



Linux is Linux but Even More on IBM LinuxONE

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Management Summary

Though not true of the several thousand global enterprises that continue to rely on IBM's mainframe technology, the majority of the rest of the IT world still harbor the superstition that the system is too expensive (or at least much more expensive than other platforms), too complex, and mired down with hardware and software technologies that do not meet the computing demands of modern infrastructures. This misbelief goes on, despite the unchallenged arguments that *IBM Z*, the most current mainframe iteration, is the most open, the most secure, the most resilient, and the highest capacity commercial computing platform available. And although evidence of its growth and persistence in key industries that drive the world's commerce abounds, many in the industry continue to predict its demise. IBM will not let that happen, even though many of the marketing messages emanating from Armonk these days do not clearly convey that strategy, but only if you are not paying attention.

Evidence the September 12, 2017, announcement of the *IBM LinuxONE Emperor II*. Most succinctly, the Emperor II is a **Linux-only** system based on the hardware introduced as the *IBM Z z14*¹ this past July. Looking under the covers of both of these systems will reveal no differences in number of cores, I/O features and capacity, or size of the main or cache memory. The only exceptions are functions or features that rely on the presence of z/OS. The processor cores are exclusively enabled as *IFLs* – *Integrated Facility for Linux* capable of running *z/VM*, IBM's virtualization hypervisor, *KVM*, a very common and well-received Linux hypervisor, other Linux system software that will be discussed later in this paper.

When IBM announced the *LinuxONE* in 2015², some observers might have considered it as a long shot, a move of desperation. After all, there was no differentiation in the hardware, and a number of all-IFL systems previously had been sold and installed successfully. But by placing boundaries on the configurability, without compromising any of the qualities of service typical of IBM mainframes,

