# Linux on IBM Z

## Efficient and trustworthy

- Efficient and economically
- Resilient and trustworthy
- Scalable and flexible
- Secure and open

## Linux at its best

Linux is mainstream—using open-source solutions is a smart way to run your cloud.

Linux on IBM Z® provides an impressive Linux platform for your on-premises cloud infrastructure, especially for workloads that require high levels of resilience, availability and security.

Linux on IBM Z is the same Linux as on other architectures, however, it is optimized to leverage the strengths and capabilities of the outstanding IBM Z technology, such as *unparalleled resiliency, comprehensive data protection, high utilization and extreme scalability.*

Security, trust, failover, compliance, accessibility and flexibility are topics that are evaluated to decide where to deploy your Linux solutions and cloud infrastructure, cost effectiveness is another—*Linux on IBM Z is the choice to meet these criteria.*

Linux can run in a highly virtualized cloud environment, able to leverage IBM® z/VM®, KVM or LPAR virtualization, as well as IBM Cloud Paks™ and Red Hat OpenShift, for which IBM[1] announced plans to bring them to IBM Z.

Running Linux on IBM Z provides not only an impressive on-premises cloud infrastructure, it also allows for tight integration with IBM z/OS®, IBM z/VSE®, or IBM z/TPF workloads. *Co-locating workloads on IBM Z can benefit from great performance and operational efficiency.*

Linux on IBM Z is Linux and can run all kind of solutions, *providing a great platform for cloud native applications.*

The IBM Z enterprise platform is designed to provide a highly secure, resilient and efficient Linux infrastructure for your on-premises cloud environment, with competitive advantages in terms of extreme scalability with high resource sharing and utilization, high resiliency and continuous operations, pervasive encryption enablement and server isolation with EAL5+ certification, and operational efficiency and business economics.

*Linux on IBM Z benefits from the IBM Z technology advantages transparently, providing a great infrastructure to meet demands in the hybrid cloud world.*

## Linux on IBM z15™ (z15)

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

- New consolidation opportunities with up to 25%[2] increased total capacity in a single footprint, with up to 190 processors and up to 40 TB Redundant Array of Independent Memory (RAIM).

- Enlarged on-chip cache per core[2] to help minimize memory waits while maximizing the throughput.

- Enhanced economies of scale with approximately 14%[2] improved single processor capacity.

- High-speed connectivity with new FICON® Express16SA and new OSA-Express7S features.

- New on-chip accelerated file compression enabled for all Linux workloads.

- Faster IBM GDPS® reconfiguration for automated startup and shutdown.

- Standardized 19-inch frame, one to four frames, to optimize cost, density and flexibility.

- Simple and consumable experience with IBM Dynamic Partition Manager extensions.

- IBM Z Data Privacy Passports, in conjunction with z15 and available via a z15 only software product, extending data protection throughout the enterprise.

- Stronger and faster data protection, for example, enabled by new on-chip cryptography capabilities and new Crypto Express7S adapter.

- In the future IBM intends[3] to provide Fibre Channel Endpoint Security to extend pervasive encryption on IBM Z.

*Penguins looking interested at new IBM z15 and IBM z14® models*

## Linux and Cloud infrastructure efficiency

The high workload density, with up to thousands of virtual Linux servers in a few square meters footprint of z15, usually means fewer components, less management efforts, less software licenses compared to competitive platforms. As well, benefiting from the IBM Z ability to grow by simply adding system resources into the existing server, on the fly—without affecting the business, Linux on IBM Z can grow 'on-demand'.

With Linux on IBM Z you can transform your IBM Z and Linux environments into a secure, private on-premises cloud environment. Integrating DevOps capabilities with cloud optimized software, allowing your teams to take advantage of IBM software via containers and microservices. In addition, through IBM's public cloud, you may take advantage of IBM Z's security services as part of your hybrid cloud.

Containers can be deployed via IBM Cloud Pak for Applications[4], IBM Private Cloud, Docker, and other container technologies. IBM announced plans[1] to bring Red Hat OpenShift and IBM Cloud Paks to the IBM Z enterprise platforms. IBM's goal for Red Hat OpenShift for IBM Z will be to help clients enable greater agility and portability through integrated tooling and a feature-rich ecosystem for cloud-native development.

