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Linux on z Systems and its Participation in the Open Source Ecosystem

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Session objectives

- Linux on z Systems value proposition
- IBM's open-source strategy for Linux on z
- Progress on enabling open-source products on the z System platform
- Preliminary performance measurements
- Future directions

World's leading businesses run on the mainframe

92

of the top 100 worldwide banks

10

out of 10 of the world's largest insurers

23

of the top 25 US retailers

23

out of 25 of the world's largest airlines

Processing the world's transactions & data

30 billion

business transactions processed on the mainframe per day

80 percent

of the world's corporate data resides or originates on mainframes

91 percent

of surveyed CIOs said that new customer-facing applications are accessing the mainframe

Linux on z Systems value proposition

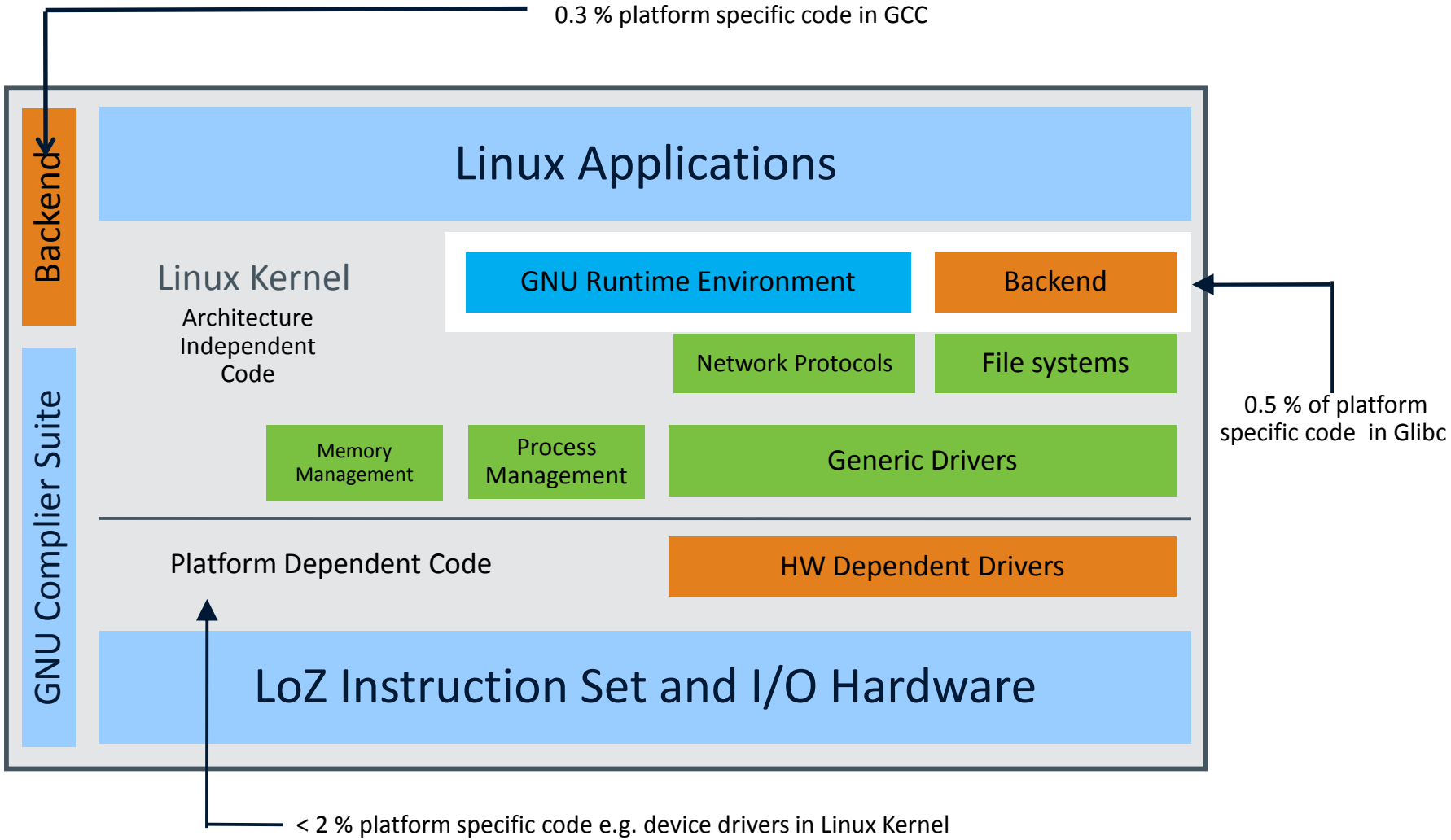
Premier quality of service at lowest platform total cost

1. **IT economic** advantage[1] with:
   - ❖ Lowest Linux platform TCO for selected workloads and environments
   - ❖ Greenest server allowing upgradeability and investment protection
2. **Highly efficient** scaling with industry-leading levels of resource sharing and utilization
   - ❖ Scale up—High server capacity with up to 141 cores running at 5 GHz
3. **Open and standard** environment, with support for key open-source software and applications
4. **Integrated SOE/SOR environment** for business processes—including cloud, analytics and mobile
5. Leadership levels of **availability and disaster recovery;** non-disruptive growth of compute capacity
6. Leading **security** environment—EAL5+ support with high-speed cryptography
7. **Cloud ready** with support for multi-tenancy, rapid provisioning, scaling on demand

