White Paper

Preparing IT Infrastructure for Cloud-Native Application Deployments

Sponsored by: Red Hat

Al Gillen
September 2019

IDC OPINION

The computer industry is fueled by challenges and thrives on new innovation. Although embracing innovative new technology is seen as a critical factor in addressing future challenges, companies also have to continue to support their existing investments — the infrastructure that is the foundation of their operations.

That's certainly the case today given that topics such as cloud computing, OpenStack and container technology, Kubernetes, microservices, cloud services, and Internet of Things (IoT) have come to dominate the conversation in the industry, but these technology changes won't replace existing investments. IDC offers the following thoughts regarding the industry today:

- Every organization needs to find a balance between embracing exciting new technologies and supporting existing investments. In other words, organizations should evaluate emerging new technologies that will become important over the next few years, yet continue to invest in the upkeep and modernization of systems that make the business run today.
- The embrace of modern infrastructure means planning for the adoption of a private cloud infrastructure and extending that to a hybrid and public cloud consumption model while continuing to support and modernize existing distributed systems and workloads.
- An ideal approach involves embracing and investing in an efficient infrastructure that can support existing workloads while preparing the environment for next-generation compute requirements. Using common components, such as virtualization, storage, and management, across current- and next-generation infrastructure can minimize disruption from future technology waves and provide a foundation for agile IT methods including DevOps.
- For most customers, the best path forward includes investment to increase standardization at the application level and promote consolidation along with the adoption of enterprise cloud management to extend existing virtualized infrastructure into a true hybrid cloud environment. Planning for next-generation application development and modernizing monolithic applications by using containers for packaging and deployment along with a reliable runtime environment are both key objectives.
- Open source software is seen as central to innovation today, with open source platforms such as Linux and KVM as central elements to a modernized and standardized platform. The role Linux and KVM play is one of cross-architecture standardization for both conventional and modern applications and physical and virtual deployments and is unique in the industry.

IN THIS WHITE PAPER

This IDC white paper considers the challenge customers face today in balancing their investments in the existing infrastructure with goals of improving efficiency and modernizing their IT infrastructure. Simultaneously, customers need to embrace new technology development and deployment techniques that offer the promise of substantial improvements in developer productivity, operational agility, and less expensive life-cycle management. We consider the options that customers have to attain both these goals by using infrastructure that can support existing and next-generation workloads and the role that standardization and modernization play in achieving operational optimization.

SITUATION OVERVIEW

The IT industry has a history of reinventing itself, and it appears that we're entering into yet another dramatic chapter of change.

Historically, we have seen major architectural shifts taking place every 10–20 years, but less radical shifts occur more frequently. During just the past 15 years, the x86 computer industry has seen many game-changing technology trends, including the emergence and widespread adoption of x86 virtualization; the availability of practical, consumable cloud computing services both on-premises and off-premises; the emergence of an incredibly rich range of open source software solutions; and, most recently, a major shift of application development and deployment techniques.

In some cases, these technology inventions or evolutions manifest themselves as a competitive solution that — at first — appears to be inferior or unsuitable when measured against existing solutions. But much like the classic *Innovator's Dilemma* scenario, these initial shortcomings are paired with desirable attributes that may be unavailable, unachievable, or unaffordable from the existing platform. Over time, the competitive platforms improve and evolve, although not necessarily into an exact replacement for the previous solution, but as an alternative platform with attractive attributes. These emerging platforms usually end up inventing new programming and consumption paradigms often by embracing new ways to solve old problems, which empowers these new platforms to differentiate themselves. Ultimately, these new platforms deliver greater functionality than the solution they followed to market.

However, it is rare for new solutions to fully eradicate the need for previous solutions. Indeed, if new solutions were to methodically chase down incumbent technology, that would likely reduce the agility and innovation in the new entrants and sentence them to early obsolescence. Instead, each new technology tends to both supplant and supplement existing solutions. There are parallels for this type of replacement/improvement cycle — it is not unlike how radio supplanted and competed with newspapers and how television subsequently supplanted and competed over time more and more directly with radio.

EMBRACING THE FUTURE

Leading customers that see the benefit of emerging IT solutions often modernize their environment by replacing aging hardware and software solutions with updated technologies that support existing requirements but also make it possible to meet new customer needs. An organization that is adding development tools and infrastructure software and updating decision support and analytics solutions to empower it to collect, analyze, and make business decisions from IoT data is a common example seen today in the industry.

