Linux on System z: An Ideal Platform to Migrate Your IT Workload

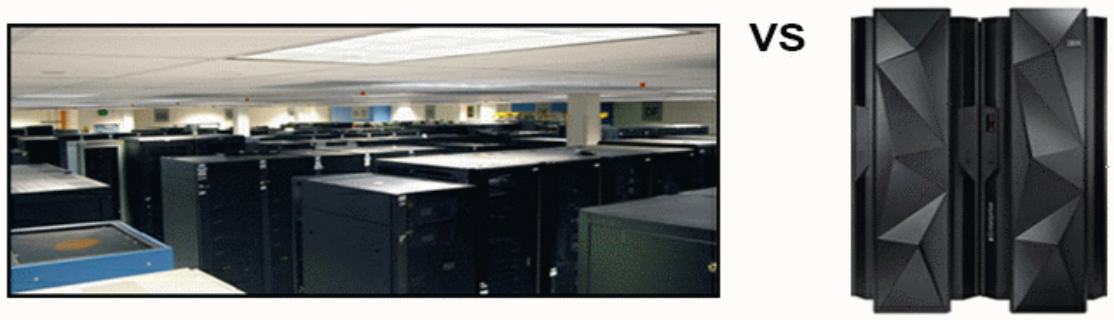
IBM Redbooks Solution Guide

IBM System z® provides a virtualized Linux infrastructure with the power and flexibility you need for your Linux workload. It is a proven Linux platform for new workload deployment and consolidation.

Linux on IBM System z is designed from the ground up for enterprise class workloads. It can help with lower software license costs, secure data from threats, and help to use fewer environmental resources. You can share system resources at extreme levels of utilization and provision flexible IT services, with load-balancing and efficient systems management to help you achieve superb levels of service and improved operational simplicity.

IBM System z can provide significant advantages over other Linux platforms, and provide benefit from its simplicity, trusted operations, and unrivaled economics. The IBM Linux-ready IT infrastructure solution combines the IBM System z server, IBM z/VM virtualization technologies, the empowering virtualization management of the new IBM Wave for z/VM (IBM Wave) and Enterprise Cloud Computing with IBM SmartCloud® and Cloud Management Suite for System z.

With this infrastructure, you can start small and grow within the server, deploy various workloads, consolidate servers, and implement cloud services that can rapidly deploy a trusted, scalable, and OpenStack-based Linux cloud environment with mainframe qualities of service.



The following topics in this solution offer guidance in selecting and migrating x86 Linux workloads and applications to Linux on System z servers to help business or technical decision makers understand the requirements to migrate to Linux on System z.

- Why you should migrate from the x86 platform
- Operating system migration
- Database and application server migration
- Example migration scenarios

In this solution, we consider selecting workloads from three separate x86 servers. Figure 1 shows our source environment has a Linux A server, which is a virtualized image on an x86 server with 4 Gb RAM, two-CPU, 6 Gb disk. The operating system is SUSE Linux Enterprise Server v11 SP3 with IBM HTTP

Server v7 installed. Linux B server is a virtualized image also on an x86 server with 4Gb RAM, two-CPU, 6 Gb disk. Its operating system is Red Hat Enterprise Linux 6 with the IBM WebSphere Application Server installed. Linux C server is a virtualized image on another x86 server with 4Gb RAM, 2 CPU and 6Gb disk. It's operating system is SLES 11 SP3 and has IBM DB2 v10.5 installed.

