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Innovate at Scale and Deploy with Confidence in a Hybrid Cloud Environment

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Executive summary

According to a recent study, CxOs have embraced hybrid cloud as an essential part of their digital transformation strategies.[1] However, there are still several open-ended questions for most when assessing a hybrid cloud platform. This IBM Redguide publication examines some common business challenges and provides solutions based on a decade worth of experience. These solutions include:

- Responding to business needs faster
- Reducing IT cost
- Prioritizing digital transformation
- Adopting hybrid cloud as a de facto enterprise model

In early 2020, IBM and Red Hat partnered to deliver a hybrid cloud platform based on the IBM Z environment and Red Hat OpenShift Platform. Today, Red Hat OpenShift is tightly integrated in the IBM Z and IBM LinuxONE platforms, taking advantage of their strengths in resiliency, performance, security, scalability, agility, and flexibility. Built on Kubernetes,[2] Red Hat OpenShift enables new cloud-native applications to be developed and existing applications to be modernized with speed and flexibility to fuel business growth.

The Red Hat OpenShift Platform on IBM Z and IBM LinuxONE offerings provide *cloud in a box* solutions to help lower the total cost of ownership (TCO) and allow for more investment in innovation. Cloud-native applications can now be integrated with traditional workloads and business-critical data by virtue of colocation, with containerized applications residing in the same footprint.

The IBM Z and IBM LinuxONE platforms together with Red Hat OpenShift and IBM Cloud Paks help businesses innovate at scale and deploy with confidence in a hybrid cloud environment. As a result, they have a choice for *best-fit* deployment of their modernized applications (build once, deploy anywhere) by using the same tooling and DevOps practices.

This IBM Redguide publication also explores various scenarios that are relevant to workload modernization and colocation when running Red Hat OpenShift and IBM Cloud Paks on IBM Z and IBM LinuxONE platforms.

[1] The Road to Hybrid Multicloud, IDC, 21 August 2020

[2] Kubernetes is an open-source system that can help automate, deploy, scale, and manage containerized applications.

Address your business challenges with hybrid cloud

Change is inevitable. Organizations worldwide are under tremendous pressure to keep their products and offerings relevant in the face of economic and social disruption. Hybrid cloud is a key enabler for developing new digitally driven business models that deliver tangible value and growth. Hybrid cloud also plays an important role in maintaining synergy between on-premises infrastructure and applications, and the cloud, especially for organizations looking to modernize critical core business applications. In many cases, establishing a private cloud as part of a wider hybrid cloud deployment is the only way to address compliance and security requirements.

Respond to business needs faster

The trend today is no longer the big beating the small; instead, it is the fast beating the slow.

Innovation and new business models are key to competitive success and long-term business survival. When IT cannot keep up with business demands and fails to deliver cutting-edge capabilities at the correct time, organizations quickly lose their marketplace advantage and are often leapfrogged by more agile and nibble disrupters.

With Red Hat OpenShift and IBM Cloud Paks on IBM Z and IBM LinuxONE platforms, organizations can accelerate service delivery and application development and achieve best-fit deployment, overcoming bottlenecks otherwise associated with developer and operational inefficiencies. Refactoring applications to use container-based cloud computing enables far greater agility, flexibility, scalability, and sustainability with increased productivity. Containers also support continuous integration/continuous delivery (CI/CD) and DevSecOps methodologies that unify operations and development, and speed processes. IBM Cloud Paks also accelerate and deliver specific technical and business capabilities across AI, data, business automation, integration, network automation, and security.

When done correctly, the benefits of a true hybrid cloud platform extend far beyond IT infrastructure optimization, allowing organizations to increase developer velocity, bring new capabilities to market more quickly, innovate more easily, and scale more efficiently, while at the same time also reducing technology risk.

Reduce IT cost

Chief information officers (CIOs) and IT leaders are under mounting pressure to rationalize their IT landscape and reduce costs wherever possible, while at the same time delivering more than simply keeping the lights on. In many cases, cost savings and cash preservation are considered the only choice for protecting and sustaining the business. Looking for cost savings in complex IT environments can be both challenging and time-consuming. Cost takeout also runs the risk of corner-cutting, eliminating any slack or contingency, moving to lower-cost alternatives that potentially deliver inferior qualities of service, and crippling innovation.

Although it might seem counterintuitive to invest in new technology to address cost reduction needs, moving workloads to Red Hat OpenShift and adopting the IBM Cloud Paks on IBM Z and IBM LinuxONE platforms can help rebalance the cost curve. How is this result possible? Red Hat OpenShift and IBM Cloud Paks significantly lower technical debt and operational costs by permitting IT organizations to fully embrace open-source technology instead of more costly commercial packages. Together they can contribute to improve developer productivity and rapid application delivery through modern DevSecOps.

IBM Cloud Paks running on Red Hat OpenShift can help you take full advantage of an open architecture that delivers observability and traceability to reduce support costs and improved operational efficiency. In addition, by choosing to deploy Red Hat OpenShift and IBM Cloud Paks on IBM Z and IBM LinuxONE platforms, you stand to benefit from all the key advantages that IBM Z and IBM LinuxONE solutions deliver, including exceptional performance, unmatched reliability and resiliency, vast scalability, and industry-leading security.