Exhibit 1 — LinuxONE Emperor II



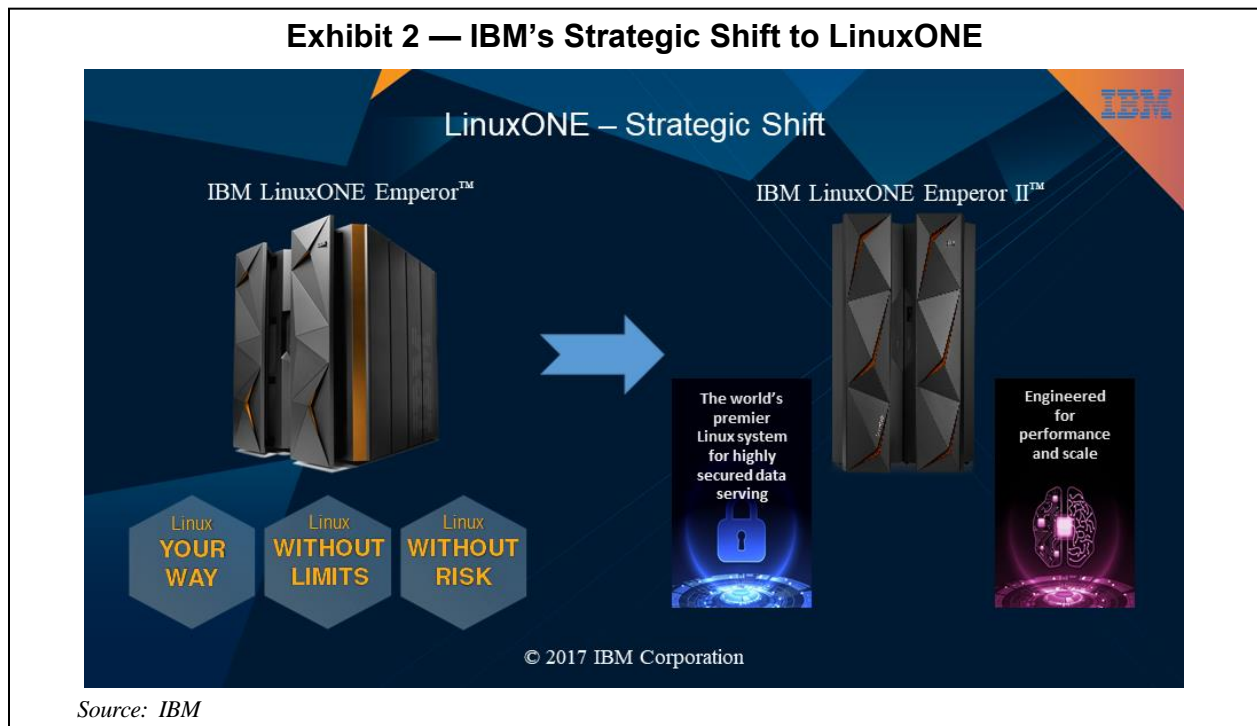
Source: IBM

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¹ For more on z14, see [The Clipper Group Navigator](http://www.clipper.com/research/TCG2017001.pdf) dated July 17, 2017, entitled *IBM z14 - The New Standard for Modern Digital Enterprises*, which is available at <http://www.clipper.com/research/TCG2017001.pdf>.

² For more on the original LinuxONE, see [The Clipper Group Navigator](http://www.clipper.com/research/TCG2016002.pdf) dated February 16, 2016, entitled *Open for the Digital Business - IBM Announces LinuxONE Systems*, which is available at <http://www.clipper.com/research/TCG2016002.pdf>.



it enabled a great deal of pricing flexibility. **The advantages were clear – LinuxONE provided a truly open system environment at a very competitive price point to x64 alternatives, avoided the necessity of customers having to learn “legacy mainframe” skills, while still providing the unmatched qualities of service provided by IBM mainframe technology.** (See Exhibit 2, above.) This paper will focus on the announcement of the *IBM LinuxONE Emperor II*, its enhancements, and the new opportunities that it brings to enterprises in its second generation. IBM first played this card over two years ago. The Emperor II announcement affirms that LinuxONE was a successful move from which IBM’s Linux customers and IBM both benefited. If you are interested in learning about the new opportunities provided by IBM LinuxONE Emperor II, please read on.

Linux is Linux but Even More on LinuxONE

LinuxONE systems are based on proven technology from IBM Z’s system line and can run the most popular open-source software and tools that work just as seamlessly as they would on more commonplace distributed servers.

- **In the operating environment domain** – SUSE and Red Hat enterprise-editions of Linux and Canonical’s *Ubuntu* are offered as operating systems. All are available to run on LinuxONE under *KVM (Kernel-based Virtual Machine)*,

the popular virtualization hypervisor that is built into the Linux kernel.

- **In the open systems language domain** – *Java, Python, Pearl, Ruby, Rails, Erlang, and Node.js* are available on LinuxONE.
- **In the database domain** – *MongoDB, MariaDB, and PostgreSQL* are available on LinuxONE with demonstrable performance gains compared to Intel-based servers³. Also, *IBM Db2LUW* and *Oracle DB* are available.
- **In the analytics domain** – *Apache Spark* and *Tools with Hadoop*, as well available *IBM Big Insights*, and *IBM DB2BLU* are available on LinuxONE.

What makes LinuxONE Emperor II unique is that it offers new communities powerful capabilities that no other platform can match.

- **Hardware designed to give good response times at up to 100% utilization.** This simplifies the solution and reduces the cost of carrying unused extra capacity.
- **Shared memory, vertical scale architecture** that is vastly superior for stateful workloads like databases and systems of record.
- **The best I/O capacity and performance in the industry** driven by up to 640 *Power (RISC)* cores in the I/O channels.
- **Most secure server hardware derived** from the benefits of its z14 heritage with the highest certified level of isolation, EAL 5+ with best-in-

³ According to IBM.

class cryptographic key protection, and *Secure Service Containers* (more on containers below).