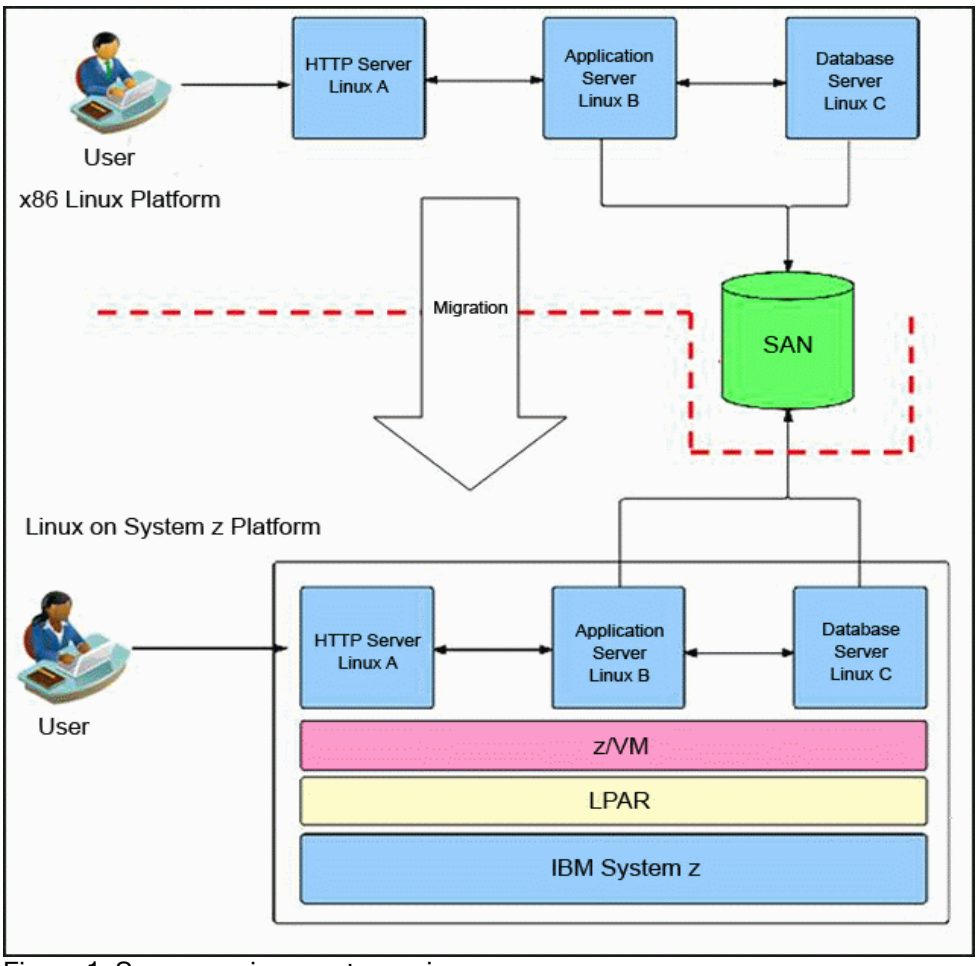


Figure 1. Source environment overview

Our target platform is an IBM System z10™ Enterprise Class (z10 EC) Model 2097 and an IBM zEnterprise EC12 (zEC12) model 2827. IBM z/VM 6.3 64-bit architecture is installed and is managed by IBM Wave for z/VM v.1.1. The operating system for virtual guests is SLES 11 SP3 64-bit and RHEL 6.4 64-bit. Each Linux guest is configured with one virtual CPU and 1 GB memory. For the network, we used a virtual switch named VSWITCH1.

Did you know?

Linux on System z can deliver new levels of integration and can manage all varieties of workload, from heightened security requirements to the deployment of standard infrastructure experience.

Because of the speed to market, and the complexity and variety of users, devices, data, and transaction types, organizations need to run quality infrastructure and applications at enterprise scale in a flexible and iterative approach. This situation is as much an operational challenge as a technological challenge. The Linux on System z platform supports the open approach for platform demands, and technology platforms model that is designed by high capacity, quick deployment, and high workload capabilities.

There are technological advantages of running Linux environment on the System z platform side by side with the core IBM CICS® transactions. You can take advantage of highly virtualized System z internal networks that provide a large amount of bandwidth and that enable scalability and flexibility with continuous operation.

- Linux on System z provides operational simplicity through its advanced virtualization technology, automation features and highly scalable server capacities.
- Linux on System z provides trust through unique leading integrated virtualization and server technologies and proven security and availability leadership.
- The unique and simple design of Linux on System z can dramatically reduce overall IT costs compared to distributed IT environments and public cloud providers.
- Linux on System z is cloud-ready. IBM SmartCloud Entry is a simple, entry-level cloud management stack that can be used as a turnkey solution based on OpenStack and z/VM 6.3 and includes Extreme Cloud Administration Toolkit (xCAT) to help you set up a rudimentary cloud environment, without acquiring an additional product.

Business value

What does this solution bring to your business? In this section, the three major points that add value are described.

Data Center simplicity

The more components an IT environments has (servers, cables, switches, routers), the more difficult managing, identifying potential problems, and ensuring compliance become. IT complexity can drain budgets and hinder a company's ability to maximize the business value of its IT investment. For this reason, Linux on System z was designed specifically to maximize resource utilization, minimize energy consumption, simplify virtualization management, and provide an economically attractive alternative to IT complexity. The more servers you have, the more difficult managing your IT environment, identifying problems, and ensuring compliance becomes. For that reason, Linux on System z was designed to pack more workloads into a single server, minimizing complexity.

- Run more virtual machines per core than x86 or RISC servers, up to 60 on a single 5.5 GHz core.
- Unique consolidated design improves virtualization management, maximizes resource utilization, and minimizes energy and space requirements.
- Auto discovery of resources and automatic accommodation of system wide changes provides single point of control to ensure uniform standards and compliance.
- The ability to run different workloads in parallel with fewer cores is highly effective and efficient in operation.

Linux on System z offers server provisioning in minutes, solid workload isolation, extensive virtualization management features, the ability to share and over-commit system resources and cost-attractive business resilience and failover solutions you need to meet your client expectations for unlimited access to existing and new services. Consolidation of smaller physical servers means fewer components, which results in less complexity, less management time, fewer licensing requirements, and less expenditure. Because Linux on System z provides a centralized environment, it is much more economical and resourceful compared with other server systems. Linux on System z simplifies operations, drives productivity, reduces dependency on scarce technical skills, and can help simplify the first steps in virtualization that are typically needed for the transformation into private cloud environments.

