

# Linux on IBM Z

## Security and efficiency you need

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### Highlights

- The cloud you need
  - Secure and open
  - Scalable and flexible
  - Resilient and trustworthy
  - Efficient and economical
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### Linux at its best

Using open-source Linux<sup>®</sup> solutions is a smart way to run your cloud and what is often called traditional IT—it's a fact.

Since the reality of hybrid IT is here, most of you are looking for solutions that leverage your investments in—and the strengths of—your existing IT and cloud services in a seamless way.

Linux on IBM Z<sup>®</sup> provides you an impressive Linux and private cloud environment, especially for workloads that require high levels of resilience, flexibility and security.

IBM<sup>®</sup> Cloud Paks<sup>®</sup> based on Red Hat<sup>®</sup> OpenShift<sup>®</sup> Container Platform, as well as running Linux workloads in a highly virtualized environment based on IBM z/VM<sup>®</sup>, KVM or LPAR virtualization, provide you the cloud you need.

Co-locating workloads on IBM Z—tightly integrating Linux and Container workloads with IBM z/OS<sup>®</sup>, IBM z/VSE<sup>®</sup>, or IBM z/TPF workloads—can not only benefit from great performance and operational efficiency, but also leverages your investments in existing assets.

Linux on IBM Z benefits from the strengths and capabilities of outstanding IBM Z technology, such as unparalleled resiliency, encryption everywhere, high utilization and extreme scalability.

*Linux on IBM Z provides you—the cloud you need—integrating seamlessly into hybrid multicloud.*

## Linux on IBM z15™ (z15)

The z15 is focused on delivering a system designed for secure digital transformation. It can help to keep services and operations running smoothly and continuously.

A key design point for all IBM Z servers is to provide a strong Linux and cloud platform, and this is continued with these z15 capabilities:

- New consolidation opportunities with increased total capacity<sup>1</sup> in a single footprint, supporting up to 190 processors and up to 40 TB Redundant Array of Independent Memory.
- Enlarged on-chip cache per core to help minimize memory waits while maximizing the throughput.
- Enhanced economies of scale with improved single processor capacity<sup>1</sup>.
- High-speed connectivity with new FICON<sup>®</sup> Express16SA and new OSA-Express7S features.
- On-chip accelerated file compression enabled for all Linux workloads.
- Faster IBM GDPS<sup>®</sup> reconfiguration for automated startup and shutdown.
- Simple and consumable management experience with IBM Dynamic Partition Manager extensions.
- IBM Z Data Privacy Passports protecting individuals' identity in a digitized world.
- Stronger and faster data protection enabled, for example, by new on-chip cryptography capabilities and a new Crypto Express7S adapter.
- IBM Fibre Channel Endpoint Security<sup>2</sup> providing an end-to-end solution for data-in-flight protection.
- Secure Execution for Linux providing a Trusted Execution Environment (TEE).

### The cloud you need

*“We provide innovative, cloud-based banking solutions to enable our clients to provide banking products over great distances straight to customers' mobiles and devices, enabling more citizens to gain access to financial services.”*

IBM Z is designed to be an integral part of your cloud. With Linux on IBM Z you can transform your IT environment into a cloud with industry-leading levels of data privacy, security and resiliency.

Building new cloud-native applications and modernizing existing applications to support cloud environments need to be done in an open, portable manner that helps clients improve time to value.

With Red Hat OpenShift Container Platform for IBM Z, the agile cloud-native world of containers and Kubernetes is reinforced by the security features, scalability and reliability of IBM's Z servers. Red Hat OpenShift brings together the core open source technologies of Linux, containers and Kubernetes, adds more open source capabilities such developer tools and a registry, and hardens, tests and optimizes the software for enterprise production use.

Red Hat OpenShift supports cloud-native applications being “built once and deployed anywhere”.

With IBM Cloud Paks, developers, data managers and administrators have an open environment to quickly build new cloud-native applications, modernize and extend existing applications, and deploy middleware in a consistent manner across multiple clouds. Cloud Paks are enterprise-ready solutions that include containerized IBM middleware and common software services for development and management. The run wherever Red Hat OpenShift runs and are optimized for productivity and performance.

The open Linux environment on IBM Z supports additional container technologies and DevOps-related tooling like IBM UrbanCode® and enterprise-level support for Java, Node.js, Spring, and other runtime environments.