Modernization of IT infrastructure is not an initiative that starts and finishes on a finite schedule. Indeed, the process of modernization is a task that is ongoing as long as an organization's IT infrastructure is expected to have value for years to come. To stop investing in the modernization of infrastructure will ensure its obsolescence. On the other hand, there are waves of technology that require more investment, replacement, and/or updating than others.

Today, the industry is in one of these higher-investment cycles, with significant change standing on the doorstep. Investment is being driven by a confluence of technologies and business transitions, including a maturing x86 platform and the expansion of a multitude of viable alternative technologies, including GPUs, FPGAs, custom processors optimized for artificial intelligence and machine learning workloads and, at the edge, a growing presence of ARM processors.

In a recent IDC study, developers said that in 2018, 57% of application development and testing was taking place on-premises, with another 43% of application development and testing taking place off-premises. Of the applications that were being developed off-premises, 22% were deployed to a platform-as-a-service (PaaS) environment — a modern application deployment scenario.

This expansion in viable architectural targets comes at a time when IBM's POWER architecture is seeing adoption through an open licensing initiative that IBM has embraced, and even IBM's System z platform has rejoined the conversation due to its embrace of the Linux operating system and layered technologies including OpenStack, Red Hat's OpenShift, Kubernetes, and virtually every other major open source software project. Collectively, the emerging software stack that makes hybrid cloud portability realistic helps abstract these various architectures in a way that customers can derive benefit with far less deployment complexity.

The current technology choices can be grouped into several buckets, including:

- **Application development changes:** New programming languages, frameworks, and application packaging are emerging. These changes are relevant primarily to brand-new applications but also can apply to legacy applications that are repackaged and deployed on cloud-native architectures. Today, customers are looking at Ruby, PHP, Perl, Python, Java, Node.js, and other application frameworks for hosting new applications. In many cases, we expect customers to move to container-based packaging formats for these new applications, typically with formats compatible with or based on Open Container Initiative (OCI) specifications, which have emerged as an industry de facto standard package. We believe that the majority of existing applications will not be refactored or rebuilt using modern languages but will likely be migrated into modern container packages over time. The business value of these existing applications remains intact, however, as the industry evolves around them. Key operating system functionality is incorporated in containers, and customers need to make conscious decisions about where the operating system components come from. So far, Red Hat has made one of the most visible responses to this requirement with its Universal Base Image (UBI), a dimension of the recent Red Hat Enterprise Linux 8 launch.

- **Deployment options:** The industry is no longer locked into a classic server/software/application deployment model. Virtualization freed workloads from the underlying hardware, which proved a boon for existing installed applications and systems. While virtualization remains the most widely used deployment technology, moving to a scenario where customers consume both private and public cloud resources is becoming common. Both new, web-scale applications and traditional applications benefit from these deployment options, although there is some divergence for what applications go where. Modern applications built in a modern language and packaged in a container are more likely to land on a private and/or public cloud in a PaaS deployment model. Classic applications are likely to be deployed in a virtualized environment today. These applications can increasingly take advantage of private cloud and public cloud infrastructure and will be deployed there in an infrastructure-as-a-service (IaaS) model.
- **Provisioning, automation, and orchestration:** Modern infrastructure is becoming increasingly dependent upon software intended to handle provisioning, automation, and orchestration. Customers building new infrastructure today are likely to look for tools specific to provisioning (Red Hat Satellite and native tools in public cloud infrastructure), automation software (Ansible, Puppet, Chef), and orchestration (Kubernetes, Mesosphere, CloudForms) and a real-time analytics engine based on a rules database (Red Hat Insights). However, more traditional application provisioning and management solutions are likely to continue to be used with existing installed applications.

FUTURE OUTLOOK

Organizations need to find a way to invest in exciting new technologies and prepare for a cloud-centric computing model while continuing to provide full support for their existing infrastructure. This is easier said than done because for most organizations, two-thirds to three-fourths of their IT spend is associated with supporting existing deployments — often simplified into "keeping the lights on." Given that only a small minority of the overall IT budget is available to be invested in new technologies, investing in technologies that improve the efficiency of existing technologies as well as support new deployments becomes all the more important.