Trusted operation

Trust and dependability are the foundations of any successful enterprise. To succeed, you need an IT infrastructure that is available, secure, and flexible enough to meet your changing needs.

- Linux on System z is based on award-winning IBM zEnterprise server technology, which is widely considered the most available and secure commercial server in the marketplace.
- It avoids or instantly recovers from failures for extremely high levels of business availability, even as a single-server instance.Also, highly advanced virtualization software allows for nondisruptive Live Guest Relocation, minimizing planned software and server outages.
- It provides impressive horizontal and vertical scalability. Its unique ability to virtualize and share all system resources (processors, communication, memory, storage, I/O, cryptographic features) provides advanced resource utilization and enables dynamic resource allocation with one point of control.
- Together with the advanced data-in-memory techniques, production system utilization rates of over 95% can be achieved and maintained.

You can assign your workload the capacity it needs today, enabling consolidation of workload into one large workload instance, which is split onto multiple servers. When the IT infrastructure needs to be expanded, the efficiency of the Enterprise Linux Server is demonstrated in particular. The infrastructure can grow inside the existing server by adding system resources as needed, without affecting the running environment. In addition, with the Capacity on Demand (CoD) capability, you can temporarily or permanently activate the inactive cores or memory units that are installed on your system. Linux on System z is the most secure commercial server available, built using new technology you can trust. Powerful encryption can ensure your data, and therefore your business, is protected around-the-clock. Its ability to isolate and protect each Linux environment allows running multiple Linux systems concurrently on the same server.

Unrivaled economics

The hidden costs of IT complexity are crippling the ability of IT organizations to innovate and drive new business services: 70% of today's IT budget is going toward day-to-day operations. Linux on System z can dramatically reduce IT costs in following areas:

- **Software acquisition and licenses costs :** A single core of Linux on System z can run a mass of virtual Linux applications. Running software on fewer cores can result in fewer licenses and support costs. Moreover, because software costs are the same for a low-used core or a well-used core, the high resource utilization also contributes to the software savings.
- **Floor space and energy costs :** Fewer servers and components can require less floor space and can mean savings in electricity and facility costs. Companies can reduce their carbon footprint by leveraging the energy-efficient, single server solution.
- **Operational management and maintenance costs :** Fewer servers means less server maintenance, fewer cables and switches, less effort. Physical and virtual resources can be dynamically shared and reconfigured, helping simplify the demands placed on your IT staff. Also, the centralized management can help reduce errors and minimize workload-balancing tasks.
- **Security and business continuity costs :** Linux on System z is based on the most secure commercial servers available; powerful encryption can ensure your business is protected around the clock. Also available are multiple disaster recovery (DR) solutions, such as copying volumes or mirroring disk volumes within one site or between two sites. Lifecycle management costs for a Linux on System z solution can be considerably less expensive than competitive system alternatives.

Solution overview

Migration from x86 Linux complexity might change by platform architecture and context of the migration. The Linux operating system is a more straightforward, well-known, and easy migration option for technical people; but, when you consider application, database, or middleware migration, you must also consider degrees of complexity, cost, and risk. The lab solution here contains a three-tier business application similar to what many enterprise customers have (the same solution architecture). The x86 platform uses Red Hat Enterprise Linux and the SUSE operating system, and a host web server, application server, and database server.

The main solution goal is to migrate all x86 environments on Linux on System z. That means the operating system, web server, application server, and database must migrate new platform architecture. Solution goals can be met by following inherent characteristics regarding new platform solution:

- It must be a virtualized environment to bring cost efficiency.
- It must be ready for Cloud.
- It must meet critical workload responsibility with more security, reliability, availability, and flexibility.
- It must support easy virtualization management.

Figure 1 shows an architectural overview for this solution. All server components at the top of the diagram can migrate to the Linux on System z environment. Although every migration has different characteristics, with this solution, we were able to quickly and flexibly migrate and deploy the operating system requirements on System z using IBM Wave for z/VM. We quickly and simply created new z/VM user IDs, did bare metal Linux installations, and created clone copies.

Solution architecture

The solution architecture that is outlined in this Solution Guide is only a small sample that demonstrates how an enterprise-level server can help your organization migrate your x86 Linux server workloads into a single Linux on System z. The Linux on System z platform can fulfill service level agreements and provide scalability, reliability, and end-to-end security.

We tested the System z hardware, zEC12, by using the Linux operating system and IBM Software. From this experience, we found that the hardware and operating system fit together and worked well for virtualized server requirements. In addition, the result of migrating the operating system was successful with the comprehensive functionality of IBM Wave for z/VM. IBM Wave for z/VM provides an easy-to-use z/VM and Linux system administration GUI. Deploying a new server complete with the operating system can be an easy and quick task.

Figure 2 illustrates the solution architecture; the numbers are steps that indicate how the solution components deploy and work together. These steps are only an overview of the platform migration method to help decision makers and project managers map the main project tasks and milestones.