1. April, 2014 IBM Competitive Project Office Benchmark

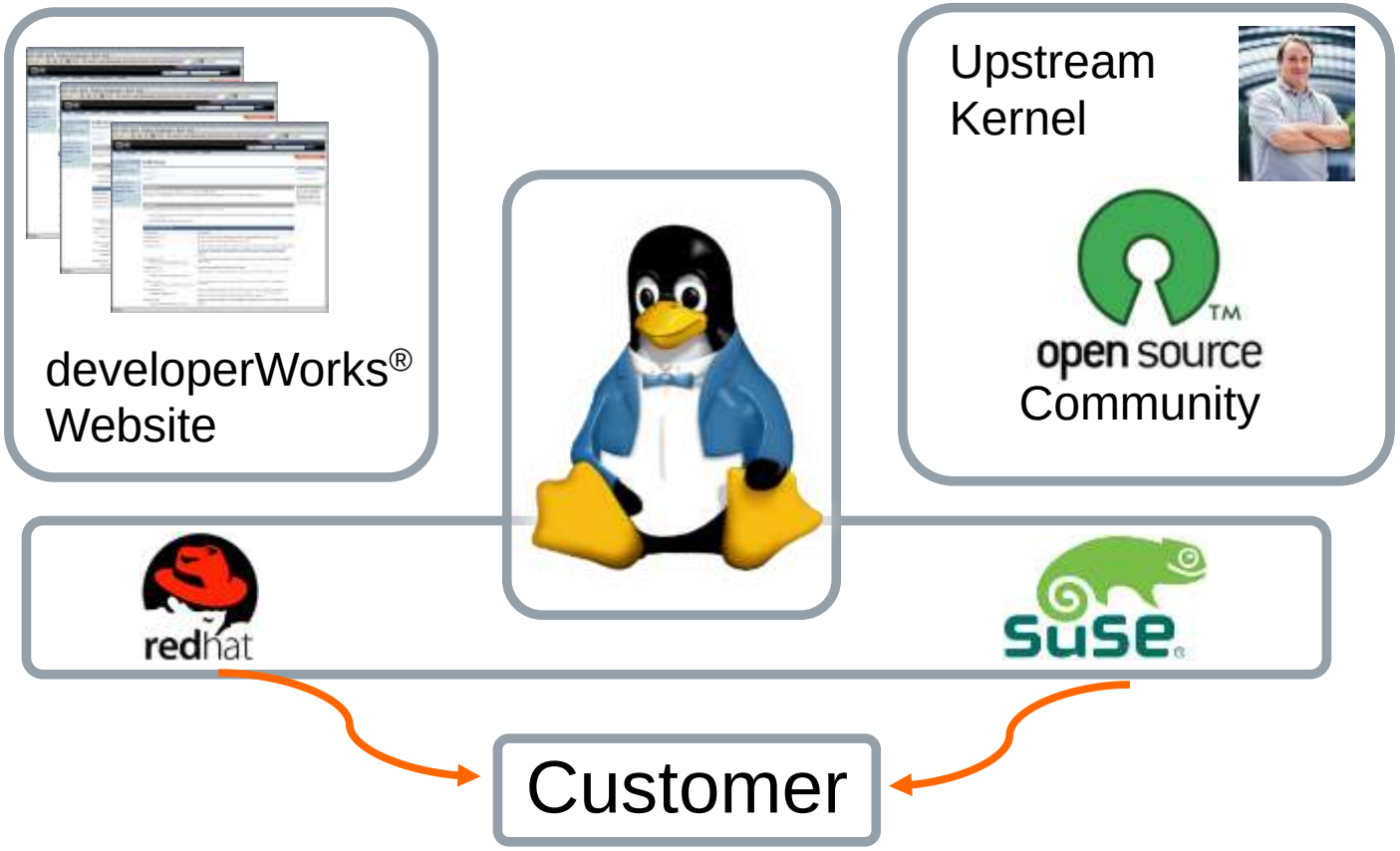
Linux is Linux is Linux

- Many Linux software packages do not require any code change to run on z Systems!



IBM Linux on z Systems Development

- IBM Linux on z Systems Development contributes in the following areas: kernel, z/Architecture®-tools, open-source tools (e.g. Eclipse, oprofile), GCC, glibc, binutils
- IBM has a dedicated development group and Linux Technology Center (LTC), to drive it



Customer base ~ 45/55 % ; mostly on RedHat 6.4-6.5 & SuSE 11.3-11.4
Latest versions available: Redhat 7.0 (7.1 in 3Q) & SuSE 12

Linux on z Systems Open-source Ecosystem CoC

- A new team in z Systems Software with the following mission:
  - Create a rich open-source ecosystem to enable Linux on z Systems as a target platform for new application deployment
  - Scope: Open-source foundational technologies for Linux on z Systems

Stakeholders	z Clients	ISVs and Distros	IBM Sponsors and Product Teams	Communities
Activities	Port, Test and Optimize	Contribute Changes	Develop Go-to-Market Strategy	Assist Client Teams
Technologies	Language and Environment	Database and Messaging	Cloud Infrastructure	Analytics and Big Data

Focus on open-source software focus

Considering various sources of input, including BlueMix, GitHub stats, direct client feedback (e.g. IBM conferences, client reps), and on-going research

Language & Environment

- Node.js V1.2
- Erlang R17
- Ruby
- gccgo 1.4.2
- OCaml (interpreter)
- Python

Database & Messaging

- PostgreSQL 9.4
- MariaDB 10
- MongoDB 2.6
- CouchDB 2.0
- RabbitMQ

Cloud Infrastructure

- Chef client/server (ICM)
- Docker

1Q15 open-source software port completions

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- **Docker**

Industry Leading Runtime Capabilities with node.js

New Release compatible with Joyent Node.js v0.12

http://www.ibm.com/developerworks/web/nodesdk

High Performance JavaScript for LoZ

- Highly scalable, event-driven platform with non-blocking I/O
- Thousands of concurrent connections with minimal overhead
- Improved TLS, TCP and clustering performance over V1.1
- Up to **52%** better performance over Intel on AcmeAir*
- Up to **81%** better performance over V1.1 on Octane*

z Systems Connectivity

- Co-locate Node.js applications for reduced latency accessing z/OS data/services
- Up to **2x** better throughput, **60%** faster response time to DB2 on z/OS*

Security and Dependability

- Leverages the trusted environments of System Z to maximize security and uptime of critical Node.js applications.