## Securing the enterprise

*“A key word we associate with IBM, and with IBM Z solutions in particular, is trust. The sophisticated encryption enabled by IBM technology puts our—and our customers’—minds at rest, knowing that their data is well protected.”*

The new IBM Data Privacy Passports offering, in conjunction with the z15, is the industry's first commercial data privacy and security enforcement solution with off-platform access revocation. You can choose who accesses data, and when and at what level to revoke their access. Data Privacy Passports is designed to protect your enterprise and your ecosystem's data, regardless of data source, at-rest and in-flight with no performance trade offs or application changes.

Secure Execution for Linux is a Trusted Execution Environment (TEE) on IBM Z designed to deliver better security at greater scale than alternative offerings. It enables workloads to run in full isolation with protection from both internal and external threats across a hybrid cloud, ensuring the integrity of each application and its data. It is supported for KVM based virtual machines, hosting a supported Linux distribution. As well, the Secure Execution for Linux technology is leveraged by IBM Hyper Protect Virtual Servers on IBM Z.

Pervasive encryption is enabled with Linux on IBM z15 and IBM z14<sup>®</sup> servers. It is transparent to existing applications and designed to improve the usability and performance of encrypting/decrypting, leveraging the continuously improved on-processor cryptography and the Crypto Express accelerators. The concept with Linux on Z is providing differentiation without being different—this is accomplished by integrating the exploitation of IBM Z encryption hardware capabilities into strategic components of the stack. The existing encryption approach keeps the same, easily consumable data protection for data in-flight and data at-rest.

‘Protected key’ encryption can provide enhanced security with Linux for data at-rest supported with the standard LUKS2<sup>3</sup> format. The protected key is a wrapped key, similar to a secure key, but providing faster encryption operations. Protected key encryption can be used to encrypt complete disks or just selected partitions. Protected key encryption is a unique IBM Z capability.

To meet regulatory and auditing needs, the IBM RACF<sup>®</sup> Security Server for z/VM provides a security system that includes access control and auditing functionality, handles resource authorization, privileged command access, and logon controls.

It is important to mention that IBM Z is the world’s only server with the high level EAL5+ hardware security certification. It guarantees that the IBM Z principal security features are reliably applied, allowing for isolation and protection of the deployed workloads, while the isolation capability inside the server offers significant operational simplicity.

## Scalable and flexible

*“With the IBM Z, we can take on more customers and still offer the same great levels of service. It’s easy to expand the IBM Z environment as and when we want, giving us the flexibility to act fast on growth opportunities.”*

The high workload density, with up to thousands of virtual Linux servers on a z15, usually means fewer components, lower management effort, and fewer software licenses compared to competitive platforms. As well, IBM Z servers provide the ability to grow inside an existing server, simply by adding system resources. Hence, Linux on IBM Z can grow ‘on-demand’—on the fly—without affecting the existing business.

Impressive scalability—horizontal and vertical—is provided with the IBM Z capabilities in combination with virtualization technologies. Resources can be prioritized dynamically and efficiently between workloads, delivering them whenever and wherever they are needed.

z/VM virtualization technology offers deep integration with IBM Z, allowing for high levels of resource sharing, data-in-memory techniques, outstanding I/O bandwidth, availability, and security. Simple administration is provided with IBM Wave for z/VM, and IBM Cloud Infrastructure Center provides simplified infrastructure management for compute, network, and storage resources, and cloud deployments for z/VM-based Linux virtual machines.

KVM virtualization enables the use of Linux administration skills on IBM Z. KVM is delivered with the Linux distributions for IBM Z, and is optimized to benefit from the IBM Z capabilities.

IBM Dynamic Partition Manager provides a simplified configuration for Linux servers, allowing for a quick and easy adoption of Linux on Z, z/VM, and KVM.

IBM Z technologies are designed to support high efficiency. One example, the new compression acceleration on each z15 processor chip (the Integrated Accelerator for z Enterprise Data Compression), can enable the reduction in the size of data to save storage space and also increase data transfer rates.

IBM Z allows for fast internal communication and with Shared Memory Communication (SMC) between Linux and z/OS, you can get even faster performance while saving compute resources.

Co-locating data and applications on IBM Z also supports efficiency, providing data serving with low latency, eliminating network handling, and centralizing system administration.