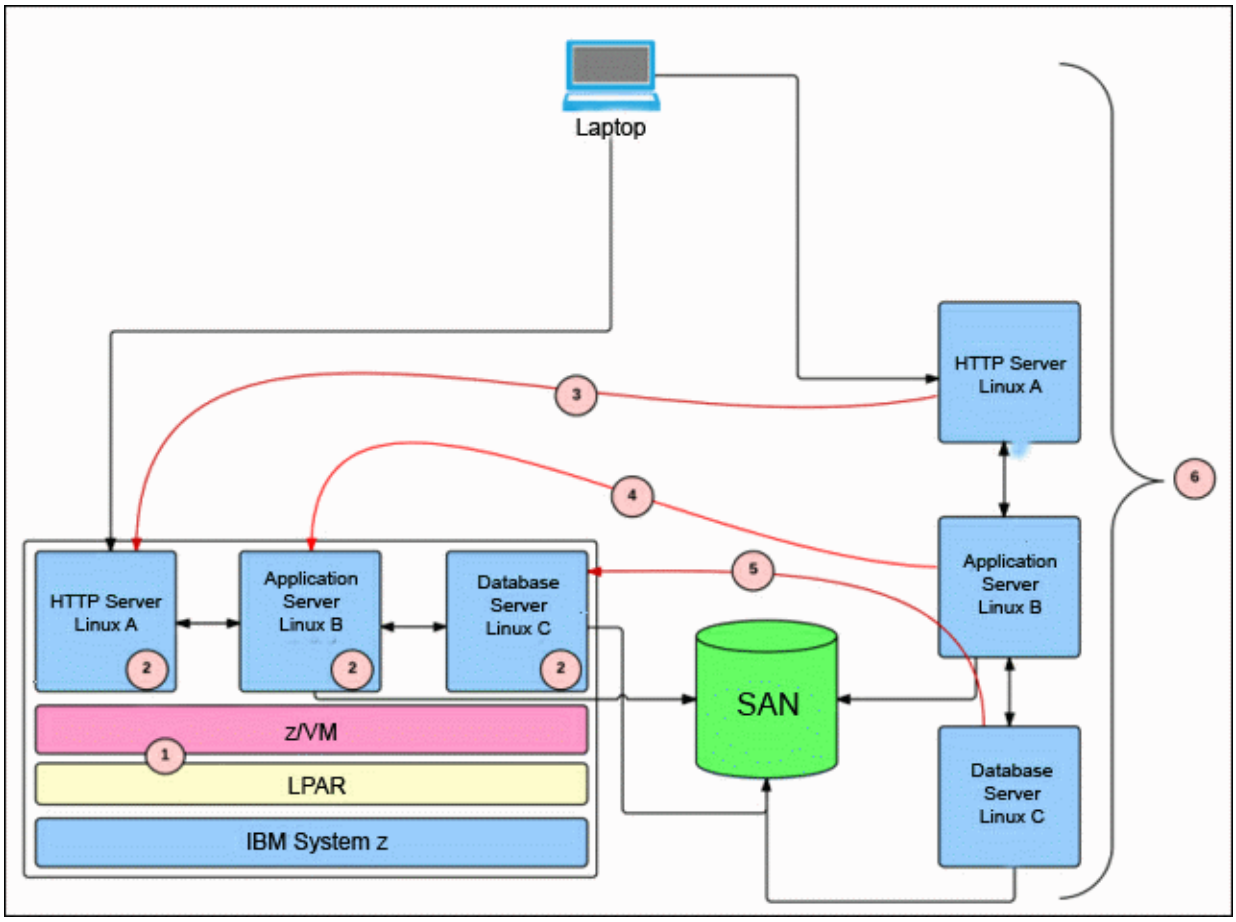


Figure 2. Linux on System z migration lab solution architecture

1. Prepare System z hardware: An important step in platform migration is planning the new platform's hardware resources.
2. Linux image preparation: Check the source operating system packages and prepare the new operating systems. This preparation means a one-time installation of each Linux on System z guest. If you use IBM Wave for z/VM, you are able to perform a bare metal installation of Linux on System z within 10 minutes. With IBM Wave, you are able to rapidly deploy multiple Linux guests with different operating systems and using different packages.
3. IBM HTTP Server migration: IBM HTTP Server running on Linux can be migrated to another Linux server by using only several steps. First, install a new IBM HTTP Server on the new server. Second, copy the `httpd.conf` file of the previous environment to the new one.Third, if they exist, copy any Secure Sockets Layer (SSL) certificates and the SSL key files to the new environment. Fourth, also, move any static web content inside the document root to the new server.
4. IBM WebSphere migration: IBM WebSphere Application Server environment migration also includes a new installation of the product on a new server. Then, you export existing applications and install then on the new server. The easiest way to transport configurations is to copy them manually. Although many tools are available for such migrations, editing the migration scripts can be more time-consuming for smaller environments. Basic configurations for a simple WebSphere Application Server environment are JVM arguments, JDBC providers, data sources, and authentication aliases.
5. IBM database server migration: We used IBM DB2 v10.5 on both the x86 and Linux on System z. We used one Linux on System z guest for each of our database servers. We used a combination of two DB2 utilities, **db2look** and **db2move**, and set the new paths to our external data drives within each

DB2 system on Linux on System z. Consult your user guides for migrating data for other database management systems.