- **Demonstrated resilience** in earthquake, fire, flood, and other catastrophic scenarios.

Erase any assumptions you may have – LinuxONE Emperor II the world’s premier Linux system for highly secured data serving and analytics, engineered from top to bottom for security, availability, performance, and scale.

Securing Data-Driven Workloads

As a result of the enhanced cryptographic processing capabilities first announced with the z14, data is protected in flight over the network with full end-to-end network security. Valued data can be protected by encryption in flight or at rest with low overhead and without change to applications, with performance superior to current x86 alternatives.

High performance and security are enhanced by industry-exclusive *protected-key encryption*. Robust, centralized full-lifecycle encryption key management ensures the availability and security of all enterprise-encrypted data with no impact to SLAs. Encrypted data is safeguarded further by protecting encryption keys with tamper-responder cryptographic hardware designed to meet FIPS 140-2 Level 4 certification, the highest level.

In addition, industry-leading secure Java performance⁴ is enabled through via *Transport Layer Security (TLS)*⁵.

Secure Service Containers for all Workloads

Secure Service Containers trace their origin to the enhancements to the *IBM z13* announced in February 2016 and the introduction of the *z Appliance Container Infrastructure (zACI)*⁶, thus signaling an expansion in the role of secured partitions. This was subsequently renamed the *IBM Secure Service Container*.⁷ At that time, the exploiters included *IBM Operations Analytics for z Systems – zAware*, *IBM Blockchain Platform*, and the *IBM zVSE Network Appliance*. The Secure Service Container included both firmware and a software framework. Recent changes deliver improvements in security, appliance management, and usability.

⁴ Two-to-three times faster than Intel according to IBM.

⁵ This is enabled by IBM modifications to the Java Virtual Machine code to allow direct access to the *Crypto Express6s* PCIe card and new instructions in the processor cores.

⁶ See The Clipper Navigator entitled *IBM z Systems Opens Up Secure Clouds and Introduces the z13s*, dated February 16, 2106, and available at <http://www.clipper.com/research/TCG2016003.pdf>.

⁷ See Clipper paper referenced in footnote #1.

Now, with the announcement of the LinuxONE Emperor II, IBM included a *Statement of Direction (SOD)* declaring its intent (on a date yet to be announced) to provide extensions of the framework to make it available to external users for the local development of container-based applications and with industry-leading container orchestration, thus facilitating seamless integration of the mainframe with its enterprise-wide DevOps and container strategy. These will provide a highly secured compute environment for sensitive data and business logic. It is a lockbox wrapper that contains everything it needs to run an application and it is *completely isolated* from all other elements of the system.

All software is protected, all data is encrypted on disk, all protection keys are encrypted and tamper-resistant, all memory is protected, and access is disabled; all of which is transparent to the user. The only access is through a web interface or RESTful API’s and all activity is maintained in protected logs. Even sysadmins cannot bypass these mechanisms, thereby providing protection from potentially malicious insiders. Containers can be easily replicated and new containers configurations can be created with very little effort. The next stage will provide a virtual appliance to provide a *Docker*-certified infrastructure for *Docker EE* with integrated management that has been tested at large scale. Only LinuxONE has the performance capacity and the security functionality to meet the needs for protected environments at large scale.

Scale-Up or Scale-Out?

If only measured by the numbers and type of servers sold, scaling out (also called horizontal scaling) seems to be the preferred data serving architecture. *But is it the most efficient and most economical?* IBM would be the first to stipulate that mainframe architectures aren’t best for every application need, for instance, e-mail systems. However if your applications rely on a “central source of the truth”, e.g., online banking, global logistics, or risk analysis, and they need to scale, then scaling up (or vertical scaling) usually provides the best (most effective and efficient) solution. In fact, the most widely used data base management systems, such as *MySQL*, *Oracle DB*, or *IBM Db2* are designed for scale-up applications. LinuxONE delivers unmatched functionality and scale to meet all the challenges of modern deployment for enterprise-class solutions.

