in contrast with these transformation projects is the rise of environmental, social, and governance (ESG) mandates that modern businesses have rightfully prioritized alongside growth and profitability.

Virtually every enterprise CIO with whom MI&S engages is in the throes of developing a plan with strategies to support these different objectives. Many are struggling to answer one question in particular, "How does an IT organization deploy underlying infrastructure that can support the business's diverse (and constantly shifting) needs and reduce its costs, power consumption, and datacenter space?"

DIGITAL TRANSFORMATION – SURVIVAL OF THE GREENEST?

"It is not the strongest of the species that survives, nor the most intelligent; it is the most adaptable to change." Often attributed to British naturalist Charles Darwin, this sentiment is perhaps more relevant than ever for businesses.

As mentioned, the specific goals of an organization's digital transformation project vary. However, the guiding principle – the north star, if you will – is survival. They must drive down costs and use technology to drive business efficiencies. The burden of achieving this goal rests squarely on CIOs and IT executives, who must rethink technology deployments and consumption.

While considering this survival, IT plays a significant role in a company's ESG goals. As it relates to the environment, the impact of IT is substantial. Consider these numbers uncovered in an IBM Institute for Business Value report on sustainability:[1]

- Collectively, as of 2021, datacenters account for 200-250 terawatt-hours (TWh) of energy – roughly 1% of all global energy consumption and 0.3% of carbon emissions.
- Further, the datacenter market is anticipated to grow by 30% through 2027.
- The dependence on workloads such as data analytics, artificial intelligence/machine learning (AI/ML), and security will further drive energy consumption due to the use of additional servers to run specialized software.
- Internet users doubled between 2010 and 2021, and internet traffic increased 15-fold.

The above demonstrates two critical roles IT plays in addressing climate change. The strategic IT decisions made around infrastructure can:

1. Have a tangible impact on the speed at which businesses can create and deliver products and services that have a measurable effect on climate; and
2. Impact IT's energy usage and carbon footprint and how much it contributes to good climate stewardship.

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[1] "IT Sustainability beyond the Data Center" – IBM Institute for Business Value
https://www.ibm.com/thought-leadership/institute-business-value/report/it-sustainability

Achieving Sustainability, Security
And Scalability With IBM LinuxONE

April 2023

These are not hyperbolic proclamations designed to elicit an emotional response. Instead, they are realistic perspectives that have resonated so strongly that 86% of companies have a sustainability strategy.[2]

STEWARDSHIP INTERSECTS WITH PRAGMATISM

With so much focus on being good climate stewards, businesses are ultimately driven by the bottom line – making money. And sustainability goals have a strong alignment with the bottom line. The rapidly rising cost of energy is making this more important than ever.

These numbers represent the cost associated with powering servers and IT infrastructure. This equation does not capture cooling, floor space, and other expenses.

From a sustainability and resulting TCO perspective, the ideal server environment would consume less power per square foot and have far less idle time because of higher utilization.

SUSTAINABILITY SHOULD NOT BE LIMITING

It is reductive to think of corporate-led, IT-driven sustainability initiatives as constraints on digital transformation. As an IT organization considers how to modernize the application frameworks, tools, and associated development methodologies used to drive transformation, "thinking green" through the application development process can instead be somewhat liberating.

To support the digitized business, IT organizations transform operations to become more cloud-like in agility and function. This leads to a shifting perspective on infrastructure. The transformation further abstracts compute platforms and CPU architectures from workloads through these cloud and cloud-native technologies. Rather than focusing on core counts, instructions per clock (IPC), and artificial benchmarks, IT organizations look for consistency in (high) performance, reliability, security, and cost of ownership. Further, IT organizations must look at power consumption in the aggregate vs at the component or even rack level.

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[2] Sustainability as a transformation catalyst – IBM Institute for Business Value
https://www.ibm.com/thought-leadership/institute-business-value/report/sustainability-transformation

With a sustainability mindset, cloud and cloud-native technologies become ever crucial for application performance efficiency. Mobility and the ability to shift to a hybrid-cloud model to support the needs of the business become necessary.

One of the keys to achieving power savings in IT infrastructure is scalability – the ability to use less (but more elastic) server technology and infrastructure to support the most demanding workloads, but also scale up for workload growth with minimal increases in energy usage.