6. Post-migration phase: After implementation and migration, you verify that the controlled migration is complete and works successfully.

Usage scenarios

The example scenarios here are from three industries: telecommunications (Telecom), healthcare, and energy and utilities.

Telecom industry: Consolidation and cloud

In this scenario, the fictional Telecom provider, *Fictional Telco Company T1*, selects the IBM System z platform for the company's Linux operating system consolidation and virtualization. Telco Company T1 wants to build a cloud platform but the company also wants to reduce its cost of operation and overall data center footprint. The company's strategy is to improve provisioning time for its business support system (BSS) and operational support system (OSS) to satisfy server requests of its users. In this example, the following technology can be employed:

- Consolidate hardware infrastructure:
  - IBM zEC12 or zBC12
  - IBM z/VM 6.3
  - Red Hat Enterprise Linux or SUSE Linux Enterprise Server on the System z platform
  - IBM protect TIER Gateway TS7680 – Deduplication and Virtual Tape Library
- Cloud:
  - IBM SmartCloud:
    - Automation with cloud: IBM Tivoli® System Automation
    - Automated provisioning: Tivoli Provisioning Manager
    - Service Lifecycle Management: IBM SmartCloud Control Desk
- Build monitoring and system management:
  - IBM Tivoli OMEGAMON® on z/VM and Linux: Information about your Linux instances running as z/VM guests and the Linux workloads reveal how they are performing and affecting z/VM and each other.
    - Compare Linux operations side by side with detailed performance metrics.
    - Data collection from the Performance Toolkit for VM (PTK is a prerequisite) complements data collection by the IBM Tivoli Monitoring for Linux for System z agent.
    - With new Dynamic Workspace Linking, you can easily navigate between Tivoli Enterprise Portal workspaces.
    - View and monitor workloads for virtual machines, groups, response times and LPAR reporting, and view reports about z/VM and Linux usage of resources such as CPU utilization, storage, mini-disk,s and TCP/IP.
    - High-level views help executives understand how systems performance influences business and the bottom line.
    - With granular views, IT staffs can more easily track complex problems that span multiple systems and platforms and share related information.

- IBM Wave for z/VM v1.1: IBM Wave is a new virtualization management product for z/VM® and Linux® virtual servers that uses visualization to dramatically automate and simplify administrative and management tasks.

  - Automate, simplify management and monitor virtual servers and resources, all from a single dashboard.
  - Perform complex virtualization tasks in a fraction of the time compared to manual execution.
  - Provision virtual resources (Servers, Network, Storage) to accelerate the transformation to cloud infrastructure.
  - Use advanced z/VM® management capabilities such as Live Guest Relocation with a few clicks.
  - Delegate responsibility and provide more self service capabilities to the appropriate teams.

Figure 3 shows the solution architecture overview for cloud solution on System z for Linux.