- **Vertical scaling** up to 170 user-accessible cores running at 5.2 GHz.⁸
- **32 TB of shared memory** enabling larger in-memory applications.
- **Single-Instruction Multiple-Data (SIMD)** – hardware instructions that accelerate analytics workloads and decimal computations, which are critical to financial applications.
- **Industry-leading Java workload performance**, up to 50% faster than Intel.⁹ One key to this performance advantage is pause-less garbage collection that enables vertical scaling while maintaining predictable performance.
- **A differentiating I/O architecture** that leverages large on-core and chip cache, on-chip *System Assist Processors (SAP)*, and dedicated Power architecture cores.

Competitive Pricing at Equal Scale

The September 12th announcement does not highlight the financial terms and conditions of the LinuxONE Emperor II, although we are confident that it will be similar, adjusted for the increased performance and functionality, to those of the first generation Emperor that emphasized its competitive total cost of acquisition (TCA).¹⁰ IBM refers to it as “the pay-as-you-go pricing model”.

LinuxONE Success is Global

There are numerous examples of LinuxONE successful implementation across industries, workloads, and geographies.

- *Met Office* is the agency of the United Kingdom that provides local and global weather forecasts, information essential to operations of many organizations. LinuxONE is the platform for its trusted, always-on services.
- *HX Express* in China is leveraging passenger data to provide more and improved services.
- *QinqDao Bai Yang Group* has implemented a cloud-based platform to promote the creation of a proactive healthcare system in China.
- *Everledger* is one of the several examples of Blockchain implementations on LinuxONE based on the Linux Foundation’s Hyperledger project.¹¹ Everledger uses LinuxONE to power its global certification system to track valuable

⁸ Support for up to 8,000 virtual Linux servers on a single footprint is claimed by IBM.

⁹ According to IBM.

¹⁰ See the Clipper paper referenced in footnote #2.

¹¹ For more on the IBM’s Blockchain initiatives, see [The Clipper Group Navigator](http://www.clipper.com/research/TCG2016008.pdf) dated August 12, 2016, entitled *IBM’s Blockchain Initiatives - More Secure with Mainframe Systems*, which is available at <http://www.clipper.com/research/TCG2016008.pdf>.

items such as diamonds, fine art, and luxury items through the supply chain to protect suppliers, buyers, and shippers against theft, counterfeiting, and other forms of corruption.

- Others include *Maersk*, the global leader in transport and logistics, for management of their Cross Border Supply Chain, a *Walmart Corporation* led effort to track food safety through its global supply chain, growers, suppliers, processors, distributors, retailers, regulators, and consumers, and the *Digital Trade Consortium*, a group of European banks that will focus on providing the financing gap of small and medium enterprises, an under-served market.

Clearly, Linux has emerged as the “universal language” of operating systems.

Conclusion

The IBM LinuxONE Emperor II presents new opportunities for simplification that leverages an existing Linux skill base, higher performance, and the latest security mechanisms to open source database deployments, allowing enterprises to build their own open source cloud with unmatched security and scale. Environments that are an easy fit for this solution include:

- **Linux server consolidation** – benefit with lower total cost of operation.
- **Non-mainframe data centers** – those requiring mainframe qualities of service – reliability, availability, scalability, and, particularly, security.
- **On-premises cloud implementation** – where preference for in-house delivery and management of open source frameworks.
- **Hosting new technology ventures and sandboxes** – for isolation from existing system and close control of costs. Emperor II, notwithstanding its ultimate scalability, also offers a modest scale, lower-cost entry point.

Regardless of your particular circumstances, if Security (with a capital S) is of top-of-the-list important to you, and why should it not be, then the only choice is to do it right and do it in real time. A secure infrastructure cannot be attained passively. The LinuxONE Emperor II provides that capability to do this economically – with scalability and resilience. IBM has the right answer: “How you do Linux does matter.” *Has your enterprise asked the right question?*



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