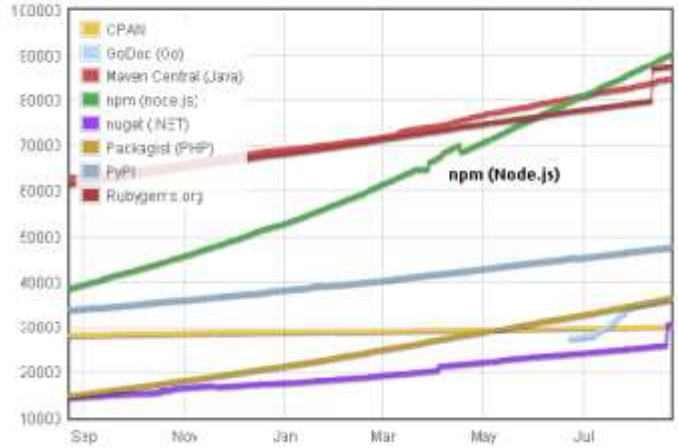
Unified Diagnostics Tooling with IBM SDKs v1.2 for Java®

- Monitor your application with IBM HealthCenter
- Debug your application using Interactive Diagnostic Data Explorer

Lots of Node packages / modules for use

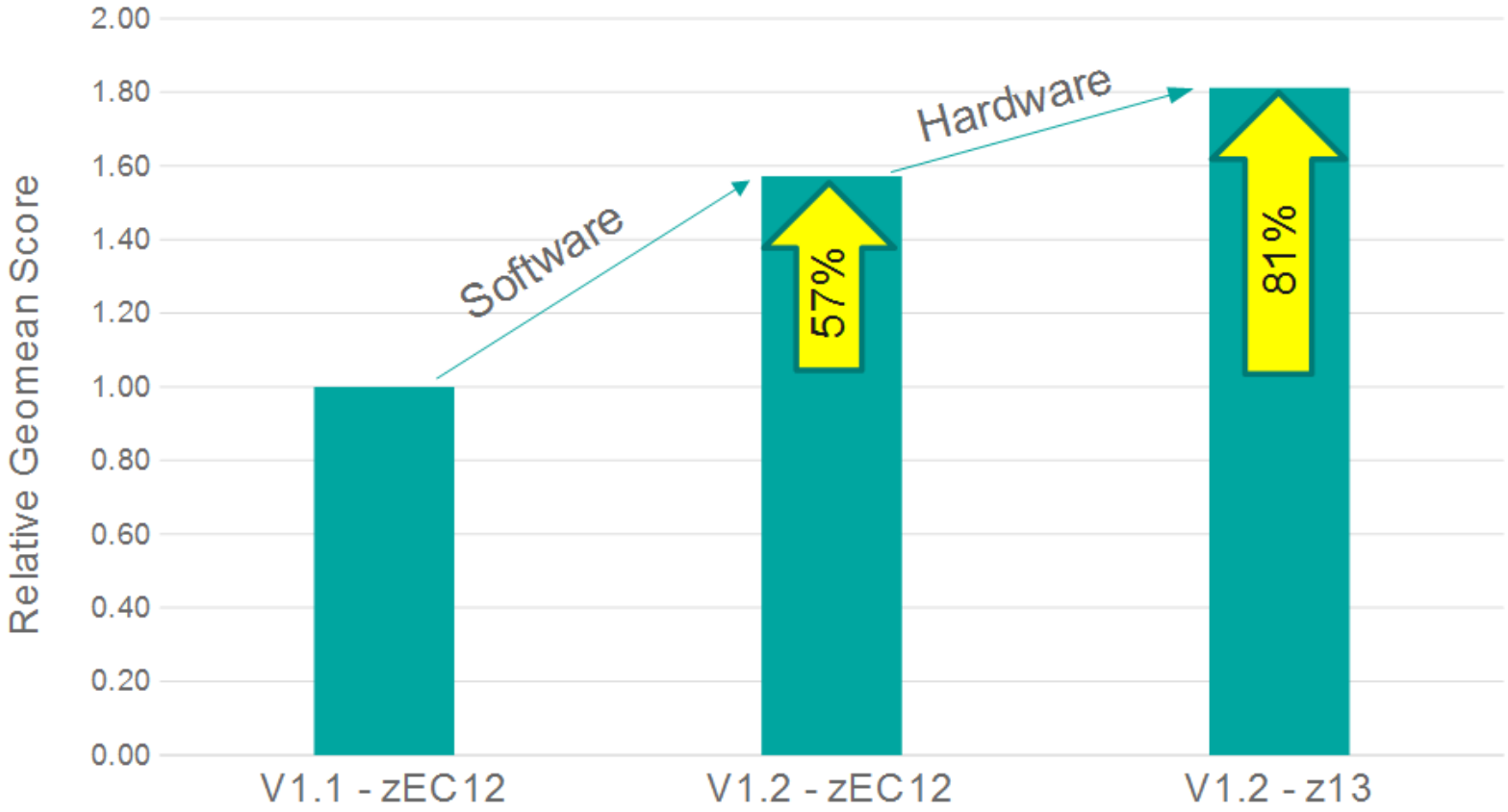
- One of the fastest growing ecosystems: 140K and growing
- Growing 3x faster than Java

