WHITE PAPER

LinuxONE — Driving Next-Generation Application Development on Scalable Infrastructure Built for Open Source

Sponsored by: IBM Corp.
Al Gillen Peter Rutten
June 2016

IDC OPINION

The information technology (IT) industry has always experienced change, and the dramatic upheaval sweeping across the industry today could not be truthfully described as the first time we’ve seen such widespread transformation impacting customer investments. However, the rate of the change and the potential outcomes from today's digital transformation have the distinct potential to separate the industry into two camps: organizations that see the developments coming and embrace them and successfully leverage them and organizations that will find themselves as roadkill on the technology highway.

Today’s digital transformation is about far more than a new architecture or a new application; it is a fundamental reshaping of applications in terms of how they are written, packaged, managed, and life cycled; the runtime environment where they are deployed; and the infrastructure on which they are hosted. These modern or next-generation applications (NGAs) will not necessarily replace existing (2nd Platform) applications in use today, but they are critical to addressing the four pillars of change impacting the industry – social, big data and analytics, mobility, and cloud computing.

A key underpinning to supporting NGAs is the emergence of open source application development tools and platform-agnostic runtime environments, which are dramatically reducing or eliminating proprietary hardware dependencies. This evolution, when combined with the increasingly urgent need to build new applications that are intended to support customer interactions originating from mobile devices, data streams from the burgeoning Internet of Things (IoT), and the business intelligence, cognitive processing, and decision support associated with big data, means dramatic disruption.

We believe that clients will seek deployment environments based on metrics not like those in the previous generation of applications. Specifically, clients will be interested in:

- **Support for runtime/deployment environments that host the applications clients want to run.** This may mean in-house-generated application or third-party-authored applications written in modern languages such as Perl, Ruby, Python, PHP, Node.js, and more.

- **Options for purchasing compute resources on an on-demand basis.** We believe that rather than continue to behave according to the capex model that has long been the foundation of corporate IT acquisition, organizations will shift to a model that allows them to acquire the resources they need, along with an option to scale consumption up on an as-needed basis, paying for increased resource consumption when consumed but then being able to dial back consumption to historical levels after peak demand has subsided. This model describes an on-premises solution with attributes that look more like those of a cloud-based consumption model.
- **Application service-level commitments.** Today, there is a concept of server availability and uptime, but in the future, clients will seek to acquire their application deployment resources using terms such as availability, scalability, and flexibility, along with cost metrics that apply to compute, storage, and network resources. On-premises and off-premises deployment models will be considered for these applications, and business will go to those that can offer the best service levels at the best cost.

- **Solutions that offer on-premises and off-premises resources and the ability to move between both locations on an as-needed basis.** Clients that lean toward an on-premises deployment will want an off-premises option both as a way to burst and for a future migration target.

### SITUATION OVERVIEW

The IT industry has always experienced change. Multiple waves of technology inventions and improvements have revolutionized, disrupted, and empowered the industry many times since IT became a mainstream technology 30 to 40 years ago. Past disruptions and enablers include the advent of on-premises computing, cost and size contractions driven by minicomputers, the PC invasion and networking revolution of the 1980s and the 1990s, the impact of the Internet in the late 1990s, and x86 server virtualization in the 2000s.

Paralleling that change over the past 20 years has been the growth of open source software. While the concept of open source software dates back well into the 1980s, it took the mainstream acceptance of Linux beginning in the early 2000s to truly legitimize the concept of open source software. Linux offered avoidance of lock-in and a relatively rich ecosystem of distribution providers and complementary third-party solutions.

Once Linux had proven that a community-developed product was not only reliable but also commercially viable and could offer an evolution path that paralleled clients’ changing requirements, other open source solutions benefited.

Today, compelling new open source projects can spin up and enjoy broad industry support, including from individual contributors, commercial vendors interested in building a business supporting the product or a derivative of the product, service providers that plan to use this technology to stand up a commercial service, and end clients that wish to see the technology mature so it can be deployed within their organization. Over time, these new projects and the applications that build on them are likely to ask for more scale, flexibility, and price/performance from the hardware platforms on which they are deployed.

These market forces have methodically converged over the past 15 years, and with the added dimension of ever faster, energy-efficient, and cost-effective compute capabilities, supported by an open source operating system, the long-anticipated transition to inject compute and data collection resources into even relatively standard or formerly “low tech” equipment and appliances creates entirely new competitive opportunities for companies willing to progressively and aggressively exploit these opportunities.
The New World Order

The IT industry is facing a rare situation where industry changes are aligning to shift the balance of the playing field in ways that do not necessarily favor the incumbent players. The sections that follow detail the factors.