Finally, organizations must consider securing their most important asset: data. How can a business run faster and more efficiently while simultaneously ensuring data privacy – whether in use, in flight, or at rest?

MI&S believes there is a server platform suited to this – IBM LinuxONE, an enterprise-grade server platform optimized for Linux workloads.

LINUXONE – SCALABLE ENTERPRISE TECHNOLOGY FOR ALL

IBM is a known and experienced voice in the enterprise. It is a company and brand that exemplifies performance and reliability in the datacenter – since datacenters have been in existence.

LinuxONE continues that tradition of enterprise-grade performance, reliability, and security, and embracing open source, giving IBM a platform that caters to all market segments – from small startups to the largest of enterprises.

In 2022, IBM introduced LinuxONE Emperor 4 to the market. This multi-frame enterprise platform leveraged the new Telum processor and a number of new features that we will detail in later sections.

Seeing the value of LinuxONE to businesses of virtually every size, IBM has now introduced additions to the LinuxONE family. LinuxONE Rockhopper 4 single frame is a one rack offering powered by up to 68 Linux cores, running at up to 4.6GHz.

LinuxONE Rockhopper 4 rack mount is a Linux platform designed, for the first time, to plug in to existing customer datacenter racks, colocating with servers powered by non-IBM processors such as x86.

Like LinuxONE Emperor 4, LinuxONE Rockhopper 4 is a platform designed for performance. Consider the following IBM claim based on internal testing: Internal IBM testing shows An IBM LinuxONE Rockhopper 4 Max 68 running Linux workloads can do the work of 36 x86 servers configured with 1440 cores, running the same Linux workloads under similar conditions and locations.[3]

Linux runs the modern datacenter, and Linux and cloud-native workloads drive the digitally transformed business. The performance, reliability, and security associated with LinuxONE is something craved by IT, and IBM has delivered. MI&S sees these additions to the LinuxONE family as a wise move and the democratization of enterprise compute.

LINUXONE 4 – SUSTAINABILITY AND TCO GAINS

LinuxONE can be an ideal compute platform for organizations looking to drive toward sustainability goals while simultaneously fueling transformation efforts. With LinuxONE 4, IBM has further extended its performance, efficiency, security, and reliability capabilities.

At the heart of LinuxONE 4 is Telum, IBM's newest processor developed for enterprise workloads. IBM designed Telum (and LinuxONE) to run at the highest utilization levels without sacrificing performance, reliability, or consistency of response time.

For x86 server IT administrators looking to compare server platforms, the default criteria tend to be around CPU cores and synthetic benchmarks such as SPEC.org integer performance testing. These comparisons are typically designed to measure the performance of a single workload. IBM LinuxONE is designed to run hundreds of workloads in a single system, so they don't measure the differences between Telum and x86; therefore, this paper will avoid the comparison. However, if one is looking for some analogous reference, IBM internal tests show that when running WebSphere and DB2 workloads, IBM LinuxONE Emperor 4 requires 16 times fewer cores than the compared

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[3] DISCLAIMER: Compared IBM Machine Type 3932 Max 68 model consisting of CPC drawers with 68 IFLs and 7 TB and an I/O drawer to support network and external storage in 1 frame versus compared 36 x86 servers (2 Skylake Xeon Gold Chips, 40 Cores) with a total of 1440 cores in 3 frames. Equivalent performance is based on IBM internal measurements, the March 10, 2023 IDC Qualitative Performance Indicator https://www.idc.com/getdoc.jsp?containerId=IDC_P39056 and IBM internal IT Economics tools which account for utilization rates and virtualization. Results may vary based on client-specific usage and location.

Achieving Sustainability, Security And Scalability With IBM LinuxONE

x86 servers. If you scale this up to a complete IT solution this means when running this workload, the IBM LinuxONE Emperor 4 Max 125 would be doing the work of about 2000 cores of the compared x86 servers.[4]