## Highly resilient and trustworthy

*“The reliability of IBM Z is outstanding—in the 20 years I’ve worked with the IBM Z platform, we’ve never experienced an hour of unplanned downtime.”*

The IBM Z enterprise platform is designed for resiliency, meaning the ability to adapt to planned or unplanned events while keeping services and operations running. IBM Z servers help to avoid or recover from failures to minimize business disruptions, realized through component reliability, redundancy and features that assist in providing fault avoidance and tolerance, as well as permitting concurrent maintenance and repair.

Further strengthening resilience of the Linux and cloud workloads, are solutions such as:

- Live Guest Relocation, enabled with the z/VM SSI feature, allowing for the non-disruptive move of running virtual Linux servers from one member of a cluster to another.
- IBM GDPS can provide multi-platform resiliency for Linux servers. It allows for disaster and failure recovery and ensures data consistency across multiple sites. When running GDPS with z/OS, you can benefit from a single point of control for the z/OS and Linux environments.
- IBM Spectrum Scale is designed to provide high availability through advanced clustering technologies, dynamic file system management and data replication.

Unlike with distributed systems or public clouds—resilience, availability and failover capabilities can be expected for Linux on IBM Z.

## Business Integration and Co-location

*“Running traditional mainframe applications on z/OS side-by-side with Linux on one IBM Z server has given us the operational flexibility on IBM Z to gradually modernize our clients' applications and embrace cutting-edge enterprise software, while still leveraging our extensive experience with the trusted and highly reliable IBM platform.”*

Business integration can help develop new services faster, by extending existing assets and reducing complexities. Business integration is characterized by enabling flexibility through the integration of systems, data, applications, and processes across and beyond the enterprise.

IBM Z integration capabilities are designed to provide extremely high speed and security-rich connections between applications and data inside and across servers. Technologies such as Shared Memory Communication further improve latency and throughput.

With IBM Cloud Paks, based on Red Hat OpenShift, developers and administrators have an open environment to quickly build new cloud-native applications, modernize and extend existing applications, and deploy middleware in a consistent manner across multiple clouds.

With IBM z/OS Cloud Broker, z/OS-based services can be integrated into the private cloud for a modern cloud native experience, providing access to z/OS services for consumption by a broader development community. z/OS Cloud Broker enables organizations to protect and leverage their IBM Z investments through integration with their hybrid multicloud.

Many Linux on IBM Z clients are investing in next generation applications, integrating them and thus expanding existing services. A few examples:

- Cloud computing: using IBM Cloud Paks or other container technologies for developing and managing on-premises containerized applications across the enterprise,
- DevOps: IBM Cloud Paks and Red Hat OpenShift provide access to a collection of tools, helping drive modernization efforts by leveraging DevOps-related tooling like IBM UrbanCode and enterprise-level support for Java, Node.js, Spring, and other runtime environments,
- Data serving: using IBM Db2<sup>®</sup> Warehouse, as well as databases from vendors and open source, like Oracle Database, Mongo DB or PostgreSQL,
- Artificial Intelligence: using IBM Watson<sup>®</sup> Explorer, IBM Cognos<sup>®</sup>, IBM SPSS<sup>®</sup>, IBM Db2 Analytics Accelerator for z/OS, and open source products with Linux and z/OS workloads,
- Service integration: using IBM App Connect, IBM Integration Bus, or IBM MQ to connect different services, for example exploiting MQ for blockchain interactions to ensure data connection and provide enhanced end-to-end data encryption in-flight and at-rest,

- Application serving: using in-house and vendor applications, such as Temenos or SAP, connected to data bases running on Linux, or to Db2 for z/OS,
- Web services: using IBM WebSphere® for Java application serving, SWIFT for end-to-end development of next generation apps, Node.js to supplement existing functionality, or open source technologies.

Using the Linux on IBM Z can help you expand the capabilities and attractiveness of your services. Working in a hybrid cloud, you can also combine your on-premises cloud with the advantages of IBM Z's security services in the IBM Cloud.