Module Counts



Node.js performance improvements

- Octane based performance on zEC12 and z13
  shows an aggregate **81%** improvement*

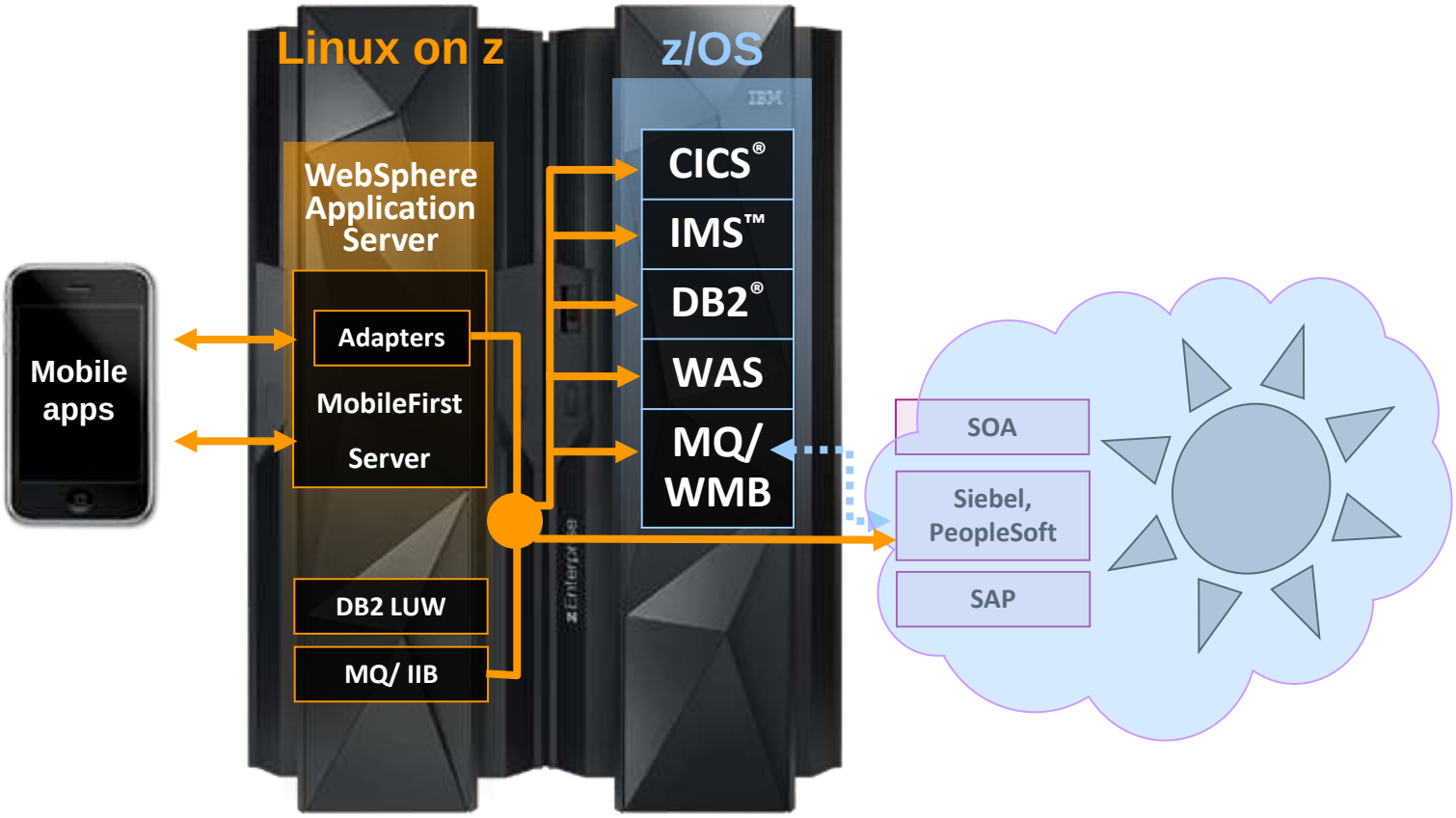


(* Controlled measurement environment, results may vary)

Node.js community moves to open governance

- On February 10th, at the Node Summit, the Node.js community announced it intends creation of the Node.js Foundation transparent and inclusive open governance model.
- IBM will be a Platinum Founding Sponsor of the Foundation and will continue maturing Node technology. Other founding members include Fidelity, Joyent, Microsoft, PayPal, and the Linux Foundation.
- Node is critical to an enterprise's open architecture strategy for the integration of new cloud, analytics, mobile and social capabilities.
- IBM is a strong supporter of an enterprise-class Node.js:
  - The IBM SDK for Node.js significantly broadened Node's platform support.
  - IBM optimized Node.js for the cloud environment by adding Node to IBM BlueMix so developers could rapidly build, manage and run Node applications in the cloud.
  - It is our intent to work with the Node community to develop a robust and scalable end-to-end JavaScript platform for enterprise application development and deployment.