IDC sees most end-user organizations facing this situation. Most companies have critical "systems of record" — large corporate databases, ERP systems, and other business applications — that are widely deployed and used and are difficult to replace or migrate. Replacing them with a brand-new application, especially one written using modern languages and deployment scenarios, is not only an impossible task but also a risky move. As a result, customers tend to protect these important applications, which over time become the legacy IT that holds back the larger organization.

Fortunately, technologies are available today to support these classic application workloads, and they do so with greater efficiency while supporting modern next-generation applications. For most organizations, the right approach is to move workloads to a new deployment environment with minimal — preferably no — changes, such as migrating a virtual machine into a container. Then the organization can begin to extend features and offload individual functions from that application in the new environment using native services.

Bridging to Cloud-Native Infrastructure

Most organizations have already begun building a bridge to modern cloud-native infrastructure through the adoption of virtualization software technology. Today, over 85% of workloads are running on virtualized infrastructure, which creates a level of agility on x86 servers that was nearly impossible just over a decade ago (for more information on virtualization, see *Market Analysis Perspective: Worldwide Software-Defined Compute, 2018,* IDC #US43407518, September 2018).

The benefits of having a virtualized infrastructure include the following:

- **Mobility:** Workloads aboard virtualized infrastructure are inherently more flexible and can be moved to where resources are aligned with resource needs.
- **Standardized:** An operating system running on a hypervisor can be handled in a more consistent manner than operating systems running directly on hardware resources.
- **Future ready:** A virtualized infrastructure is able to run across a broader mix of IT infrastructure and is able to support the requirements for a cloud-native environment.

While a modern environment supporting a collection of container-based microservice-oriented applications gets all the buzz in the trade press and at conferences, the only companies that can embrace that compute model without some allowance for supporting existing, installed workloads are new start-ups that have no legacy IT. For the rest of the industry — the vast majority of the industry — a strategy of supporting both legacy and cloud-native applications is not only optimal but also arguably mandatory. During the near term, organizations must separate development and deployment of containerized legacy applications from development and deployment of cloud-native applications.

However, vendors such as Red Hat make it possible to repackage existing installed applications into a containerized deployment, which provides upside benefit from a deployment and life-cycle management perspective with little risk. How broadly customers choose to repackage existing applications into containers remains to be seen, but early indications are that repackaging is a modernization strategy that is being applied to at least some installed applications.

Linux customers enjoy an added benefit in navigating this transition because the vast majority of cloud-native applications are built on Linux as the underlying platform. As a result, the same basic infrastructure can be used for both existing installed base applications and new cloud-native applications. Container-based applications are intended to be used with a "thin" Linux operating system, such as Red Hat Enterprise Linux CoreOS. Red Hat Enterprise Linux customers can easily mix and match classic applications hosted on Red Hat Enterprise Linux and cloud-native Red Hat Enterprise Linux CoreOS containerized applications aboard the same virtualized infrastructure. The prerequisite for this deployment option is the use of Red Hat OpenShift 4.0, while Red Hat Enterprise Linux CoreOS is a component of the Red Hat Enterprise Linux 8 family.

Beyond the Operating System: Enabling Private and Hybrid Cloud

Most customers today, particularly upper midmarket to large customers, need far more than just infrastructure software for their environments. Larger organizations need to have a full set of solutions, including storage, management, orchestration, virtualization, virtualization management, and cloud system software. The Linux and open source ecosystem includes all of the previously mentioned prerequisites, thanks to an industry that is highly Linux centric. That is, open source projects today are usually built with the assumption that the default operating system and hypervisor will be Linux and KVM.

The modern public (and private) cloud environment is possible because of Linux and the adjacent stack of open source software projects.

For example, container technology was developed specifically for Linux environments, building off capabilities that were native to the Linux platform. The Cloud Native Computing Foundation drove the widespread adoption of the Open Container Initiative format, leading to an almost universally adopted de facto standard. The Open Container Initiative format is supported by products such as Red Hat OpenShift. Likewise, other open source technologies, such as the open source Ceph distributed storage system software, have been embraced by Linux distribution vendors. For example, Red Hat was built on the open source Ceph technology to deliver an open source–based storage solution. Further up the stack, key technologies that span and make possible private, hybrid, and public cloud environments include OCI (container packaging), Kubernetes (container orchestration), Istio (service management), and Kafka (message streaming). The list includes dozens of related technologies.