Impressive scalability—horizontal and vertical—is provided with the IBM Z capabilities in combination with the virtualization technologies. Resources can be assigned dynamically and efficiently between workloads, 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, security, and a simple administration, provided with IBM Wave for z/VM.

KVM virtualization enables the use of Linux administration skills on IBM Z. KVM is delivered with the Linux distributions for IBM Z, and 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, z/VM Single System Image (SSI) feature supports simple systems management, non-disruptive maintenance, and concurrent support for virtual machines. Another example, the new compression acceleration on each z15 processor chip, 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 between Linux and z/OS, you can get even faster performance while saving compute power.

Co-locating data and applications on IBM Z also supports efficiency, allowing for data serving with minimal latency, elimination of network handling, and centralized management.

Bottom-line, Linux on IBM Z can provide a highly efficient on-premises cloud infrastructure as part of your open hybrid multicloud platform with common services, and multi-cluster management at its core.

## Highly resilient and trustworthy

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 infrastructure, are solutions such as:

- Live Guest Relocation, enabled with the z/VM SSI feature, allowing for the non-disruptive move of virtual Linux servers from one member of a cluster to another member.

- 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.

## Secure enterprise

Pervasive encryption is enabled with Linux on IBM z15 and IBM z14 servers. Pervasive encryption with Linux is transparent to existing applications and designed to improve the usability and performance of encrypting/decrypting, leveraging the on-processor cryptography[5] and the Crypto Express accelerators.

Encryption with Linux allows for simple implementation and optimized performance. Clients don't have to change their encryption approach, they simply get consumable data protection for data in-flight and data at-rest. 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.

'Protected key' encryption can provide enhanced security with Linux for data at-rest supported with the standard LUKS2[6] format. The protected key is a wrapped key, similar a secure key, but providing faster encryption operations. 'Protected key' encryption is a unique IBM Z capability. 'Protected key' encryption can be used to encrypt complete disks or selected partitions.

The new IBM Z Data Privacy Passports offering, in conjunction with the z15 and available via a z15 only software product, is designed to enforce security and privacy protection of data across an organization's multi-platform environment. The solution allows z15 to enable data protection that can span hybrid and multi-party computing environments.

To meet regulatory and auditing needs, the IBM RACF® (Resource Access Control Facility) 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.

With IBM Secure Boot for Linux, you will be able to validate that only signed Linux versions can boot, thus adding additional protection to the system and ensuring Common Criteria compliance.

Remains to mention, IBM Z are the world's only servers 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.

# Business Integration and Co-location

Business integration can help on developing 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, and technologies such as Shared Memory Communication further improve latency and throughput.

With microservices and standard APIs, existing assets can be used in new ways, delivering into next generation application services. Standard APIs ease the creation and microservices offer the architectural style to create independently deployable units for agility and scalability.

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[1] and Red Hat OpenShift[1], IBM Cloud Privat or other container technologies for developing and managing on-premises containerized applications across the enterprise,

- DevOps: using Linux for languages and practices that are used everywhere, allows for a cloud-based development with things such as Git as well,

- Data serving: using IBM Db2® Warehouse for instant insights, as well as databases from vendors and open source, like Oracle Database, Mongo DB or PostgeSQL,

- Cognitive computing: using IBM Watson® Explorer, IBM Cognos®, IBM SPSS®, IBM Db2 Analytics Accelerator for z/OS, and open source products with Linux and z/OS workloads,

- Service integration: using IBM Integration Bus or IBM MQ to connect different services. Using MQ for blockchain interactions for example, ensuring data connection and providing 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 the data bases 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 to expand the capabilities and attractiveness of your services, while benefiting from the resilient and highly secure cloud infrastructure on IBM Z.