In summary, if organizations want to achieve and sustain a lower IT spend, they need to look beyond simple IT budget cuts to a more holistic cost model. Investing in technology (and the correct technology) remains key to accelerating digital transformation and delivering tangible business value.

Prioritize digital transformation

Challenging economic times and changing market dynamics are compelling organizations to take another look at every aspect of their business. For many CIOs, this second look has meant focusing on modernizing their IT systems and current IT processes. Although such an approach reduces technical debt, lowers IT costs, and helps IT to respond quicker to the needs of the business, it stops short of realizing the full potential of digital transformation, which effectively leaves growth potential and value on the table.

Unlike IT modernization, digital transformation is really all about the use of technologies to reinvent and transform your business. Put another way, digital transformation is the holistic adoption of change across people, processes, and technology to create new business opportunities. What do we mean by holistic adoption? Modernizing monolithic applications to cloud-based microservices delivers a step change in technology, but by itself does not deliver any process or operating model improvement. In contrast, taking a digital transformation approach is about rediscovering the fundamental business need, transforming non-digital and manual processes (including human touch points) with digital capabilities. It is also about ensuring that customer expectations are not only met but exceeded. All of it is facilitated by the application of technology.

Digital transformation should extend to understanding the business processes and human touchpoints, possibly reshaping and augmenting them with cutting-edge AI or robotic process automation (RPA) to deliver innovative differentiation. Emphasis needs to be placed on making the workforce smarter and more productive at every process touchpoint. For this reason, adopting a hybrid cloud platform, integrated with cloud-native workloads and infused with AI and automation, is key.

With Red Hat OpenShift and IBM Cloud Paks on IBM Z and IBM LinuxONE platforms, organizations can greatly accelerate their digital experimentation needs thanks to AI, advanced analytics, business automation, network automation, and security capabilities. And, when ready, they can scale their digital transformation plays across their enterprise.

Adopt hybrid cloud as a de facto enterprise model

Without a doubt, cloud computing has revolutionized the way many organizations globally consume IT resources and services to achieve their business goals. Despite much fanfair, several impediments have prevented workloads from moving en masse to the public cloud, including concerns related to compliance and data sovereignty, latency, availability, security, and mission-critical business systems that do not easily lend themselves to being moved out of the data center.

With Red Hat OpenShift and IBM Cloud Paks, organizations can implement a truly unified hybrid cloud environment for running workloads consistently across on-premises infrastructure and the cloud platforms of an organization's choice. Furthermore, Red Hat OpenShift allows you to develop your applications once and deploy them essentially everywhere. Recognizing that some cloud-native applications might well be tied into core business systems or systems of record, it is highly beneficial for those applications to run colocated with enterprise data on the same platform to minimize latency and take advantage of superior qualities of service offered by the platform. Similarly, concerns with compliance, data sovereignty, and security can be mitigated with pervasive encryption, the industry-leading security capability of the IBM Z and LinuxONE platforms.

In summary, by deploying Red Hat OpenShift and IBM Cloud Paks on IBM Z or IBM LinuxONE platforms, container and cloud-native applications can benefit from the exceptional performance, reliability, resiliency, scalability and security capabilities of the IBM Z and IBM LinuxONE platforms.

The value case for hybrid cloud on IBM Z and IBM LinuxONE platforms

The availability of Red Hat OpenShift and IBM Cloud Paks on IBM Z and IBM LinuxONE platforms is a major milestone for enterprise computing, as it brings the immediate, tangible benefits of cloud-native applications and services, containers, container management and orchestration, automation, and open-source technology to the platform that delivers one of the highest levels of scalability, resiliency, and security in the industry.

A hybrid cloud platform deployed on IBM Z and LinuxONE platforms can provide benefits that span across operations, development, IT cost optimization, and business growth.

Operational benefits

Old ways of working, including manually installing and configuring software, installing fix packs, stopping and restarting servers, the repeated deployment of application releases, and the isolation and remediation of problems, are all too slow and inhibitors of agility and digital transformation in today's world of IT.

With Red Hat OpenShift and IBM Cloud Paks on IBM Z and IBM LinuxONE platforms, IT operations teams can automate once repetitive manual tasks and focus on what they need to manage. The result is that IT operations teams achieve greater productivity, with business applications up and running faster.

Infrastructure provisioning efficiencies

IBM Cloud Pak® for Multi-Cloud Management, includes IBM Cloud Automation Manager (CAM), running on Red Hat OpenShift, using IBM Cloud Infrastructure Center as the IaaS layer for IBM Z or IBM LinuxONE platforms, is capable of automating the provisioning and configuration of virtual servers, running Linux or Red Hat OpenShift.