Digital Transformation

The digital transformation is not a new phenomenon; it has been taking place for at least 15 years, but with the end of the 2nd Platform era looming, organizations are increasingly asking themselves what it means to complete the digital transformation, move remaining manual and paper processes to electronic media, and automate and instrument machinery that is in use, both leading to better predictive analytics and driving higher operational efficiency.

Part of the digital transformation process means that new applications have to be created and deployed to support the automation and the data generated by digital operations. Most existing 2nd Platform applications were never designed to process live data in a digital organization, leading to the creation of 3rd Platform applications that will marry 2nd Platform applications at the data layer. The change taking place in the industry is being driven by the convergence of maturing infrastructure from the 2nd Platform era and the massive digital transformation that is taking off today.

Next-Generation Applications

Developers employed by corporate IT departments and ISVs alike are looking favorably at adopting cutting-edge application development, packaging, and life-cycle deployment techniques. Attributes of modern applications include:

- **Platform independence.** Modern applications are typically written using open source developer tools and use open source frameworks and runtime environments, making these applications highly portable. Compiled applications may need to be recompiled for the target platform, but little or no development work or optimization is usually required. In many cases, platform as a service (PaaS), often referred to as cloud-native applications today, is offered by cloud solution providers and is also available from platform vendors.

- **Microservice oriented.** Reuse of proven code segments, the long-awaited promise, is once again rising to the forefront of developer techniques. Today, the focus is on microservices with stable APIs that other applications can consume. Modern, cloud-native applications are designed to scale horizontally, deliver integral resilience, and perform well in a shared environment.

- **DevOps deployment model.** Modern application deployment techniques call for developers to stand up applications using a DevOps model. This means that developers, in many cases, also do the deployments. Application code tends to be ephemeral in nature, meaning a given instance of an application component may be used for minutes, hours, or days but eventually is replaced with updated code and receives no in-place maintenance during its life cycle.

Open Source First

Open source software has established credibility — so much credibility that even Microsoft has caved in and today supports Linux on its Azure public cloud. Linux has been the poster child for open source software, having overcome tremendous opposition and competitive pressure from Microsoft through the years, and has established itself as the favored operating system for NGAs and for IoT infrastructure software and as the preferred foundation for analytics, big data, and cognitive computing.
Other open source software products range from databases, cloud infrastructure software, and virtualization software to container packaging and developer tools. Thanks to multiple layers of abstraction from the underlying infrastructure, open source has become a vehicle that makes it possible for clients to begin to shift away from specifying a platform preference to specifying a preference for attributes and behaviors of a platform when it comes to deployment.

**INTRODUCING IBM LINUXONE**

In August 2015, IBM brought forward a bold initiative centered on delivering a Linux-only platform that could meet the requirements described previously and named it LinuxONE. The product, which includes two separate solutions, was formally launched at the industry's premier Linux event, the Linux Foundation's LinuxCon.

A smaller-scale solution and a larger-scale solution make up the LinuxONE family. The smaller of the two servers carries the name "Rockhopper" (a breed of small penguins) and is available in a configuration that starts with two LinuxONE cores (for z Systems connoisseurs: LinuxONE cores are identical to IFLs). Rockhopper offers an attractive entry point with the potential for dramatic scale-up in the same frame.

The larger system is named "Emperor" (a breed of large penguins) and is sold with as few as six LinuxONE cores. Rockhopper and Emperor give clients two very different starting points, both of which scale up as clients' needs grow over time.

The LinuxONE product has a fresh feel to it and is positioned as a new product portfolio in IBM's Systems business unit. The LinuxONE family is based on the same underlying hardware as the z13 platform while also leveraging the POWER architecture for its I/O capabilities, but the similarities end when it comes to the go-to-market plan for LinuxONE compared with the go-to-market plans for classic IBM mainframe systems.

With the LinuxONE server announcement, IBM added technologies such as Apache Spark, MongoDB, MariaDB, Chef, and Docker to an already comprehensive list of open source software solutions that have been brought to IBM's large system Linux offering. In addition to its long-time Linux partners SUSE and Red Hat, IBM brought on board a new distribution – Canonical's Ubuntu.

The addition of Ubuntu illustrates the understanding of staying in sync with the community. With the growth of OpenStack, and more recently with the rapid acceleration of Docker, the use of Canonical's Ubuntu distribution has increased among developers and especially among administrators piloting OpenStack. Adding support for a host of languages, databases, and analytic capabilities provides valuable benefits to developers.