CHALLENGES/OPPORTUNITIES

The activities being pursued as part of an IT modernization project have changed over the years, and today's activities are heavily focused around consolidation and standardization, with that work taking on an increasing urgency to embrace next-generation application development and deployment models.

Challenges and opportunities associated with IT modernization include:

- **Challenge: Greater hardware agnosticism —** Over the past 20 years, many organizations worked to standardize their hardware around x86 servers. Since then, the industry is again shifting back to support a multiple architecture environment in public cloud. The widespread use of GPUs, FPGAs, ARM processors, RISC-V processors, and other emerging processors is causing a return to a multiarchitecture compute footprint.
- **Opportunity: Modern application development —** There exists a meaningful opportunity for customers to embrace modern application development using containers and OpenShift deployments across multiple architectures. Modern applications and the abstraction layers that are integral to modern infrastructure software help make a heterogeneous compute layer more consumable.
- **Challenge: Building a hybrid cloud environment —** The more modern a customer's environment may be, the greater the potential that it will support a hybrid cloud consumption scenario, working in conjunction with public cloud resources. However, for many customers, that is not a small step; rather, it is a leap.
- **Opportunity: Interoperating with public cloud services —** The more standardized the software stack is in an organization's IT infrastructure, the greater the potential it will interoperate with public cloud under a hybrid cloud scenario. While not every organization is in a rush to move to public cloud infrastructure, having the technology in place to do so when the time comes can be an advantage. In the interim, having a private cloud that uses technologies similar to those that will be used in public cloud — including Kubernetes, container support, Istio, and related solutions — eases future expansion.
- **Opportunity: Operating system portability —** Linux has proven to be a common denominator in the industry and has been ported to every major architecture in use. The use of a minimal number of operating system products (vendors) and, even within a given vendor, a limited number of release versions reduces the support matrix, lowers operational costs, reduces the difficulty of managing life cycles and, in turn, standardizes software product selections further

up the stack. Multiple general-purpose Linux distributions in use today have proven to be highly portable across clouds, improving customers' ability to leverage a hybrid cloud environment without porting applications. This portability is not necessarily true for Linux distributions that have been optimized for a single cloud or a single deployment environment.

- **Opportunity: Management as an enabler —** The movement toward a greater level of standardization is directly related to reducing the burden on IT to stand up, manage, and orchestrate workloads. While automating legacy applications has its challenges, most IT organizations recognize the opportunity to improve automation with modern cloud-native applications. Typically, deployments for cloud-native solutions land in a private or a public cloud and as such are dependent upon self-service provisioning tools, use automation software for management, and are orchestrated using software versus manual oversight. Red Hat has invested in both organic development and acquisitions (with its acquisition of Ansible) to build out its management portfolio to support a DevOps deployment model.
- **Challenge: Application portability —** As organizations move to cloud-native deployments using next-generation applications, those applications, and groups of applications, are able to be moved from private cloud to public cloud or from one public cloud to another, thanks to the abstraction provided by container packaging.
- **Opportunity: Application package standardization —** The single most exciting development in the industry today is the emergence of application container technology that allows application code and its direct dependencies (runtime libraries, frameworks, etc.) to be grouped together in a container. This self-contained application is then able to be deployed on a less comprehensive operating system stack that offers a smaller attack surface and the ability to be patched and maintained without directly impacting the runtime containers that use it.

CONCLUSION

Innovation is a hallmark of the technology industry. Change can be perceived as disruptive and costly, but it is nonetheless necessary if organizations are to remain competitive and avoid obsolescence in an ever-changing world.

Organizations need to embrace change to their IT infrastructure, both software and hardware, in a way that balances the needs of existing, business-critical infrastructure and services while empowering and enabling agile application delivery to compete and win in a constantly changing competitive landscape. Open source software has emerged as one of the key enablers for organizations wishing to remain agile and competitive and become cloud ready while empowering customers to efficiently support and modernize existing business-critical applications. For most enterprise customers, commercially supported open source software offers added benefits because customers can focus their expertise on line-of-business applications rather than get sidetracked supporting infrastructure software layers where competitive differentiation is most difficult.

For most customers, the path toward tomorrow's compute paradigm mandates a perpetual cycle of infrastructure modernization. Planning for next-generation application development by using containers for application packaging and deployment along with a reliable runtime environment for existing infrastructure, making hybrid cloud a realistic possibility, remains the holy grail.

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Global Headquarters

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