Container deployment efficiencies

Red Hat OpenShift uses Kubernetes Operators to deploy and manage containerized applications. Operators have varying levels of maturity, from just deploying workloads to automatically managing them. These varying levels enable deployment and management efficiencies for Red Hat OpenShift, not available on other Kubernetes-based platforms.

Systems administration efficiencies

Systems administration is more efficient with Red Hat OpenShift as the integrated monitoring, logging, services, and Kubernetes cluster management capabilities automate many of the repetitive and laborious tasks otherwise associated with managing applications at scale. As the volume of applications increases, efficiency dividends become more apparent.

Security incident avoidance

Red Hat OpenShift is combined with the Vulnerability Advisor capability from IBM Cloud Paks to keep the security status of your containers in check. Vulnerability Advisor verifies the status of container images and scans running containers for security vulnerabilities, malware, policy compliance, and configuration compliance. Vulnerability Advisor also integrates with the IBM X-Force® threat intelligence and IBM Guardium® data protection platforms for risk analysis. Tools like Twistlock, Sysdig, Qualys, and Aqua can also be consumed for protection from other attack vectors.

Developer benefits

Red Hat OpenShift and IBM Cloud Paks provide developers open-architecture-based tools and runtimes that drive innovation and accelerate developer velocity. As a result, development cycles get significantly accelerated and businesses achieve faster time to market. According to a recent Forrester Total Economic Impact study, development cycles can be accelerated by up to 66% when combining Red Hat and IBM solutions.

Developer tools and experience

Red Hat OpenShift and IBM Cloud Paks provide a consistent developer experience across all platforms, whether it be on premises, public cloud, or hybrid. Developers no longer need to constrain themselves to a single tool that was available on one platform but not another. Instead, developers can truly code once and run essentially anywhere by developing against the underlying Kubernetes platform in Red Hat OpenShift and IBM Cloud Paks. Developers also only need to familiarize themselves with a single application-centric user interface (UI) that allows them to build code, deploy containers, link services, and more.

Software catalog

Red Hat OpenShift delivers a catalog of software container images that are ready to use. The catalog contains both IBM software, such as IBM WebSphere Liberty, IBM MQ; Red Hat middleware software, such as AMQ, JBoss EAP, Fuse for Red Hat OpenShift; and many open-source software offerings, such as Tomcat, MongoDB, Kafka, and PostgreSQL. Red Hat OpenShift can consolidate additional catalogs with full role-based access control (RBAC) analysis. The ability for developers to quickly find, deploy, and start using such software is one reason why developer productivity and innovation is greatly accelerated.

Modern CI/CD

Red Hat OpenShift allows developers to achieve their continuous integration, continuous delivery (CI/CD) objectives that include automation of processes to promote code through build, test, and deployment. Red Hat OpenShift includes OpenShift Pipelines, which is a Kubernetes-style CI/CD solution based on Tekton. Jenkins is also supported on Red Hat OpenShift. In either case, a pipeline is critical in supporting CI/CD processes. By automating the process, the objective is to minimize human error and maintain a consistent process for how software is deployed.

Self-service provisioning of IBM z/OS resources

With IBM z/OS® Cloud Broker deployed to Red Hat OpenShift and IBM Cloud Paks on the IBM Z platform, developers can quickly provision and gain access to z/OS resources and middleware, such as IBM CICS and IBM Db2 for z/OS.

IT cost reduction and avoidance

With Red Hat OpenShift and IBM Cloud Paks on IBM Z and IBM LinuxONE platforms, organizations stand to drive out IT costs and ultimately lower their overall TOC.

Lower TOC

One of the main reasons organizations choose Red Hat OpenShift and IBM Cloud Paks on IBM Z and IBM LinuxONE platforms is the lower TCO. When hardware, software, networking, staff, power, and facilities costs are all taken into account, IBM Z and IBM LinuxONE platforms can deliver up to a 22% lower TCO compared to an equivalent x86-based environment, according to a recent study conducted by IBM IT Economics Consulting and Research.[3]

Furthermore, for organizations that are looking to modernize existing on-premises application and shift to open-source containerized applications and runtimes included with Red Hat OpenShift, the gain is anticipated to be even higher. How is it possible? Software costs are often directly tied to compute resources, such as the number of processor cores or virtual central processing units (vCPUs). With IBM Z and IBM LinuxONE platforms delivering more performance per CPU, or Integrated Facility for Linux (IFL), it therefore stands that you can do more with less and ultimately lower your software expenditure. IBM Z and IBM LinuxONE platforms also deliver benefits in terms of reduced staff, due to there being fewer parts to manage, reduced networking, and a smaller data center footprint.