Instead, it's better to understand that from the compute complex to cache to memory and I/O, Telum is designed for the most demanding environments. Telum is also the CPU utilized in IBM's zSystems servers, which power the most demanding workloads in the enterprise.
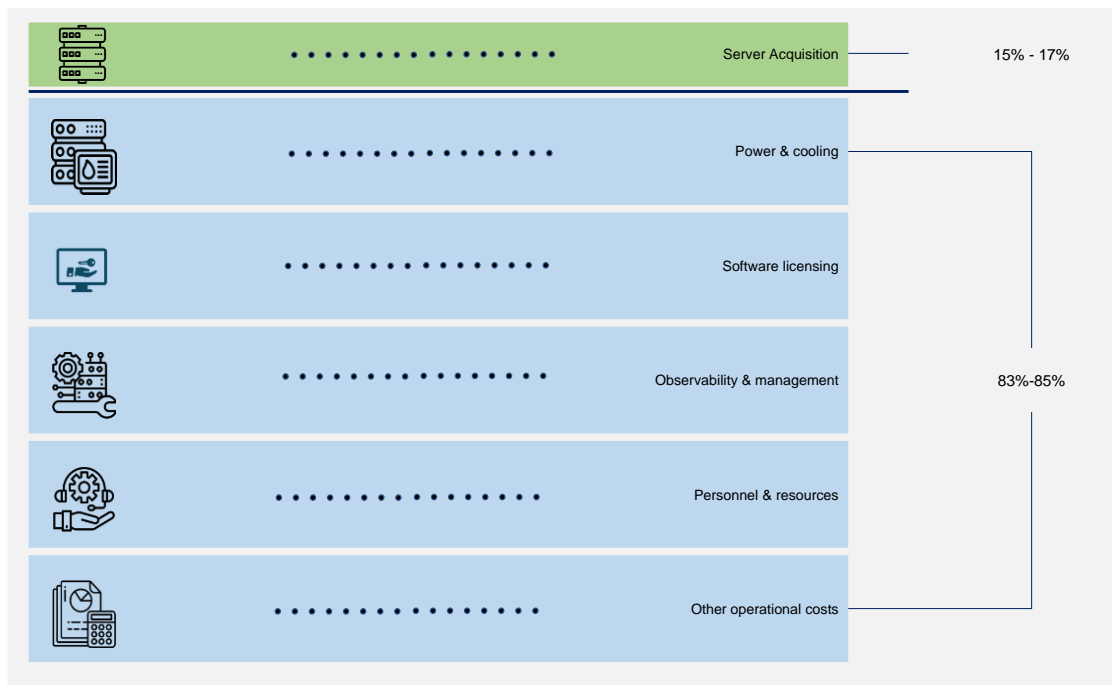
Several on-chip accelerators are built into Telum and designed to deliver real-world performance improvements, such as encryption acceleration, data compression, and AI inferencing. By developing dedicated accelerators, security, data management, and inferencing performance are greatly enhanced without taxing the core CPU complex.

Sustainability, scalability, and security extend from Telum into system design, where, for example, IBM LinuxONE Emperor 4 pairs Telum's high-performance cores with up to 40TB of memory, dedicated I/O processors, and the accelerators mentioned above.

The result is scalable infrastructure that enables vertical and horizontal scale in a single platform. And this scalability has further enabled the ability to allocate capacity automatically, permanently, or temporarily based on priority – the very essence of the flexible, just-in-time concept that drives greater efficiencies.

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[4] Disclaimer: This is an IBM internal study designed to replicate a typical IBM customer workload usage in the marketplace. Results may vary. The core consolidation study targeted comparison of the following IBM LinuxONE and x86 servers: IBM LinuxONE Emperor 4 Max 125 system consists of three CPC drawers containing 125 configurable processor units (IFLs or zIIPs) and two I/O drawers to support both network and external storage. Lenovo ThinkSystem SR650 (2U) with two 2nd Gen Intel® Xeon® Platinum processors 2.1 GHz, 16 cores per CPU. Both the x86-based and LinuxONE solutions had access to the same storage array. The workloads consisted of a transactional application running on WebSphere Application Server and IBM DB2 simulating core online banking functions. The actual test results were extrapolated to the stated above x86 servers using IDC QPI metrics and IBM sizing methodology using the following assumptions on a typical IT environment of a banking client using x86 servers. The production IT environment has 16 x86 servers running at 50% average utilization. There are 48 x86 servers in the non-production IT environments: development (4 environments with 2 servers each, 8 servers total), development test environment (4 servers), system integration test environment (8 servers), performance test environment (16 servers), user acceptance test environment (4 servers), production fix test environment (8 servers). A typical average CPU utilization is 7% across all non-production environments. An equivalent LinuxONE Emperor 4 solution requires a single Max 125 server running at 85% average utilization across all IT environments separated using LPAR technology.