Take advantage imediatelly with IBM MobileFirst on Linux on z Systems



IBM z Systems®

- **Server side software components and adapters for channeling System z to mobile devices** with IBM MobileFirst Server
- **Mobile application support** with WebSphere Application Server on System z
- **Mobile protocol connectivity with core System z applications** including CICS, IMS, TPF, MQ, WMB and DB2

The NoSQL wave and for what workloads

NoSQL technology was pioneered by leading internet companies — including Google, Facebook, Amazon, and LinkedIn

- to overcome the limitations of relational database technology
- for use with web applications and unstructured data

- Today, enterprises are adopting NoSQL for a growing number of uses cases:
- Big number of users,
- Big amount of unstructured data,
- Internet of Things,
- Cloud Computing

Port of MongoDB to Linux on z Systems

- MongoDB is the most popular NoSQL database[1]
- IBM maintains a port to big-endian platforms
  - Latest stable version: 2.6.6
  - Source: https://github.com/linux-on-ibm-z/mongo
  - Instructions: https://github.com/linux-on-ibm-z/docs/wiki/Building-MongoDB
  - Fixing little-endian assumptions in the code is not rocket science!
    - Use C++ templates and overloaded operators to replace reinterpret_cast's and avoid explicit byte swapping
    - 6% files patched (1 new file added), 0.35% code (total: ~300 kLOCs) modified
- Currently porting version 3.0+

- Goals
  - Merge IBM port back to development branch
  - Containerize MongoDB for cloud environments on z Systems
  - Partnership with MongoDB to support z customers

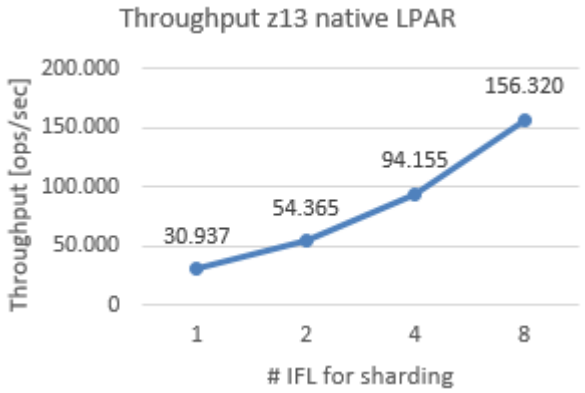
[1] DB-engines.com, Feburary 2015

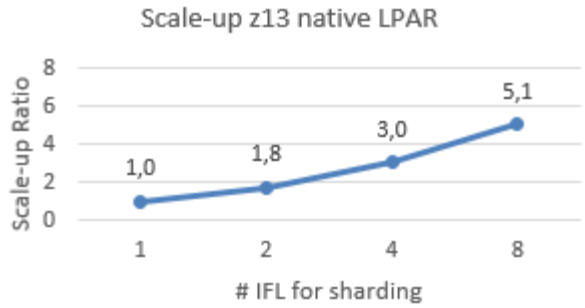
MongoDB 2.4.9 sharding performance

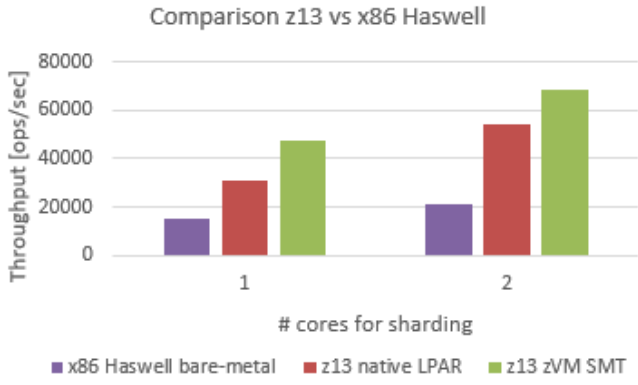
•Compare MongoDB 2.4.9 sharding (partitioned DB – collections) scale-out performance on:
  - z13 native LPAR
  - z13 z/VM with SMT enabled
  - x86 (Haswell) bare metal
- Benchmark: YCSB Workload A (50% read/50% write)

- Scaling results in line with MongoDB's sharding design
  - •Read operations are distributed to all shards; good scaling
  - •Write operations always go to the first shard; contention causes poorer scaling

- Comparison with preliminary x86 results show that z13 out-performs Haswell
  - •z13 native LPAR vs. Haswell: **~2.25x**
  - •z13 z/VM SMT vs. Haswell: **~3.00x**
  - •z13 native LPAR vs. z13 z/VM SMT: **~1.35x**







MariaDB

The dominance of the LAMP (Linux, Apache, MySQL, PHP/Python/Perl) stack of technologies for websites has had a lot to do with MySQL's position as a popular open source database.

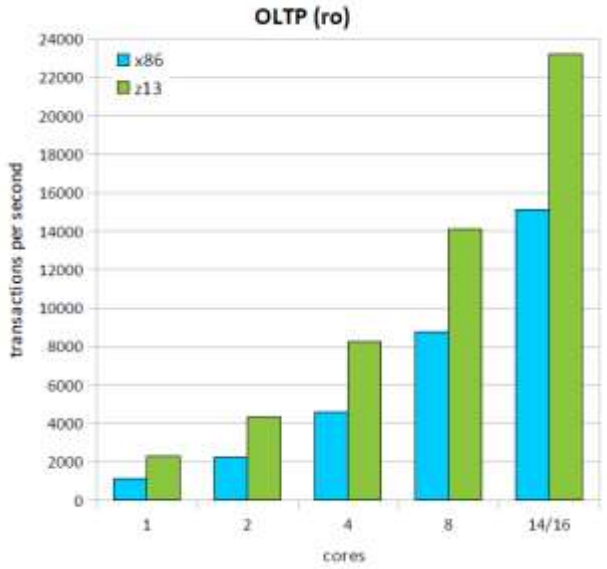
- This preeminent position is probably why so many people were worried when Sun Microsystems purchased MySQL (the company behind MySQL) and then when Oracle purchased Sun.