Reduction in data center costs

A sprawling data center can represent a significant burden to any organization. Server farms of distributed systems typically consume more power, dissipate more heat, take up a larger footprint, and become increasingly more demanding on personnel as parts fail with age. By migrating applications to Red Hat OpenShift and IBM Cloud Paks on IBM Z and IBM LinuxONE platforms, organizations can do more with a smaller infrastructure footprint. As a result, data center overhead and carbon emissions are greatly reduced. According to a study conducted by IBM IT Economics Consulting and Research, the IBM LinuxONE platform can deliver up to a 62% saving in annual energy consumption and a 86% annual saving in floor space when compared to an equivalent x86 environment.[4]

Kubernetes buy verses build cost avoidance

Red Hat OpenShift and IBM Cloud Paks not only exploit open-source components, such as containers and Kubernetes, but they also delivers significant added value in terms of enterprise-ready monitoring, logging, metering, security, and interaction with the network and storage layers. All these advantages are backed by Red Hat and IBM product expertise and global support infrastructure. In contrast, organizations that choose to build and maintain their own Kubernetes-based platforms often spend a considerable amount of time and resources doing so, which distracts from focusing on business deliverables.

[3] Benefits of running OpenShift workloads on IBM Z, an IBM internal study, March 2021.
[4] IT organizations worldwide are finding solutions to reduce greenhouse gas emissions, IBM, February 2020.

Business benefits

Technology transformation drives innovation and business value creation, ultimately resulting in growth and profitability. Putting Red Hat OpenShift and IBM Cloud Paks on IBM Z and IBM LinuxONE platforms at the center of your hybrid cloud strategy can help achieve multifold tangible business objectives.

Reduced time to market

Red Hat OpenShift and IBM Cloud Paks deliver reduced time to market through rapid application development and delivery. As such, business teams are able to introduce new functionality at a much faster rate, allowing them to be more responsive to customer needs while identifying new business opportunities.

Expanded value

Putting Red Hat OpenShift and IBM Cloud Paks on IBM Z and IBM LinuxONE platforms at the center of your hybrid cloud strategy can help achieve the most ambitious business goals and drive up to 2.5 times more value than a single-cloud approach, according to the IBM Institute for Business Value.[5]

Increased revenue

Red Hat OpenShift and IBM Cloud Paks accelerate the ability to launch innovative and differentiating business applications that open new revenue streams. With IBM Cloud Pak for Data on the IBM Z or IBM LinuxONE platform, innovation can be accelerated by using data engineering and AI with applications and business processes. Containerized workloads running on a hybrid cloud platform provide fit-for-purpose deployment of new applications to increase developer velocity and achieve faster time to value.

In addition, Red Hat OpenShift and IBM Cloud Paks on the IBM Z or IBM LinuxONE platform can deploy containerized applications on the platform that delivers among the highest levels of reliability, availability, and serviceability in the industry. IBM Z and IBM LinuxONE platforms provide hardware fault tolerance and redundancy by design. Applications deployed to Red Hat OpenShift and IBM Cloud Paks exploit the built-in resiliency capabilities offered by Kubernetes, including high availability through clustering, self-healing, and horizontal auto scaling of pods. When both the inherent benefits of IBM Z and IBM LinuxONE platforms are coupled with the benefits of Red Hat OpenShift and IBM Cloud Paks, loss of revenue because of downtime (planned or unplanned outages) is all but eliminated.

Use the strengths of IBM Z and IBM LinuxONE platforms for hybrid cloud

With modern technologies and trusted governance mechanisms, IBM Z and IBM LinuxONE platforms can be effective cornerstones for establishing a modern hybrid cloud platform with a low TCO. By deploying Red Hat OpenShift and IBM Cloud Paks on the IBM Z or IBM LinuxONE platform, a hybrid cloud platform can benefit from the exceptional performance, reliability, resiliency, scalability, and security capabilities of IBM Z and IBM LinuxONE platforms.

[5] The hybrid cloud platform advantage

Outstanding performance

IBM Z and IBM LinuxONE platforms are optimized for performance and data-intensive processing by design. They include the fastest commercial processor on the market today at 5.2 GHz, a state-of-the-art four-level cache, and a dedicated input/output (I/O) subsystem that supports high I/O bandwidth workloads and results in superior throughput. Why does it matter? The ability to drive workload consolidation and utilization are directly attributed to processor and system design. Unlike other platforms, IBM Z and IBM LinuxONE platforms deliver among the highest levels of serial fitness (that is, how fast will each thread process instructions given that data is available) and data fitness (that is, how much data is available close to each thread). As a result, more workloads can be consolidated on fewer CPUs or IFLs. Furthermore, as more workloads are consolidated, the individual peak to average utilization variances of the component workloads are reduced in the aggregate. Consequently, less headroom or wasted capacity results. This process makes the IBM Z and IBM LinuxONE solutions exceptionally efficient platforms and fit for purpose.

Unmatched reliability and resiliency

The implications of downtime can be considerable. Planned and unplanned system outages can negatively impact both customer loyalty and an organization's bottom line. IBM Z and IBM LinuxONE platforms can provide the highest levels of reliability, availability, and security of any sever platform on the market, as cited in the recent independent ITIC 2020 Global Server Hardware and Server OS Reliability Survey. For the 12th straight year, IBM Z and IBM LinuxONE platforms consistently outperformed all competitors in every reliability category.