Achieving Sustainability, Security   April 2023
                                    And Scalability With IBM LinuxONE
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FIGURE 1: THE ELEMENTS OF TCO

Hardware acquisition costs are a fraction of overall TCO
Source: Moor Insights & Strategy

WHAT DRIVES TCO?

While TCO has been a somewhat nebulous term contorted to fit marketing narratives, TCO itself is accurate. And significantly lowering costs associated with driving business services will be critical to the survival of IT. While many TCO has many elements, three of the larger contributors to this model center around energy consumption, manageability, and software licensing.

When considering LinuxONE as a pillar of digital transformation, MI&S believes organizations can achieve actual TCO savings while increasing business responsiveness to this everchanging economy, with power savings being an increasingly large contributor to the TCO equation. Part of what drives this belief is research conducted by IBM showing that consolidating Linux workloads on an IBM LinuxONE Rockhopper 4 instead of running them on compared x86 servers with similar conditions and location can reduce energy consumption by 75% and space by 67%.[5]

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[5] DISCLAIMER: Compared IBM Machine Type 3932 Max 68 model consisting of a CPC drawer and an I/O drawer to support network and external storage with 68 IFLs and 7 TB of memory in 1 frame versus

Achieving Sustainability, Security
And Scalability With IBM LinuxONE

While significant, energy savings is one element of the TCO model, another contributor to TCO is the cost of managing the servers. And this is a second area where IBM LinuxONE shines relative to its x86 counterparts.

From a management perspective – monitoring, observability, and management – the value of IBM LinuxONE is clear since it is a single centralized system rather than a distributed system. The consolidation of many server platforms alone makes the management value of IBM LinuxONE compelling. And the architecting of so many reliability capabilities only adds to IBM LinuxONE's differentiation.

IBM LinuxONE – Sustainability With Scalability And Security

Along with LinuxONE's ability to help IT organizations contribute to organization-wide sustainability goals, scalability and security are two additional areas of innovation worthy of spotlighting.

This discussion must start with recognizing IBM's longevity in a Darwinistic enterprise IT services market. While x86 dominates the datacenter and new entrants like the Arm-based silicon ecosystem begin to emerge, many enterprise IT organizations continue to run their most mission-critical workloads on IBM technology.

The reason for IBM's longevity is simple – reliability, security, and consistency of performance. Organizations know that these critical workloads running on IBM technology will consistently run as expected.

Further, because of the design of IBM LinuxONE, customers of all sizes can achieve workload consolidation never thought of in the x86 market, on CPU and compute platforms designed to run at the highest utilization levels. While there is a wide range of estimates around the average utilization rates of x86 servers, MI&S consistently sees

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Compared 36 x86 servers (2 Skylake Xeon Gold Chips, 40 Cores) with a total of 1440 cores. IBM Machine Type 3932 Max 68 model power consumption was measured on systems and confirmed using the IBM Power estimator for the IBM Machine Type 3932 Max 68 model configuration. x86 power values were based on Feb. 2023 IDC QPI power values and reduced to 55% based on measurements of x86 servers by IBM and observed values in the field. The x86 server compared to uses approximately .6083 KWhr, 55% of IDC QPI system watts value. Savings assumes the Worldwide Data Center Power Utilization Effectiveness (PUE) factor of 1.55 to calculate the additional power needed for cooling. PUE is based on Uptime Institute 2022 Global Data Center Survey (https://uptimeinstitute.com/resources/research-and-reports/uptime-institute-global-data-center-survey-results-2022). x86 system space calculations require 3 racks. Results may vary based on client-specific usage and location.

utilization below 30%, which means that 70% of the computational resources sit unused.

SCALABLE AND ELASTIC—REQUIREMENTS FOR THE DIGITAL BUSINESS

The successfully transformed digital business is cloud-native and intelligence-driven. Applications made up of thousands of services access data from a seemingly infinite number of data sources (traditional SQL databases such as IBM's Db2 or Oracle, as well as NoSQL and unstructured data platforms) and synthesize it into intelligence that drives the business. These cloud-native workloads are often scale-out due to the mobile, distributed, and lightweight nature of container-based applications, but some of these scale-out workloads will rapidly grow and inherit some attributes of scale-up workloads.