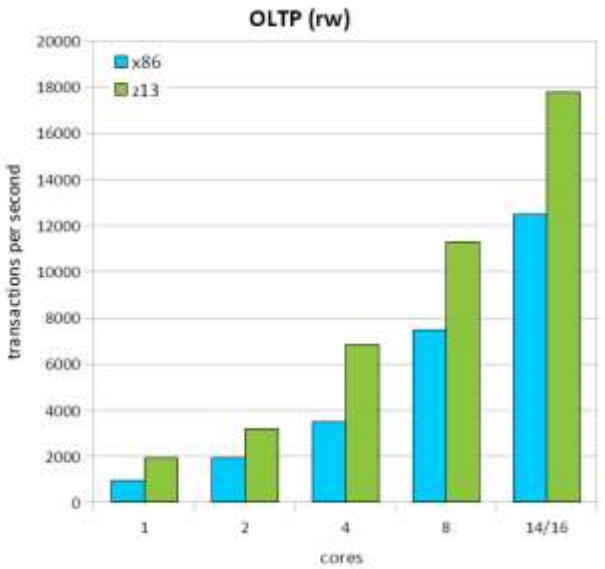
- One group of (mostly) former MySQL employees, led and funded by MySQL co-founder Michael "Monty" Widenius, start a new company (Monty Program), and create a branch of MySQL called **MariaDB**.

- The goal for Maria-DB is to be a drop-in replacement for MySQL – with more features and better performance.

Proving MariaDB performance on Linux on z

- MariaDB, the fork of the popular MySQL database
  - Drop-in replacement
  - Shipped by distributions as default
  - Already available on Linux on z (RHEL, SLES)
- MariaDB 10.0.16 throughput comparison
  - IBM z13 vs. Intel Haswell, SMT2 enabled on both, RAM disk, CPU pinning
  - z13 shows **1.5x to 2x** better performance than Haswell (no code change or tuning)

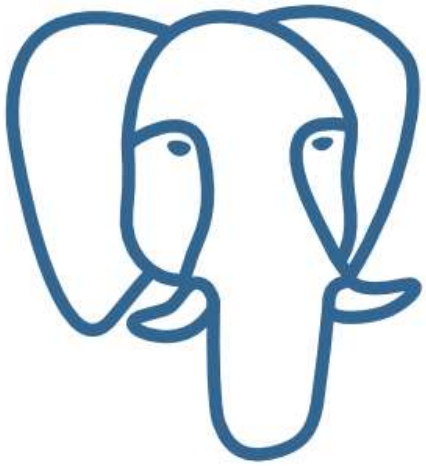




(* Controlled measurement environment, results may vary)

PostgreSQL a choice of database for Linux on z

- IBM is collaborating with 2ndQuadrant to bring PostgreSQL to z
  - Provide enterprise support, and optimize performance
  - “2ndQuadrant is also testing on the new IBM z13 . We expect the results will far exceed our goal.” —Howard Rolph, Worldwide Marketing Manager, 2ndQuadrant*
  - Linux on z build system added to PostgreSQL build farm in February 2015
- Official RPM repository will provide z binaries (work in progress)
  - Easy build instructions now available for early adopters
  - https://github.com/linux-on-ibm-z/docs/wiki/Building-PostgreSQL-9.4-on-RHEL7
  - https://github.com/linux-on-ibm-z/docs/wiki/Building-PostgreSQL-9.4-on-SLES12
- Contact
  - info@2ndquadrant.com for consultancy and support



* http://www-03.ibm.com/systems/z/solutions/isv/quotes/

What are Containers in Linux - positioning

linuxcontainers.org is the umbrella project behind Linux Containers (LXC), Linux Container 'hypervisor' (LXD), Linux Container FileSystem (LXCFS) and Linux cgroup deamon (CGManager).

- The goal is to offer a distro and vendor neutral environment for the development of Linux container technologies.
- The main focus is system containers. This is achieved through a combination of kernel security features such as namespaces, mandatory access control and control groups.

Container characteristics:

- ❖ Isolated application environments within a Linux OS instance
- ❖ Serve a single task
- ❖ Self contained set of files for applications
- ❖ Startup time and efficiency compare to native execution

Docker

Docker is one implementation of Linux containers

- Open, portable, light-weight run-time and packaging tool
- Container in standard operating environment and delivery vehicle for applications with wildly different requirements
  - Much faster to spin-up and efficient to run than a VM
  - Isolated from each other
- Easily build and ship complex application, without worrying about infrastructure differences or interference from other software stacks
- Quickly and reliably deploy and run applications on any infrastructure
- Docker Hub: share container building blocks and automate workflows
- Essential for horizontally scaling apps on the cloud

Terminology:

- Image: set of self contained files. Read-only.
- Container: a running instance, based on an image.