Vast scalability

IBM Z and IBM LinuxONE platforms deliver multidimensional growth and scalability options. System resources, CPUs, memory, and I/O, with IBM Z and IBM LinuxONE platform can be either shared or dedicated, and dynamically added or removed without disruption to the running environment. The platforms exhibit tremendous flexibility, enabling both horizontal scaling, adding and removing virtual guests (such as running Linux or Red Hat OpenShift), and vertical scaling, growing and shrinking an existing virtual guest, with ease. Hence, a system can be allocated for peak utilization, with unused resources automatically reallocated as needed. Ultimately, this method also leads to less administrative and operational effort.

Industry-leading security

In an increasingly intricate world of regulatory requirements and cyberthreats, the security of sensitive data and mission-critical workloads is paramount. Not surprisingly, security and compliance are two of the biggest concerns for many organizations today.

IBM Z and IBM LinuxONE platforms are highly securable systems, and the latest IBM z15 and IBM LinuxONE III continue to enhance an already robust system with pervasive encryption, taking advantage of features, such as the Central Processor Assist for Cryptographic Functions (CPACF) and the IBM Crypto Express. CPACF is a high-performance, low-latency coprocessor that performs symmetric key encryption operations and calculates message digests, hashes, in hardware. Crypto Express features with the hardware security module (HSM) enabled for FIPS140-2 Level 4 certified encryption.

Logical partitions on IBM Z and IBM LinuxONE platforms are EAL 5+ certified and can allow for workloads to be run in highly secure isolation from one another on a single system.

Lastly, applications communicating across partitions in IBM Z and IBM LinuxONE environments do so without a physical network and at memory speeds, which is a clear advantage over air-gapped clusters of commodity servers, but can be susceptible to vulnerable networking equipment. This communication is not only more secure, but helps ensure that latency is minimized, and service delivery levels can be maintained.

IBM Hyper Protect Services

IBM announced its first confidential computing capabilities at IBM THINK® in 2018 with the launch of IBM Hyper Protect Services, public cloud solutions, secured by the HSM in the IBM Crypto Express features.

Regardless of your cloud model (public, private, or hybrid), with the IBM Z and IBM LinuxONE platforms, you take control of securing and protecting your most sensitive data and workloads, both from outside and inside threats. IBM z15 and IBM LinuxONE III were the first platforms to enter the quantum-safe computing era, introducing Dilithium cryptography curves.

The Hyper Protect Services are at the center of the world's first financial-services-ready public cloud.[6]

IBM Cloud also offers several services under the IBM Hyper Protect brand, such as IBM Hyper Protect Virtual Server, IBM Hyper Protect DBaaS, and IBM Hyper Protect Crypto Services. Each of these services can be used as an extension of your private cloud environment while maintaining privacy and confidentiality and meeting industry's highest compliance standards.

You can use IBM Hyper Protect Services for elastic compute or bursting along with use cases spanning public and private infrastructure through a secured pipe. For more information about IBM Hyper Protect Services, see *Securing Your Critical Workloads with IBM Hyper Protect Services*, SG2-48469.

Digital modernization and transformation

For most enterprises, the ability to take advantage of modern development and deployment of solutions while still using technology investments is an optimal outcome. Today, it has become practical reality, according to IDC study.[7]

With most corporate data and core services originating on z/OS platforms, organizations are using the data gravity; that is, bringing the new cloud services closer to the data, avoiding costly data exports and potential security breaches associated with it.

You can integrate cloud-native applications with your z/OS mission-critical services, providing world-class services to your customers. There is no need to re-engineer your entire software applications landscape to modernize. Assess your applications and find the best candidates, and start modernizing incrementally.

Red Hat OpenShift on the IBM Z platform provides a solid platform for a digital transformation and your journey to cloud and microservices. It is secure, available, and performant. The developers can focus on digital transformation tasks, using the common and open tooling for easy, agile, and flexible software development. IBM Z operations can be automated and streamlined through IBM System Automation for z/OS and Red Hat Ansible for z/OS.

[6] IBM Developing World's First Financial Services-Ready Public Cloud; Bank of America Joins as First Collaborator
[7] Building the Open Enterprise: Leveraging Red Hat Enterprise Linux, OpenShift and Ansible on IBM Z, IDC white paper sponsored by IBM, April 2020.

For more information, see Red Hat OpenShift Container Platform on IBM Z and IBM LinuxONE.

Figure 1 shows the possible scenario of integration of core z/OS services, such as IBM CICS®, IBM IMS, and IBM Db2® for z/OS with containerized workloads and a stack of the technologies to streamline the workload transformation.