This data environment evolution requires an underlying evolution of infrastructure, implementing scale-out servers to support the scale-up environments that support legacy virtualized and traditional database infrastructure. This evolution, however, comes at a floorspace, power, and management cost that can be significant.

IBM's LinuxONE platform is unique in that it enables IT organizations to support their traditional scale-up and cloud-native scale-out environments simultaneously. And as cloud-native workloads become more "bursty" in nature, IBM LinuxONE can commit and decommit compute resources automatically, MI&S has not seen any other server platform that can simultaneously support these environments with divergent performance characteristics and underlying platform requirements.

Further, given its support for major Linux distributions (Red Hat, SUSE, Ubuntu) and Red Hat's OpenShift container management platform, LinuxONE is an ideal hybrid-cloud platform for mission-critical workloads.

DESIGNED FOR COMPREHENSIVE SECURITY

And finally, through many IBM innovations, LinuxONE offers a wide range of advanced security capabilities. Pervasive encryption aided by hardware acceleration makes locking down data in flight automatic and undetectable from a performance perspective. Confidential computing isolates workloads at scale and can encrypt physical memory.

An excellent example of the forward-thinking nature of IBM can be found in its quantum-safe cryptography technologies newly available in IBM LinuxONE 4. Traditional public-

key cryptography relies upon mathematical problems that are difficult to solve on classical computers. However, popular cryptographic schemes, such as RSA and ECC, can be easily broken by a sufficiently large quantum computer.

While one could argue quantum computing is still at an early stage of evolution, it is a technology coming to the market and will be here quickly. Much like AI, there is a lot of work and enablement being done in quantum that will make it appear faster than anticipated. In support of this, IBM LinuxONE 4 ushers in a suite of algorithms designed to be resistant to attacks by both classical and quantum computers.

Because of this, MI&S believes IBM has a significant opportunity to expand its market footprint with the release of IBM LinuxONE 4.

FIGURE 2: POWERING THE MODERN ENTERPRISE WITH IBM LINUXONE
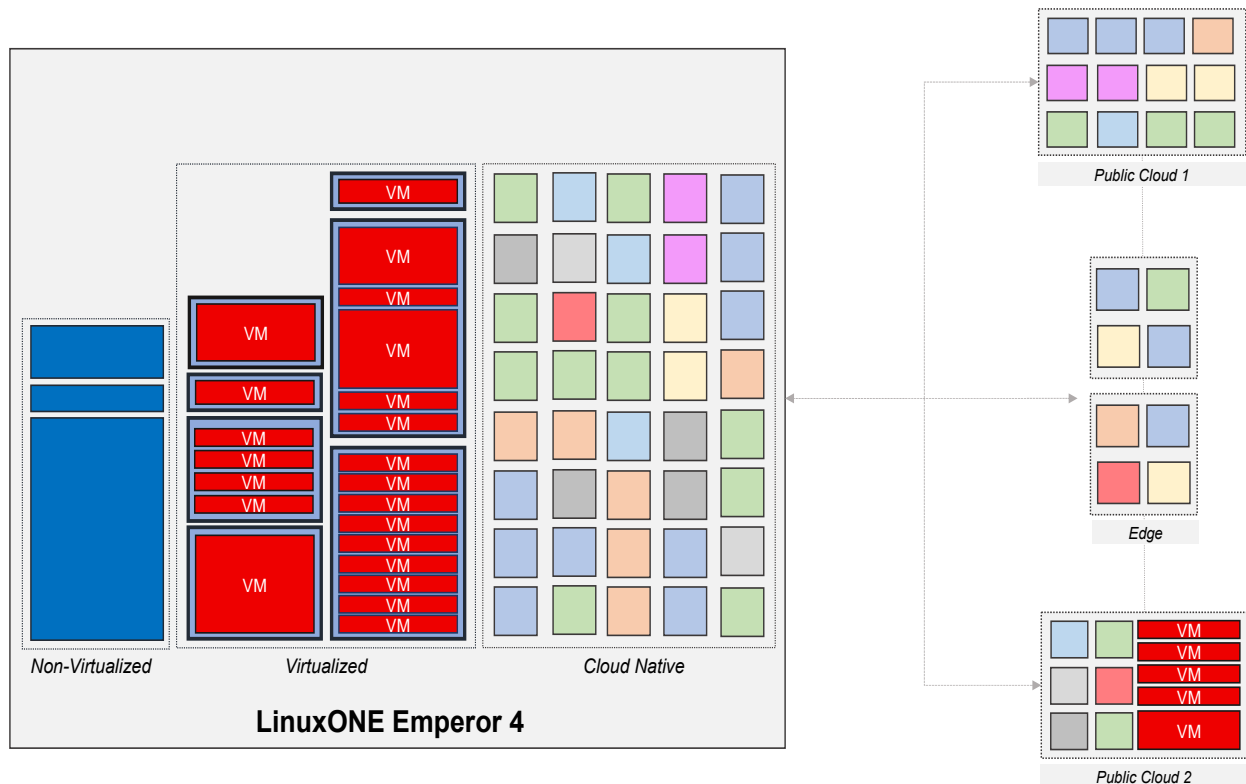
Source: Moor Insights & Strategy