Enabling Docker for Linux on z Systems

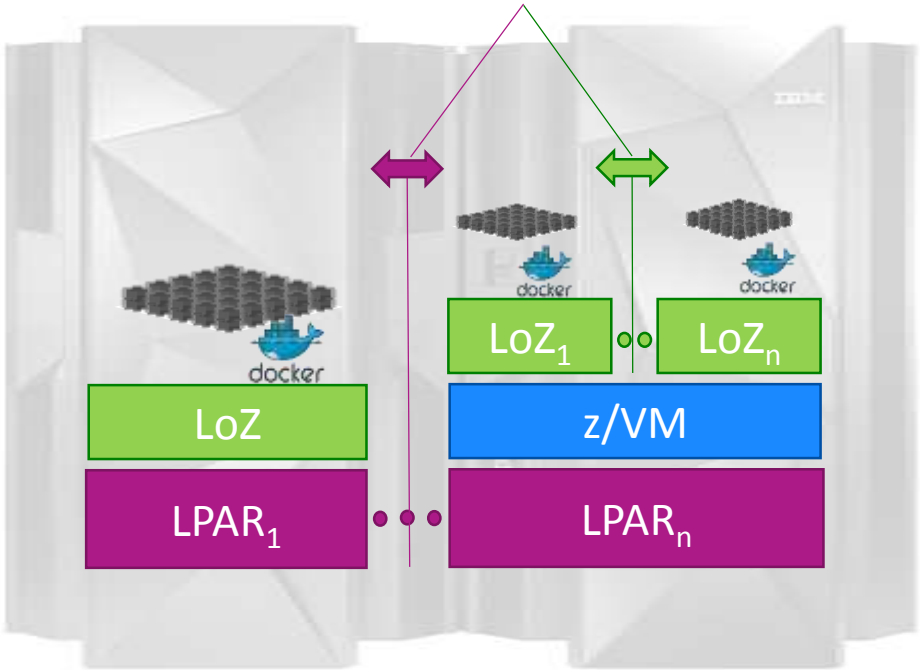
- IBM built Docker on Linux on z with gccgo
- Binaries for technology preview available now (RHEL 7 and SLES 12)
  - http://www.ibm.com/developerworks/linux/linux390/docker.html
  - Instructions on setting up and building base images:
    - http://containerz.blogspot.ca/2015/03/first-steps-with-docker.html
    - http://containerz.blogspot.ca/2015/03/creating-base-images.html
  - Create a Docker image that runs a private repository on Linux on z
    - Same instruction as for other platforms:
    - https://github.com/docker/docker-registry/blob/master/ADVANCED.md
- IBM-managed images to be uploaded to ibmcom namespace in Docker Hub
  - Linux on z images are named with "_s390x" suffix, until multi-arch support is available
- Docker is Docker is Docker… on Linux on z too!
- Follow our blog:

  http://containerz.blogspot.com/

Docker on z Systems: Performance and Security

- Initial measurement and analysis show: Docker performs very well on z
  - New SMT capability in IBM z13 gives even greater throughput
- Security isolation is an important issue in enterprise environments; running containers on the same node may not provide an adequate level of isolation
- z/VM Hypervisors provide the proven enterprise-grade virtualization technology to isolate multi-tenant guests
  - Full security isolation between Docker swarms; configurable for different use cases
  - High container density: minimal z/VM overhead, superior resource over-commit technology

Levels of isolation in a multi-tenant setup



CHEF – the Open source Automation software

Chef delivers fast, scalable, flexible IT automation.

- With Chef, you can automate how you build, deploy, and manage your infrastructure.
- Your infrastructure becomes as versionable, testable, and repeatable as application code.
- Chef server stores your recipes as well as other configuration data.
- The Chef client is installed on each server, virtual machine, container, or networking device you manage — call these all nodes.
- The client periodically polls Chef server latest policy and state of your network.

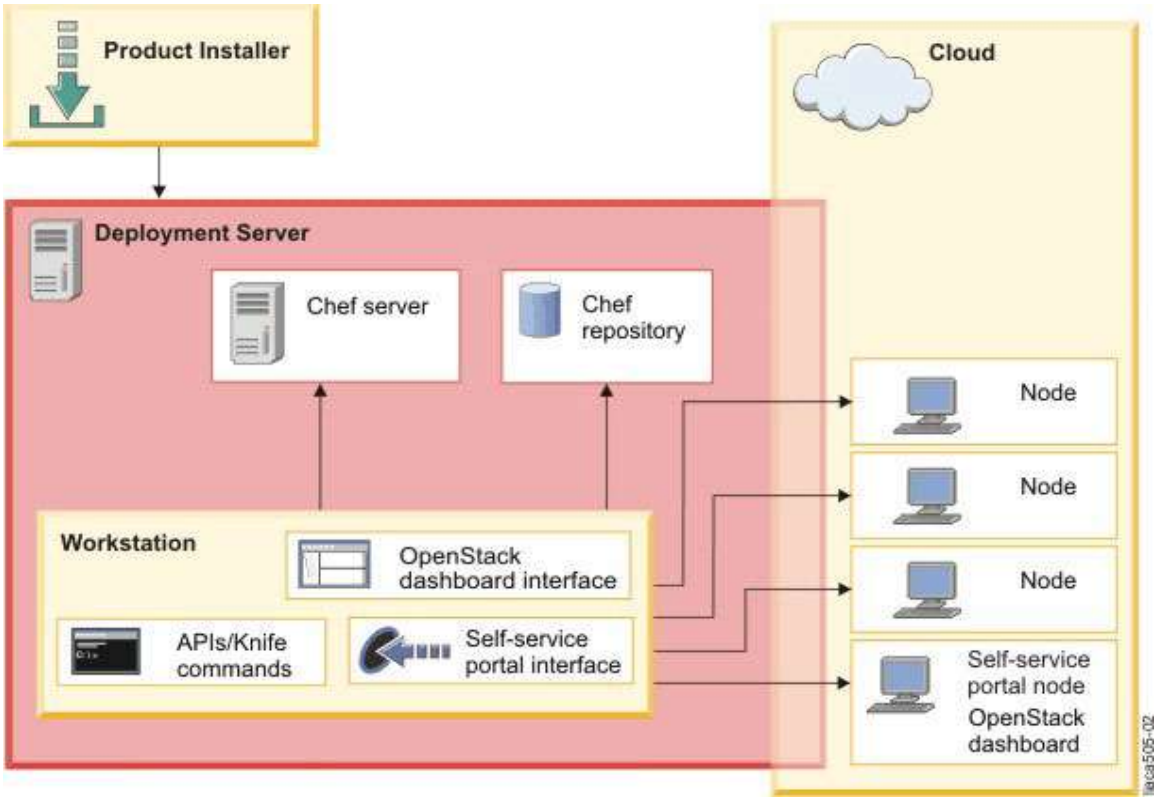
- **Chef is also an automation platform for managing and configuring containers.**
- **Chef can be used to build workflows that combine the power of Chef with the convenience of containers.**