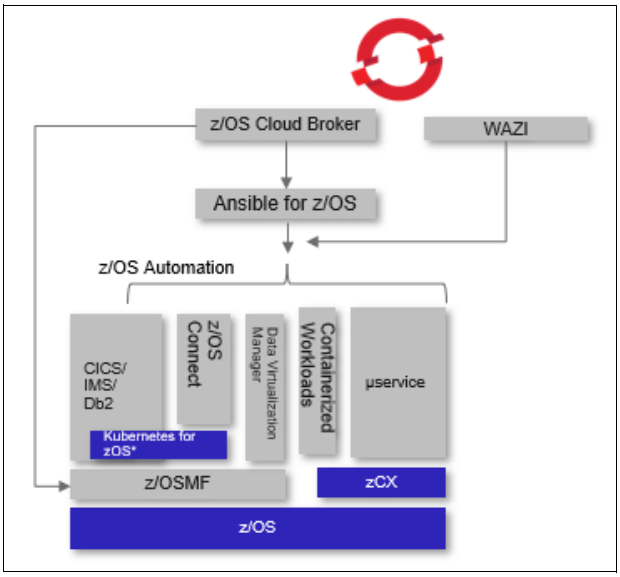

Figure 1 IBM z/OS and OpenShift integration scenario

The following components are the building blocks of the solution:

- IBM z/OS Connect Enterprise Edition helps you to enable a wide community of developers with a simple and intuitive way to consume data and services hosted on IBM Z platform. It provides a single, common way to unleash your existing market-differentiating assets on IBM with RESTful APIs.
- IBM z/OS Container Extensions (IBM zCX) makes it possible to integrate run dockerized applications with z/OS. Application developers can develop and data centers can operate popular open-source packages, Linux applications, IBM software, and third-party software together with z/OS applications and data. IBM zCX provides Docker CE for applications. See the statement of direction.[8]
- IBM z/OSMF framework improves a z/OS system programmer's productivity by using simplified, streamlined and automated tasks. This functionality can help reduce both programmer training time and the learning curve. z/OSMF is designed to simplify and modernize z/OS management.
- IBM z/OS Cloud Broker integrates z/OS-based services and resources into your private cloud platform for a modern cloud-native experience. It is a software product to provide access to z/OS services within private cloud platforms, such as Red Hat OpenShift, for consumption by the broader development community.
- The Red Hat Ansible Certified Content for IBM Z, today's content for z/OS, allows you connect the IBM Z platform to your wider enterprise automation strategy through the Red Hat Ansible Automation Platform ecosystem. Red Hat Ansible Certified Content for IBM Z helps enable development and operations automation through unified workflow orchestration with configuration management, provisioning, and application deployment in one platform. It is an important step to providing a comprehensive enterprise-grade solution for building and operating IT automation at scale.

[8] Statement of direction: IBM intends to deliver containers and Kubernetes orchestration support for IBM z/OS.

- IBM Wazi Developer for Red Hat CodeReady Workspaces (IBM Wazi Developer) is an add-on to IBM Cloud Pak for Applications, providing a consistent and familiar developer experience with z/OS. It is a development environment that fully integrates into any enterprise-wide standard DevOps pipeline.
- Kubernetes for z/OS is not available at the time of this writing. For more information, see the statement of direction.[8]

The market demands more agility and scale, and you can achieve both by creating hybrid cloud solutions, maximizing the value of your IBM Z core services, with the addition of new edge and innovative services. These type of solutions span the services across public and private clouds: the workload runs where it fits the best. Figure 2 shows one of the potential scenarios of the deployment.

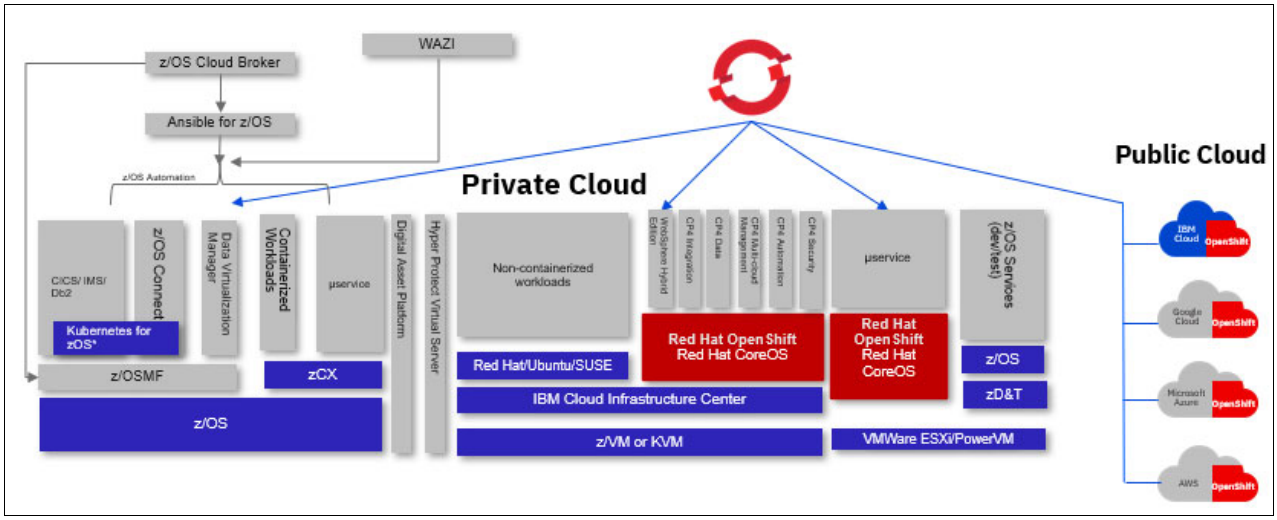

Figure 2 Hybrid cloud deployment: Red Hat Advanced Cluster Management and IBM Cloud Pak solution