Another important aspect of this initiative highlights how the new IBM is now thinking about open source and ecosystem. With LinuxONE, IBM has packaged a system in the way the market wants to acquire and consume this technology – removing proprietary barriers, supporting an expanded set of open source tools, and offering attractive pricing options that will have broader appeal. In the context of NGA creation and deployment, LinuxONE offers a technologically complete solution.

That completeness includes a hardware platform that delivers unique capabilities by any measure, including a range of infrastructure characteristics that are specifically advantageous for mobile, analytics, cloud, and DevOps.
The Emperor scales from 6 cores to 141 cores, which translates to an ability to run 350-8,000 virtual machines (VMs) in a single frame. The processor or LinuxONE core is the same 5.0GHz processor as the standard z13 processor except that it has extra microcode to optimize its Linux performance, making it the fastest commercially available processor on the market today. LinuxONE cores can only be used for Linux and have been available in z Systems for 15 years.

The LinuxONE core also supports simultaneous multithreading, which allows multiple execution threads to be processed in parallel. There are four levels of cache, and the system provides 10TB of memory. IDC considers the LinuxONE range of systems, when configured in a Parallel Sysplex, to be the most reliable systems in the industry.

Bandwidth per I/O demand is very high thanks to the I/O subsystem that contains hundreds of processing cores that deliver added power to workloads. The platform has SIMD processors that can perform the same operation on a large amount of data, resulting in very fast parallelism for analytics. It contains cryptographic and data compression coprocessors that help protect data integrity.

IBM LinuxONE supports Linux versions of various IBM software solutions that deliver powerful capabilities in a platform for mobile, analytics, cloud, and DevOps:

- IBM zAware, which identifies unusual system behavior before it affects the system and helps reduce IT staff time needed to diagnose and respond to problems
- Geographically Dispersed Parallel Sysplex (GDPS) virtual appliance, which automates recovery procedures for planned and unplanned outages and adds to the system's very high availability
- IBM InfoSphere BigInsights (based on Hadoop), which obtains business insights from massive volumes of data such as log records, click streams, social media, and sensor outputs
- IBM Cloud Manager with OpenStack, which provides cloud management based on OpenStack
- IBM DB2 with Blu Acceleration, which allows DB2 to execute very fast in-memory computing

The Rockhopper serves as the entry point into the LinuxONE family, supporting 2-20 LinuxONE cores. The jury is still out on whether it is possible for IBM to convince clients to consume LinuxONE servers in lieu of x86 servers. While the traditional mainframe was seen as a proprietary platform, supporting widely adopted 3rd Platform technologies should alleviate lock-in concerns, and IBM needs to highlight that value to clients as a differentiator.

**Comparisons with x86 Servers**

In the past, comparing large system solutions and x86 servers involved comparing their respective purchase price; flexibility; availability of infrastructure software, middleware, databases, tools, and applications and, perhaps most importantly today, the availability of people who know how to manage, run, and write new applications for the systems.

From a cost perspective, IBM LinuxONE systems are competitive with x86 servers on a by-instance basis when the system is only partially utilized. In the case of Rockhopper, a customer pays a fixed cost of 50% of the system's capability, with incremental costs for utilization rates greater than 50%. The system monitors utilization at 15-second increments through each month of use, and clients pay based on the actual utilization.

The larger Emperor system is billed at an entry point of 25% of the system's capacity in year one, with utilization monitored and billed based on actual usage (tracked in 15-second increments) each month.
In the second year of use, the baseline billing grows to 30% of system capacity, and in year three, the customer is charged at a baseline rate of 40% of capacity. Either system is available on an annual lease basis, with clients able to cancel a contract at the end of the first year of use.

IBM total-cost-of-ownership (TCO) calculations suggest that clients will find that LinuxONE systems become cost competitive at between 50 Linux VMs and 100 Linux VMs in use; below that total, IBM has trouble competing with the costs of an x86 solution; above that total, IBM LinuxONE has a more attractive TCO.

Performance testing conducted by IBM suggests that light workloads (typified by Java-based Web workloads), when supported by the LinuxONE cores, will scale equivalent to 12 x86 cores in a private cloud deployment. By comparison, a medium workload, consisting of Java-based Web workloads driving transactions, will require about 8 x86 cores to match the capability of one IFL. At the high end, database workloads would require 8 x86 cores to support the same workloads as one IFL. The Rockhopper model can scale up to 20 LinuxONE cores, and the Emperor model can scale up to 141 LinuxONE cores. Utilization rates can be maintained at high levels, since the customer has reserve capacity should it be needed. System capacity can be increased as customer needs dictate and scaled back down as seasonality or customer behavior dictates.