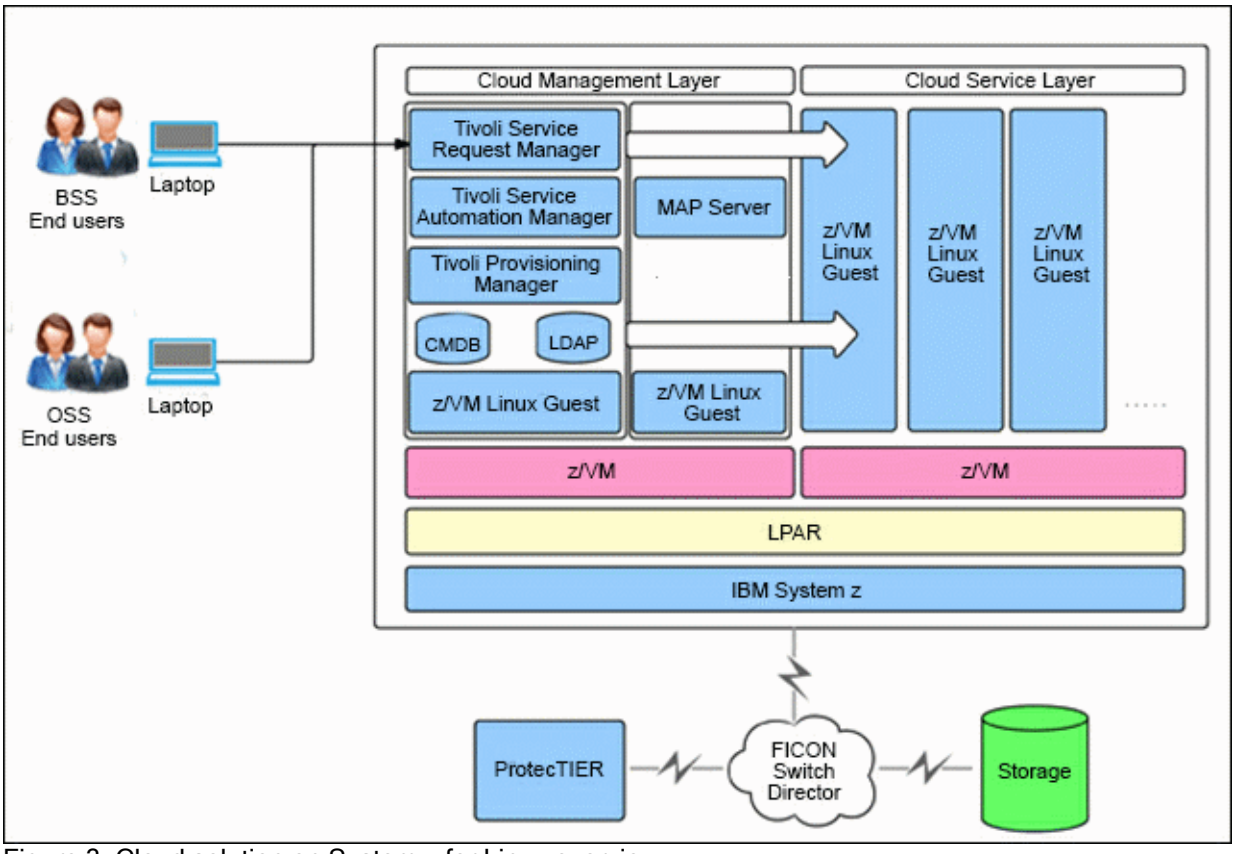


Figure 3. Cloud solution on System z for Linux overview

Healthcare industry: Mobile and Internet solution

In this scenario, the fictional healthcare company, *Fictional Hospital H1*, also chooses Linux on System z as its mobile application platform. Hospital H1 wants to build a secure platform, increase responsiveness and value perception, and reduce multi-platform development costs:

- Build a secure platform:
  - IBM Worklight® provides an extensible authentication model as part of its function. To comply with the Federal Information Processing Standards (FIPS), Hospital H1 uses Worklight with WebSphere Application Server for added protection. The hospital configures WebSphere Application Server to protect the application and adapters for the back-end servers and data.
  - Using Worklight, Hospital H1 can grant access to data on a role, time, and location basis. Doctors can access patient records on mobile devices. However, it requires extra authentication approval if they are at home or on call to review the latest observations of patients. In addition, although doctors have access to the information of their patients, medical suppliers have access to check inventory and update stock.
- Increase responsiveness and perceived value perception:
  - Hospital H1 is looking for a communication solution to find employees anywhere in the hospital. Using Worklight, the hospital can build an application that allows instant and secure communication. Doctors and nurses can quickly find colleagues without stopping what they are doing.
  - Doctors at Hospital H1 must input prescriptions when their mobile devices are not connected to the network. JSONStore, the document-oriented storage system in Worklight, uses an encrypted container and ensures that the documents in the application are always available to doctors even when the devices running the application are offline.
  - With the application, patients can pre-register for appointments and input their allergies and health history by using mobile devices. Worklight uses Secure Sockets Layer with server identity verification and enables communication over HTTPS to protect the information.
- Reduce multi-platform development costs:
  - Worklight provides a standards-based platform and allows Hospital H1 to use third-party libraries and frameworks.
  - Using Worklight, Hospital H1 can also create mobile applications quickly by using any combination of HTML5, native, and hybrid development methods.

Figure 4 shows the secured access from a mobile device to a back-end transactional core system on the Linux on System z platform by using the global security policies and end-to-end secure transactions.