The following components are included:

- Red Hat Advanced Cluster Management for Kubernetes controls clusters and applications from a single console, with built-in security policies. Extend the value of Red Hat OpenShift by deploying applications, managing multiple clusters, and enforcing policies across multiple clusters at scale.
- Red Hat CodeReady Workspaces is a collaborative Kubernetes-native solution for rapid application development that delivers consistent developer environments on Red Hat OpenShift.
- IBM Multicloud Manager provides a way to perform parallel queries against multiple clusters and aggregate that information by various criteria. Information is augmented by near real-time pod traffic views by using Weave Scope, which enables an understanding of how pods intercommunicate.
- IBM Cloud Infrastructure Center is an IaaS offering that provides a consistent, industry-standard user experience to define, instantiate, and manage the lifecycle of virtual infrastructure, deployment of images, and policies to maximize resource utilization. It provides simplified infrastructure management for compute, network, and storage resources, and cloud deployments for IBM z/VM® and Red Hat Enterprise Linux KVM-based Linux virtual machines. It also delivers the foundation for scalable infrastructure-as-a-service (IaaS) cloud management on IBM Z and IBM LinuxONE platforms, including the integration to higher-level cloud automation tools.

- Persistent storage for stateful workloads: IBM Spectrum® Scale Container Native Storage Access (CNSA) Cluster, Red Hat OpenShift Data Foundation (formerly Red Hat OpenShift Container Storage), and Network File System (NFS).
- Public clouds running OpenShift: IBM Cloud, Google Cloud, Amazon Web Services (AWS), Microsoft Azure, and others.

Colocation for latency reduction

Colocating your workloads on IBM Z® platform can provide a significant advantage over an environment consists of x86 servers. It leads to a low-latency and high-volume transaction processing system. Colocation consolidates the applications, data, and system resources on a single shared environment for better throughput, performance, and cost.

By remaining within a physical system, all communications to application tiers can bypass external connectivity in the data center. An IBM performance study shows that you can achieve up to 7.3 times lower latency in a colocation environment compared to a distributed server environment.[9]

Processor Resource/System Manager (PR/SM) is the hardware-level hypervisor that is unique to and a vital component of the IBM Z platform. PR/SM manages and partitions all the computing resources, such as CPU, memory, and I/O, among the various logical partitions (LPARs) that run on the platform. PR/SM provides each LPAR with its allocated resources and dynamically adjusts them depending on the workload priority. The workloads remain completely isolated from each other, helping to ensure integrity and security.

In addition, the IBM Z platform supports specialized internal connections for intra-system communication at memory speed through IBM HiperSockets and internal shared memory (ISM). These technologies provide secured high-speed internal connections, removing the need for a complex network infrastructure with many physical layers of switches and firewalls.

Figure 3 shows one of the potential colocation scenarios across two IBM Z LPARs.

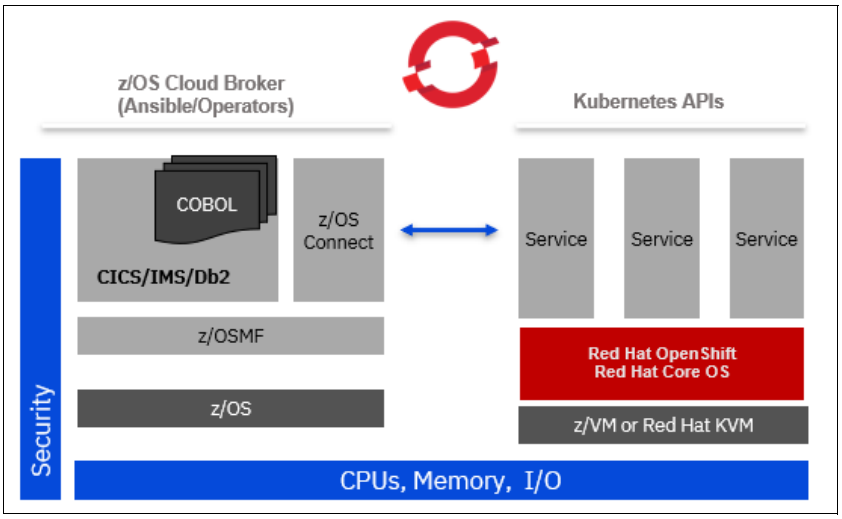

Figure 3 Colocation of workloads on different IBM Z LPARs

[9] Linux Workload Performance on LinuxONE III / z15™, IBM, 17 June, 2020.

Cloud in a box: Extreme consolidation and scalable data serving

With several decades of experience designing and optimizing the entire end-to-end hardware and software stack for enterprises, Linux on IBM Z and IBM LinuxONE Platforms can handle a significantly higher workload per CPU than competing platforms. This advantage enables several efficiencies as defined in “Lower TOC” on page 6. Workloads like Oracle or IBM WebSphere® Application Server can see reduction in costs due to consolidation and with Red Hat OpenShift, containerized workloads can get similar benefits.