The benefit of consolidating a substantial number of Linux instances on a LinuxONE system brings other advantages to clients. The in-frame environment ensures extremely low latency from one operational VM to another VM. In addition, IDC’s return-on-investment studies typically find that larger systems tend to require less administration and management labor costs than distributed servers.

The ease-of-use story is made possible by IBM’s embrace of open source software from the hypervisor on up through the application layers, including all the layers in between. Because all the software layers are open source, there is little or no lock-in for clients that opt to deploy their Linux instances on a LinuxONE system.

Clients that are seeking to perform server consolidation and to run Web-scale or public cloud-like deployments or supporting modern workloads such as analytics, mobile, or other NGA application types are likely to find a good match between their deployment needs and IBM LinuxONE capabilities.

**FUTURE OUTLOOK**

The industry is on the edge of a transition to support significantly larger numbers of instances of NGAs on Linux infrastructure, and as new application deployments increase, infrastructure requirements are likely to change in the following ways:

- **Xxx as a service becomes more attractive.** Because of the transition to applications that are more abstracted from a more standardized (consistent) underlying infrastructure, clients can begin to focus on environment attributes rather than underlying software layers. A customer deploying NGAs will care less about what distribution is supporting the application deployment environment and will be focus more on the scale, availability, and cost per instance for the deployment itself.

- **Open source-based infrastructure becomes the norm.** Linux has become the standard solution in the industry, and service orientation is becoming the norm. Many major players are moving toward (or have already embraced) Linux as the foundational element of their public clouds.
CHALLENGES/OPPORTUNITIES

- **Challenge**: Clients still tend to think about servers in the context of their reputation, perceived cost, and common use scenarios. The challenge many clients face is transitioning to seeing platform decisions being less about the architecture and more about the attributes of that total solution.

- **Opportunity**: Clients that move to an xxx-as-a-service approach to their deployments will be able to lower management and support costs and increase their choice and agility. Clients that are able to see their needs as being served by an open source ecosystem can take advantage of a reshaped playing field.

- **Challenge**: Winning in service provider accounts is critical for IBM LinuxONE to succeed longer term. As clients increasingly move to an xxx-as-a-service consumption model, shared public cloud will become more attractive. But for IBM and clients to benefit from the value proposition that a LinuxONE platform offers, service providers must also embrace the value proposition IBM is offering with LinuxONE.

- **Opportunity**: Service providers are inherently attracted to cost-effective solutions that offer performance, high levels of security and availability, and pay-as-you-go pricing. Offering end clients these benefits in a Linux-based open source ecosystem makes for a potentially compelling solution for end clients and service providers alike.

CONCLUSION

Clients that are forward looking and see NGAs as their ticket to future workloads should be looking beyond the platform itself and should instead be focusing on the xxx-as-a-service capabilities. A platform that offers scale, availability, pay-as-you-go pricing, and the same rich ecosystem that other platforms may offer on a more distributed basis has distinct value to clients.

While IBM has been a significant open source power player over the years even outside of Linux itself, the company appears to be operating under even more aggressive rules of engagement with respect to solutions based on and around open source solutions.

This new IBM, which is in the midst of one of the most significant transformations in its long history, is investing heavily to build out the developer ecosystem around its product offerings and has to come to understand the ecosystem building power of open source in today's platform battleground. By aggressively supporting a broad portfolio of open source solutions on highly scalable, cost-effective hardware, IBM with LinuxONE can deliver a compelling solution that is applicable to a much larger portion of the industry than IBM has been able to support in the past.
About IDC

International Data Corporation (IDC) is the premier global provider of market intelligence, advisory services, and events for the information technology, telecommunications and consumer technology markets. IDC helps IT professionals, business executives, and the investment community make fact-based decisions on technology purchases and business strategy. More than 1,100 IDC analysts provide global, regional, and local expertise on technology and industry opportunities and trends in over 110 countries worldwide. For 50 years, IDC has provided strategic insights to help our clients achieve their key business objectives. IDC is a subsidiary of IDG, the world's leading technology media, research, and events company.

Global Headquarters

5 Speen Street
Framingham, MA  01701
USA
508.872.8200
Twitter: @IDC
idc-community.com
www.idc.com

Copyright Notice

External Publication of IDC Information and Data – Any IDC information that is to be used in advertising, press releases, or promotional materials requires prior written approval from the appropriate IDC Vice President or Country Manager. A draft of the proposed document should accompany any such request. IDC reserves the right to deny approval of external usage for any reason.

Copyright 2016 IDC. Reproduction without written permission is completely forbidden.