## Efficient and Economical

*“The IBM Z server remains an excellent option to run our clients’ applications, because it offers outstanding performance and availability. Furthermore, IBM Z help us minimize administration costs compared to other platforms, so we can maintain a large environment with a remarkably small team.”*

Operational efficiency is supported by running up to thousands of virtual Linux servers on one IBM Z server, with outstanding scalability, horizontal and vertical, based on the immense total IBM Z capacity. Usually this results in less effort for maintenance and administration compared to other platforms and provides potential cost reduction in several areas.

The ability to add resources to an existing server on the fly, to share and reconfigure resources dynamically, and to run Linux side-by-side with other operating systems—benefiting thereby from unique arrangements for the system—also support operational efficiency.

With IBM Cloud Paks, Red Hat OpenShift, and the IBM DevOps software portfolio developers and administrators can deliver automation to develop, deploy, and manage cloud-native applications while utilizing the portability and agility through tight integration with tools and runtimes. In one IBM Z system, existing back-office data and applications are co-located and integrate with cloud native.

Taking these different aspects of running Linux and cloud on IBM Z into consideration, it seems obvious that they can also provide an economic advantage compared to other platforms.

The potential cost advantages are based on the high capacity of IBM Z servers that provides low cost per workload, the integrated IBM Z system design providing high performance and throughput per core, on-chip acceleration for encryption and data compression, centralized operation that enables less management and administration effort, and the proven security and continuity capabilities available with built-in features and proven high availability and disaster recovery solutions.

### ***Workloads that fit well***

*Workloads with per core pricing.* Linux workloads that have a software license price per processor (or socket) are strong candidates for deployment from a financial perspective. This is due to differences in centralized versus distributed server architecture such as processor speeds, with the result that distributed servers require more processor cores to run the same Linux workloads than on Z.

*Workloads with variable resource requirements.* Linux workloads with activity fluctuations are very well suited for Z. Centralized servers provide compute elasticity, or resource sharing, so that memory, CPU and I/O can be allocated to workloads with diverse timeline requirements over a 24-hour period.

*Workloads with I/O demands.* Most business workloads, for example databases, messaging, and stream processing workloads, tend to be I/O driven and can accelerate response times by leveraging FICON or the Fibre Channel Protocol (FCP) designed to enhance data transfer and to increase sustained CPU utilization through advanced workload management capabilities.

*Workloads with high availability requirements.* Workloads that require 24x7 availability are often placed on Z to leverage built-in redundancy and resiliency. Capacity Backup (CBU) for Z allows hardware engines to be used for disaster recovery without incurring additional software charges if the production server is temporarily unavailable. In the absence of a DR event, organizations are not charged for unused licenses in a non-production environment.

*Workloads with low latency and high transaction requirements.* Many IT organizations keep their system of record data on Z. If the data on z/OS would be used from applications on distributed servers, latency increases as the data is accessed by an off-platform environment. Overall application performance is reduced since the data must constantly access the system of record over TCP/IP. These applications are best collocated with the data on the same physical server as the system of record.

*Workloads with high security requirements.* Workloads that access sensitive data are typically placed on IBM Z to minimize the possibility of a security event. Z provides unique security benefits to lower the risk of a data or privacy breach.

*Workloads headed toward the cloud.* Both new cloud native and existing workloads targeted for modernization for the cloud are good fits for Z using IBM Cloud Paks.

**IBM Z is designed to provide a highly secure, resilient and efficient *Linux and cloud* environment, with containers and Kubernetes to build and modernize cloud services, with potential competitive advantages in operational efficiency and business economics, extreme scalability, high resource sharing and utilization, encryption enablement, data privacy and server isolation, continuous operations and cyber resiliency.**

## Why IBM?

As you transform your business and differentiate yourself in a trust economy, IBM remains your partner.

We have the total expertise in systems, software, delivery and financing to help you create a secure, open and intelligent foundation for the future.

Our experts can help you configure, design and implement Linux on IBM Z, not only as your on-premises cloud, but always optimized for your needs.

## For more information

To learn more about Linux on IBM Z, please contact your IBM representative or IBM Business Partner, or visit:

[ibm.com/it-infrastructure/z/linux](https://ibm.com/it-infrastructure/z/linux)

<sup>1</sup> Compared to IBM z14 with some variation based on workload and configuration

<sup>2</sup> Available with z15 Model T01. IBM is working with its Linux distribution partners to get the functionality included in the Linux distributions for IBM Z

<sup>3</sup> LUKS2 = Linux Unified Key Setup version 2 for disk encryption management

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