Red Hat OpenShift provides a platform-as-a-service (PaaS) layer similar to public cloud vendors and with tools like the IBM Cloud Infrastructure Center, the IBM Z and LinuxONE platforms can offer a cloud-like IaaS layer. Together, these tools provide a cloud in a box with the ability to run up to thousands of monolithic, business-critical, non-containerized workloads along with up to millions of containerized microservices, all in the same form factor as shown in Figure 4.

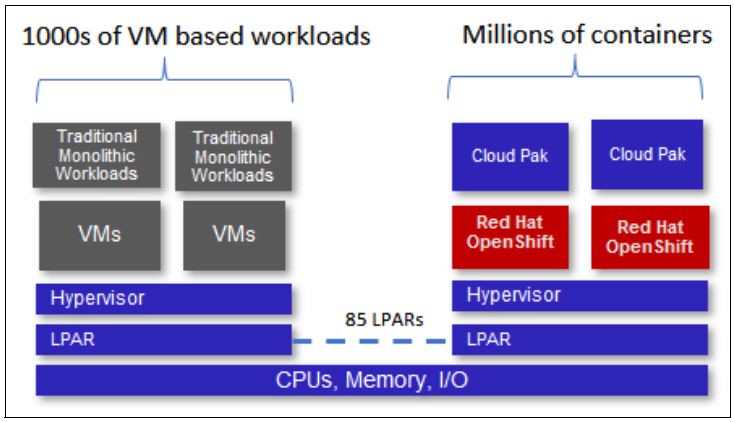

Figure 4 Cloud in a box: IBM Z and IBM LinuxONE platforms

Consistent DevOps experience across platforms

Over the past decade, implementation of DevOps practices have provided a significant reduction in time to market. With multiple platforms at play, having a consistent developer experience is key. Red Hat OpenShift Container Platform provides developer consistency across platforms whether public, private, or hybrid cloud, as shown in Figure 5. This consistency enables developers to write code once and deploy on multiple platforms. A consistent DevOps experience also spans operating systems, such as Linux, Windows, or z/OS.

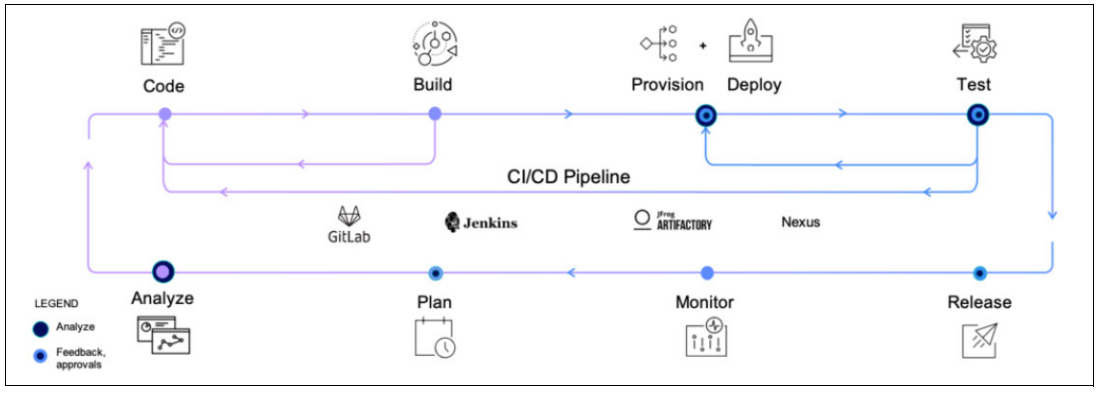

Figure 5 DevOps practices: CI/CD pipeline

In addition to deployment, Red Hat OpenShift combined with Red Hat Advanced Cluster Management and IBM Cloud Pak for MultiCloud Management provides a consistent operational experience across all the platforms.

For a list of use cases, see Mainframe application modernization architecture at the IBM Cloud Architecture Center.

IBM and Red Hat can help

IBM has highly skilled acceleration teams to help ensure the technology will meet your business goals. For a no-cost, no-obligation assessment, send an email to zaccel@us.ibm.com.

IBM also offers a no-cost assessment for a Red Hat OpenShift on IBM LinuxONE as part of our IBM LinuxONE Community Cloud offering.

Red Hat provides information about the business benefits and innovative advantages of Red Hat OpenShift. For more information about how to start your journey, see Red Hat OpenShift.

For more information about hybrid cloud environments on IBM Z, including automation and application development, testing, and management, see Hybrid Cloud with IBM Z.

For more information about the capabilities and benefits of the IBM Cloud Pak offerings, including the various use case they address, and services to help you get started, see IBM Cloud Paks.

The IBM Z content solutions website provides comprehensive information to help you start your journey to hybrid cloud on the IBM Z platform. For more information, see the content solutions web page.

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