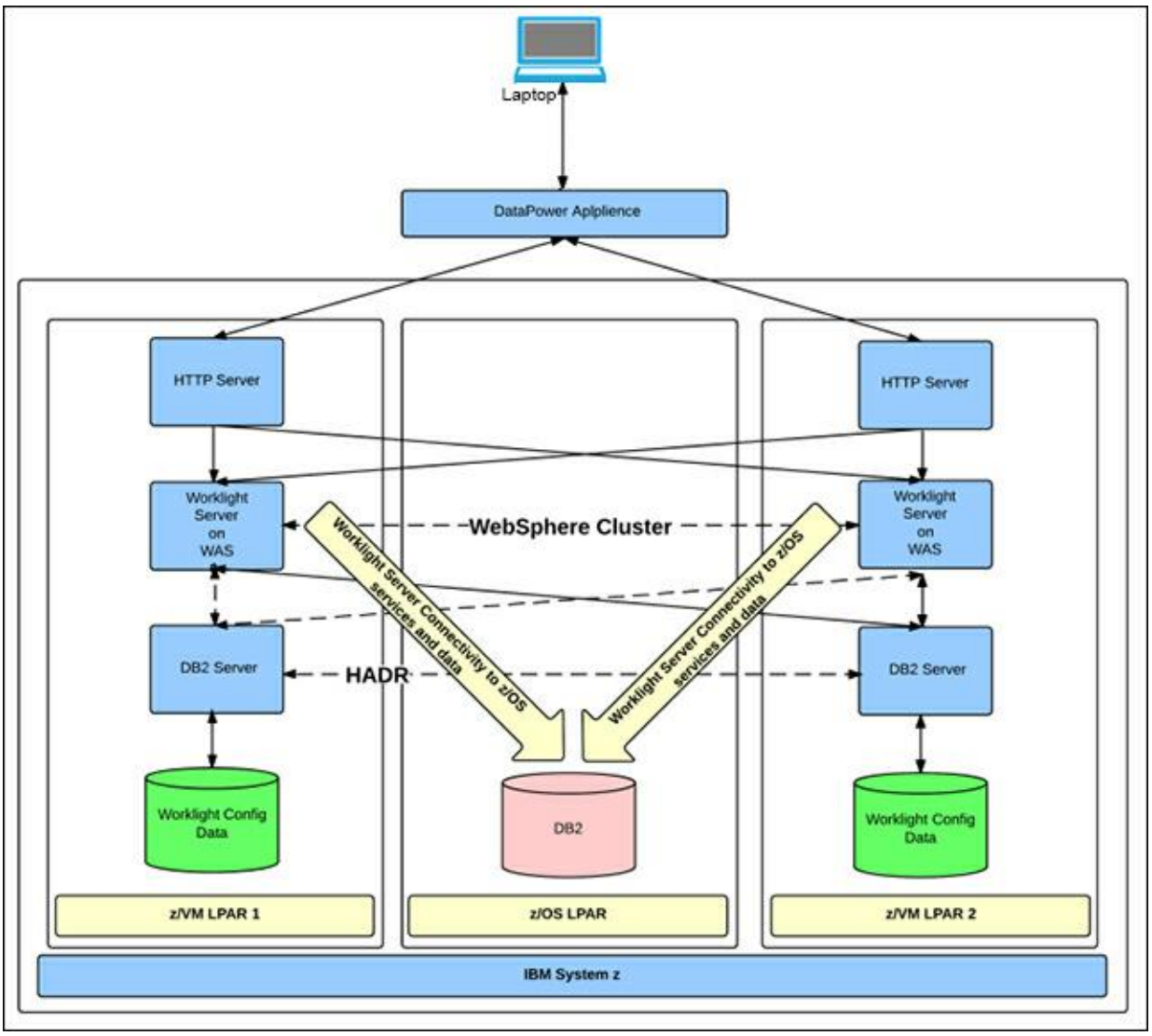


Figure 4. Access from a mobile device to a back-end transactional core system

Energy and utilities industry : SAP Cloud and Automation solution on System z

In this scenario, the fictional energy and utilities company, *Fictional Energy E1*, also chooses System z platform as its SAP application running on Linux and database on IBM z/OS®. Energy E1 wants to reduce the time spent to copy and refresh complete SAP systems from days to hours with a cloud solution and SAP system automation, which can automate, standardize, and increase the speed of day-to-day operations for SAP systems, reducing the risk of mistakes caused by human error. The company wants to reduce time spent on complex, repetitive tasks, freeing up skilled staff for higher value work and deliver higher operational efficiency, helping to slash costs and accelerate the time-to-value ratio for new workloads.

- Build a virtual platform:
  - IBM zEC12 or zBC12
  - IBM z/VM 6.3
  - Red Hat Enterprise Linux or SUSE Linux Enterprise Server on System z platform
  - IBM DB2® for z/OS®
  - IBM Database Provisioning System (DPS)
    - Web application JCL Engine
    - Database Management
    - Integrated with DB2 Cloning Tool
  - IBM DB2 Cloning Tool for z/OS: The DB2 Cloning Tool automates the cloning process to provide usable DB2 clones within minutes, boosting efficiency and freeing up DBA time.
    - Quickly clones DB2 subsystems, DB2 table spaces, or index spaces to create up-to-date test environments.
    - Automates the cloning process to provide usable DB2 clones within minutes.
    - Clones a DB2 subsystem by renaming and cataloging the data sets, fixing the volume internals, and updating the DB2 internal control information.
    - Fast copy technology quickly copies DB2 data sets within a subsystem or to a different subsystem.
    - Automates the cloning process using any volume level technology, such as IBM FlashCopy®, to clone DB2 subsystems and any data set copy technology, such as FlashCopy, to clone table and index spaces and automatically translates the object IDs to simplify and automate the refresh of data
  - SAP NetWeaver Landscape Virtualization Management (LVM): By streamlining and automating critical business processes, SAP NetWeaver Landscape Virtualization Management software enables your IT department to focus on responding to new initiatives, controlling IT costs, and differentiating your business.
    - Manage your SAP landscape in physical and virtualized environments.
    - Central management point for your SAP landscape, start/stop, and mass operations.
    - Automate standard, day-to-day administrative and lifecycle management tasks.
    - Save time, effort, and money by automating copy, clone and refresh.
- Build IBM Entry Cloud Solution for SAP with automated lifecycle management operations:
  - SAP System Clone: Provision a fresh SAP system based on a new system copy.
  - SAP System Copy: Create a customized SAP system based on existing system.
  - SAP System Refresh: Copy DB content from PRD to Non-PRD including post processing.
  - Create an extra Dialog instance: Adding extra application server instances, for example for monthly closing.