Cooking with Chef on Linux on z

- Increasing interest from z Systems customers to support native OpenStack and related interfaces (e.g. Chef) from which they can build their own clouds
- Chef: one of the most popular configuration management systems
  - Infrastructure as code: speed, flexibility, scalability
  - Integration with cloud computing platforms
- IBM made customizations to build Open Source Chef on Linux on z
  - Chef client builds cleanly out of the box
  - Chef server requires replacing language dependencies (e.g. Java, Node.js); minor changes to Ohai for system information collection
  - Instructions for building your own Chef on z:
    - https://github.com/linux-on-ibm-z/docs/wiki/Building-Chef-client-12.1.2
    - https://github.com/linux-on-ibm-z/docs/wiki/Building-Chef-server-12.0.4

IBM Cloud Manager (ICM) with OpenStack 4.2

- Easy-to-use cloud management offering based on OpenStack and Chef
  - Integrates Chef server/client for Linux on z; built-in HEAT engine works with Chef
  - http://www.ibm.com/developerworks/servicemanagement/cvm/sce/
  - IBM value-add: simplification, robustness enhancements, and support



IBM Custom Patterns for Linux on z Systems

- IBM has announced 12 Chef patterns for our most popular middleware that clients run on Linux on z today, and a catalog of over 200 cookbooks/recipes
  - http://rds.lexington.ibm.com/overview/patternLab.php

- Dramatically accelerates infrastructure agility and time to value that leads to increased business agility
- Helps reduce operating and capital expenses through accelerated deployment
- Takes advantage of delivering an automated approach that helps to reduce errors and the need for specialized skills
- Helps improve delivery quality by using proven deployment patterns combined with testing and validation
- Other patterns are available; we are building a broad portfolio—seeking customer input on ones of interest (e.g. Oracle)

- WebSphere Application Server Network Deployment V8.5.5 with Custom Pattern for Linux on z Systems
- WebSphere Application Server Liberty Core V8.5.5 with Custom Pattern for Linux on z Systems
- DB2 Enterprise Server Edition V10.5 with Custom Pattern for Linux on z Systems
- WebSphere MQ V8.0 with Custom Pattern for Linux on z Systems
- Integration Bus V9.0 with Custom Pattern for Linux on z Systems
- Decision Center V8.7 with Custom Pattern for Linux on z Systems
- Decision Server Advanced V8.7 with Custom Pattern for Linux on z Systems
- Process Center Advanced V8.5.5 with Custom Pattern for Linux on z Systems
- Process Server Advanced V8.5.5 with Custom Pattern for Linux on z Systems
- Business Monitor V8.5.5 with Custom Pattern for Linux on z Systems
- WebSphere Portal Server V8.5 with Custom Pattern for Linux on z Systems
- MobileFirst Platform Foundation V6.3 with Custom Pattern for Linux on z Systems

Actively investing to make Chef the preferred mechanism to deploy patterns, even our own IBM software products!

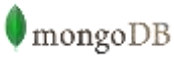
Future directions

- Continue to port foundational and popular Linux software to z
  - Help open-source projects optimize their code on z hardware
- Simplify access to open-source software for Linux on z Systems
  - An online system for packaging software for Linux on z, and distributing them to clients
  - Some ideas being considered:
    - Docker containers for fast and painless application development and testing
    - RPM-based package repository that eases deployment on major distributions
    - LoZ cloud registry, making software packages available via an update manager
- Collaborate with distributions to expand coverage for IBM platforms

Open Source Priorities in 2015 (feedback / proposals welcome)

Green:
port/test done
open source versions

Databases-Messaging



Dev Languages-Environments

Interpreter

Compiler

Cloud Infrastructure

Cluster Computing

Linux on z Open-source Ecosystem Community

- We have created a developerWorks community; visit us today!
  - https://www.ibm.com/developerworks/community/groups/community/lozopensource/

- Information on all open-source software we have brought to Linux on z:
  - Recipes for building the software on Linux on z
  - Pointers to binaries if available
  - Other related news and information
- Source code repositories and build instructions maintained on GitHub
  - https://github.com/linux-on-ibm-z/docs/wiki/

- Open to every one interested in Linux on z Systems
  - Users can post questions/comments regarding Linux on z
  - Give feedback to the Linux on z Open-source Ecosystem team

We look forward to hearing from you!

Session summary

- Linux on z Systems increased value proposition:
  - Open and standard Linux environment, combined with the reliability, availability and security of z Systems
  - Efficiency from workload consolidation and data co-location
  - High server capacity and scalability of z Systems make apps run better on z
- IBM is investing heavily on nurturing an open- source ecosystem around Linux on z Systems
- Excellent performance out of the box
- We are listening to your needs

Questions?

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Global Skills Initiative

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Notes:

Performance is in Internal Throughput Rate (ITR) ratio based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will vary depending upon considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput improvements equivalent to the performance ratios stated here.
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