THE MODERN BUSINESS THRIVES WITH LINUXONE

IT organizations undertaking digital transformation aim to adopt cloud-like practices to best serve the business. This means that applications and services are delivered on demand while IT professionals take a more consultive role within business units.

For IT organizations transforming with no real consideration for transforming infrastructure, this means acquiring, deploying, powering, and managing new specialized platforms to support new and emerging data management environments and applications. In other words, the very goals of transformation – do more with less – are being defeated.

LinuxONE 4 can drive a hybrid multi-cloud environment to the business with a fraction of the platforms, enabling the goal of expanding services while reducing complexity, cost, and resources. As previously discussed, an IBM LinuxONE Rockhopper 4 Max 68 running Linux workloads can do the work of a compared configuration of 36 x86 servers with 1440 cores, running the same Linux workloads under similar conditions and locations.[6]

CALL TO ACTION

The debate around climate change has ended, and its effects are felt more now than ever. The business world mirrors this global sense of urgency, with corporations of all sizes, industries, and geographies making sustainability a top-tier business goal to be tracked.

Running parallel to sustainability is the need for organizations to transform. Modernizing and automating functions enables faster time to value and market and faster response to customer needs and competitive threats.

While achieving these sustainability and transformation goals, IT organizations are being asked to do more with less budget and fewer resources. And smaller organizations already struggling to maintain support for a growing business that relies

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[6] DISCLAIMER: Compared IBM Machine Type 3932 Max 68 model consisting of CPC drawers with 68 IFLs and 7 TB and an I/O drawer to support network and external storage in 1 frame versus compared 36 x86 servers (2 Skylake Xeon Gold Chips, 40 Cores) with a total of 1440 cores in 3 frames. Equivalent performance is based on IBM internal measurements, the March 10, 2023 IDC Qualitative Performance Indicator https://www.idc.com/getdoc.jsp?containerId=IDC_P39056 and IBM internal IT Economics tools which account for utilization rates and virtualization. Results may vary based on client-specific usage and location.

         Achieving Sustainability, Security   April 2023
And Scalability With IBM LinuxONE

on technology to differentiate its products, services, and customer outreach feel the impact of these initiatives even more.

Some may look at this dynamic and see a litany of contradictions. As technology becomes the driving force of the business, more infrastructure, software, and resources are needed to deliver such capabilities.

In a view that runs counter to this narrative, MI&S believes companies that drive sustainability at the lowest levels of business planning can achieve cost savings and drive competitive differentiation while achieving the altruistic goals of being good stewards of this planet

IBM designed LinuxONE as a platform to enable the flexibility and power of the cloud while significantly reducing datacenter power and floorspace requirements. With IBM LinuxONE 4, the cost savings, operational agility, and rich security differentiate this platform more than ever.

Further, IBM LinuxONE 4 Rockhopper rack mount enables customers to deploy LinuxONE in environments that have not necessarily deployed IBM compute in the past. This slight shift in IBM's approach is smart and opens LinuxONE 4 to all. No longer is enterprise-grade compute limited to the enterprise.

Seeing LinuxONE as uniquely qualified to enable IT organizations to simultaneously achieve digital transformation and sustainability goals, MI&S strongly recommends IT organizations consider LinuxONE as a hybrid cloud platform enabling the business to compete in this digital economy.

For more information, visit www.ibm.com/linuxone.

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