Figure 5 illustrates the solution architecture overview.

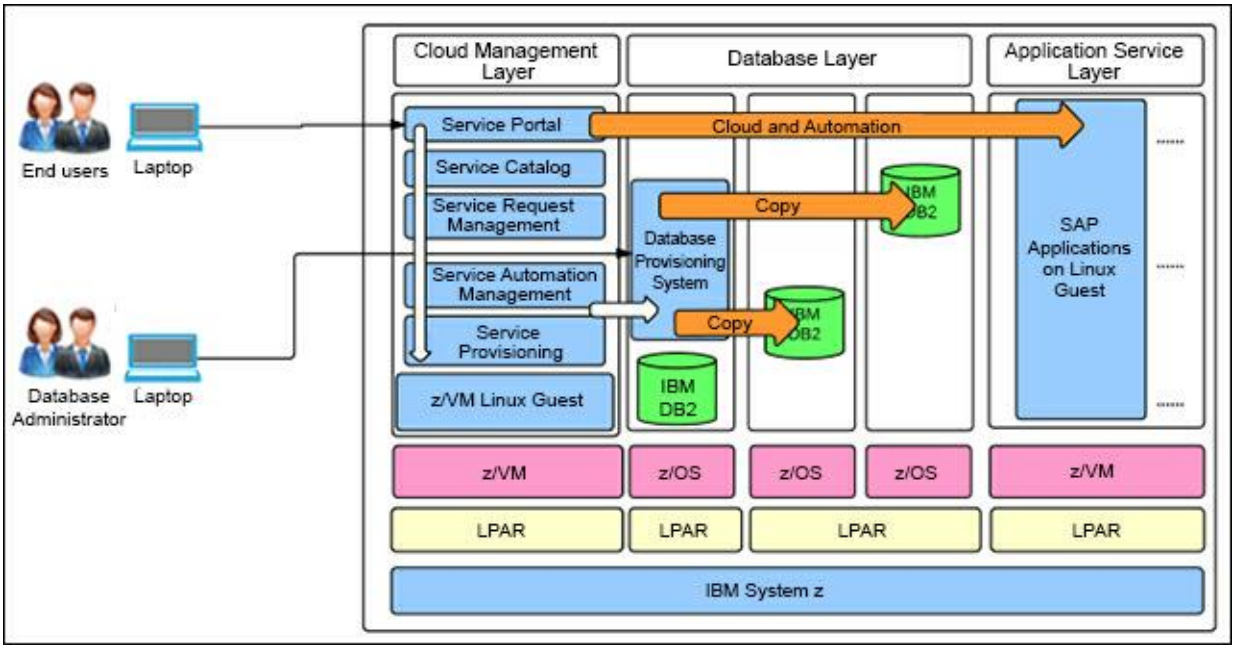


Figure 5. Automate SAP System Copy with IBM Entry Cloud Solution for SAP

The IBM Entry Cloud Configuration solution automates complex tasks typically performed by administrators of databases, operating systems, storage systems, and SAP Basis. When combined with SAP NetWeaver LVM, the configuration can reduce the time spent to copy and refresh complete SAP systems from days to hours. The high degree of automation also improves the quality and efficiency of SAP operations. The Linux on System z, IBM Entry Cloud Configuration solution is the ideal productivity tool for any IT organization running SAP Business Suite on zEnterprise with IBM DB2 for z/OS. It is well-suited for computer services organizations hosting SAP systems for their clients, and for any IT organization seeking to run its SAP operations with zEnterprise in an on-premises, self-managed, cloud computing environment. Figure 6 shows the added value of this solution and how it reduces operation and administration time when compared to traditional operations.

Figure 6. Value delivered by cloud, based on IBM internal use; might vary depending on underlying infrastructure

Integration

The solution integrates well with technologies and transactional and information services by using the following products:

- Red Hat Enterprise Linux on System z
- SUSE Linux Enterprise Server on System z
- SAP Automation
- IBM z/OS
- IBM Http server
- IBM WebSphere Application Server
- IBM DB2
- IBM Wave for z/VM
- IBM SmartCloud
- IBM Data Power
- IBM Worklight

Supported platforms

This migration from x86 to Linux on System z is supported on both Red Hat Enterprise Linux and SUSE Linux Enterprise Servers. For more information about Linux on System z platform support, see the following web page:
http://www-03.ibm.com/systems/z/os/linux/resources/testedplatforms.html

Ordering information

Ordering information for IBM Wave for z/VM is shown in the following table. For all other software, see your authorized IBM sales representative.

Table 1. Ordering information

Program name	PID number	Charge unit description
IBM Wave for z/VM	5648-AE1 1.1	Per value unit
IBM Wave for z/VM S&S	5648-AE2 1.1	Per value unit

Related information

For more information, see *IBM Redbooks: x86 Practical Migration to Linux on System z*, SG24-8217:
http://www.redbooks.ibm.com/abstracts/sg248217.html

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