# Economic Linux and Cloud infrastructure

Using Linux on IBM Z as your Linux and on-premises cloud infrastructure can provide enormous benefits in:

## Operational efficiency

*"We can demonstrate our customers our capability to modernize and innovate in new technologies while providing them with a very modern and cost-effective infrastructure, a key competitive differentiator."*

Running up to thousands of virtual Linux servers on one IBM Z server requires fewer servers, cables, routers, etc., usually results in less effort for systems, maintenance and administration. Linux on Z can support the consolidation of multiple cores from competitive platforms onto a single IBM Z core, which often results in a dramatic cost reduction since software licensing costs for Linux are usually priced per core. Administrator efficiency is supported with the abilities to add resources into an existing server on the fly, to share and reconfigure resources dynamically, and to run Linux side-by-side with other operating systems—benefiting from unique arrangements for operation, even in environments running multiple and different workloads on different operating systems. Mostly underestimated when using public clouds are the costs, which are almost predictable running your cloud infrastructure on Linux on IBM Z.

*"Because we run everything on an IBM Z server, we can easily take on additional workload and scale up as needed without an increase in complexity."*

## Resiliency and business continuity

*"The simplicity and reliability of the IBM Z platform confirm time after time that it is the right choice for us. IBM Z enables us to provide fast, efficient, first-class service for clerks to let them get on with their tasks without interruption, to the benefit of citizens."*

Linux on IBM Z provides trusted operations; it can scale up and out to meet spikes in server activity, potentially devastating system crashes. The suite of IBM Z built-in features can rapidly respond to, or even anticipate, threats to system health—thus helping to prevent costly downtime. IBM Z can dynamically respond to workload increases while meeting service requirements. Businesses of any size can realize the benefits of shared-everything scalability, capacity on demand, and flexibility across internal, external, and microservices platforms. As well, high availability and disaster recovery solutions are available.

*"IBM Z platform is very cost-effective and delivers exceptional reliability, availability and serviceability levels helping us improve the quality of service we deliver to our clients."*

## Business integration and co-location

*"The ability to run our legacy applications and our modern, specialist ones using both the IBM z/OS and Linux on Z is super convenient, and gives us a high degree of IT management flexibility."*

IBM Z enables business integration and co-location to reduce complexities, extend services and deploy next generation apps very fast. Co-locating applications and data on IBM Z—running on Linux, z/OS, z/VSE or z/TPF—provide not only the unique opportunity to tightly connect 'systems of records' and 'systems of interaction', it also allows to build and integrate cloud native applications with existing applications. Integrating your services on IBM Z can benefit from faster time-to-market, high performance and operational efficiency.

*"Running applications on z/OS side-by-side with Linux on one IBM Z server has given us the operational flexibility to gradually modernize our applications, while still leveraging our extensive experience with the trusted and highly reliable IBM platform. This cost-efficient path for a digital transformation has enabled us to reinvent our business model, transitioning from a mainframe shop to an innovative, forward-looking full-service provider."*

## Secure the enterprise

*"Our customers trust us to protect their personal data. It is critical that we achieve a smooth transition to any new IT solutions and that we continue to keep our systems very secure."*

Consumable data protection is possible with Linux on IBM Z for data in-flight and data at-rest. Pervasive encryption is enabled via the on-chip cryptography and the Crypto Express adaptors. 'Protected key' encryption, unique to IBM Z servers, is using the on-chip cryptography—thus it is very fast. IBM Z Data Privacy Passports protects data not only on IBM Z, but across hybrid- and multi-cloud environments. Access control and auditing functionality is provided with RACF Security Server for z/VM, or other security servers, and IBM Z are the world's only servers with EAL5+ hardware certification—it comes with the server, without additional investment. Bottom-line, IBM Z is the most securable commercial server.

*"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."*

**IBM Z provides an efficient and trustworthy Linux, and on-premises cloud infrastructure — the cloud for critical workloads that integrates seamlessly into your hybrid multicloud.**

## 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 a Linux on IBM z15, not only as your on-premises cloud infrastructure, 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

[1] *Please see: ibm.co/2OAtVkO*

[2] *Compared to IBM z14 with some variation based on workload and configuration*

[3] *Statements by IBM regarding its plans, directions, and intent are subject to change or withdrawal without notice at the sole discretion of IBM. Information regarding potential future products is intended to outline general product direction and should not relied on in making a purchasing decision.*

[4] *Please check the level of support available for each version of IBM Cloud Pak for Applications*

[5] *CPACF = Central Processor Assist Crypto Functions*

[6] *LUKS2 = Linux Unified Key Setup version 2 for disk encryption management*