Unleashing the Full Potential of Linux and Open Technologies to Fuel New Innovation

Jim Elliott
z Systems Consultant
zChampion and Linux Ambassador
IBM Systems, IBM Canada Ltd.
The world’s leading businesses run on mainframes

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

30 billion business transactions processed on mainframes per day
91 percent of surveyed CIOs said that new customer-facing applications are accessing the mainframe
80 percent of the world’s corporate data resides or originates on mainframes
55 percent of all enterprise applications need the mainframe to complete transactions
Marketplace dynamics are driving hyper growth opportunity for the IBM mainframe

- **Traditional** 1964–2014
  - Batch / Accounts payable/receivable
  - Transaction Systems / Client Databases
  - Inventory, CRM, ERP

- **Linux and Java** 1999–2014
  - Server Consolidation
  - Oracle Consolidation
  - Early Private Clouds
  - Java®, Web and eCommerce

- **CAMSS²** 2015–2020
  - On/Off Premise, Hybrid Cloud
  - Big Data and Analytics
  - Enterprise Mobile Apps
  - Security solutions

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1. MIPS: Millions of Instructions per Second or the metric z uses to measure client workload
2. CAMSS: Cloud, Analytics, Mobile, Social, Security
Time for the next open breakthrough

- The best of IBM z Systems
  - Dynamic resource allocation
  - Non-disruptive scalability
  - Continuous business availability
  - Operational efficiency
  - Trusted security
  - Data and transaction serving

- The best of Linux and Open
  - Freedom and Agility
  - Standards based
  - Speed to Innovate
  - Developer productivity
  - Community collaboration
  - Open Source software and applications

It’s simple
z Systems and Linux provide a better, faster solution to IT complexity
A path built on proven technology

- Built on z13 technology
- The world’s fastest processor
- Massive I/O throughput
- Large memory pools with 4 levels of cache
- IT analytics to avoid future outages
- Dedicated cryptographic processors
- 6 to 141 Linux cores
- 350 to 8,000 Virtual Machines

IBM LinuxONE Emperor™

- Built on zBC12 technology
- Entry point into the z Systems Linux family
- All the same great capabilities in a smaller package
- 2 to 13 Linux cores
- 40 to 600 Virtual Machines

IBM LinuxONE Rockhopper™

2015-10-26
Unleashing the Full Potential of Linux and Open Technologies to Fuel New Innovation
Agility = Capability + Speed

Agility is the ability to get to market quickly and effectively to solve the business problems you care about by leveraging best-of-breed capabilities across eco-system, security and management, while benefiting from industry leading scale and performance.
Open Source in the Enterprise

- **64%** of companies participate in Open Source projects
- 67% of companies with > 5k employees
- **78%** of companies run on Open Source
- **66%** of companies build software on Open Source

**Open Source usage by the numbers**

- **88%** of companies to increase open source contributions in the next 2-3 years
- **39%** Plan to start own external OSS project
- **47%** To release internal tools & projects as OSS
- **53%** Expect to reduce barriers to employee participation
- **50%** of companies say that more than half their engineers are working on open source projects

Source: Black Duck, 2015 Future of Open Source Survey Results
Distributions
SUSE
redhat.
ubuntu
Hypervisors
KVM
z/VM®
PR/SM LPAR
Languages
python
Ruby
php
ERLANG
Scala
Clojure
JS
OCaml
Java
Runtimes
nodeJS
docker
CHEF
juju
ZF
openstack
OpenJDK
vmware
Cloud Manager
Runtimes
Management
MariaDB
mongoDB
PostgreSQL
cassandra
InfoSphere BigInsights
Database
Spark
Hadoop
ubuntu
vat
trie
IBM z Systems
Analytics
Cloud Manager
DB2
vRealize
Oracle
LinuxONE and IBM z Systems Open Source and ISV Ecosystem

Stakeholders
- z Clients
- ISVs, Business Partners and Distros
- IBM Sponsors and Product teams
- Communities

Activities
- Port Test
- Contribute changes
- Develop Go-to-Market strategy
- Available for Client team

Foundational Technologies
- Dev Language and Environment
- Database and Messaging
- Cloud Infrastructure
- Big Data and Analytics
# Open Source and ISV Linux SW Capability

## Tier 1: Foundation packages*

<table>
<thead>
<tr>
<th>Languages and Dev Environment</th>
<th>Database and Messaging</th>
<th>Cloud infrastructure</th>
<th>Big Data and Analytics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node.js</td>
<td>MySQL</td>
<td>Docker</td>
<td>Hadoop (via Veristorm, BigInsights)</td>
</tr>
<tr>
<td>Ruby</td>
<td>PostgreSQL</td>
<td>Chef</td>
<td>Drupal</td>
</tr>
<tr>
<td>Rails</td>
<td>MariaDB</td>
<td>Puppet</td>
<td>ELK (Elasticsearch, Logstash, Kibana)</td>
</tr>
<tr>
<td>Python</td>
<td>MongoDB</td>
<td>OpenStack</td>
<td>Apache SPARK</td>
</tr>
<tr>
<td>LLVM</td>
<td>Cassandra</td>
<td>Cloud Foundry</td>
<td>Cloudera</td>
</tr>
<tr>
<td>OpenJDK, OpenJDK JIT</td>
<td>Redis</td>
<td>OpenShift</td>
<td>HortonWorks</td>
</tr>
<tr>
<td>GCCGO, Golang compiler</td>
<td>CouchDB</td>
<td></td>
<td>Apache Kafka</td>
</tr>
<tr>
<td>oCaml, oCaml native compiler</td>
<td>Geode</td>
<td></td>
<td>Joomla</td>
</tr>
<tr>
<td>Erlang, Erlang native compiler</td>
<td>RabbitMQ</td>
<td></td>
<td>Solr</td>
</tr>
<tr>
<td>Apache HTTP Web Server</td>
<td>CouchBase</td>
<td></td>
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</tr>
<tr>
<td>PHP/Zend</td>
<td>Neo4j</td>
<td></td>
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<tr>
<td>R language</td>
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<tr>
<td>Clojure</td>
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<tr>
<td>Scala</td>
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<tr>
<td>Swift (Apple)</td>
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</tr>
</tbody>
</table>

* Content and priority subject to change
## Open Source and ISV Linux SW Capability

**Tier 2: Popular tools and applications***

<table>
<thead>
<tr>
<th>Application development and DevOps</th>
<th>Configuration, monitoring management and tools</th>
<th>Web Application Development</th>
<th>eCommerce and Application server</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xerces-c</td>
<td>Fluentd</td>
<td>jMeter</td>
<td>jBoss</td>
</tr>
<tr>
<td>XMLSec</td>
<td>Ansible</td>
<td>Wordpress</td>
<td>Magento</td>
</tr>
<tr>
<td>protobuf</td>
<td>SaltStack</td>
<td>Ceilometer</td>
<td>X-Cart</td>
</tr>
<tr>
<td>Doxygen</td>
<td>cAdvisor</td>
<td>Apache Tomcat</td>
<td></td>
</tr>
<tr>
<td>ANTLR</td>
<td>virt-install</td>
<td>HAProxy</td>
<td></td>
</tr>
<tr>
<td>Maven</td>
<td>Zenoss</td>
<td>NGNIX</td>
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</tr>
<tr>
<td>Jenkins</td>
<td>Zookeeper</td>
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<tr>
<td>Apigility</td>
<td>DataDog</td>
<td></td>
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<tr>
<td>.Net</td>
<td>ElasticBox</td>
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</tr>
<tr>
<td>Node.js extended components</td>
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</tr>
</tbody>
</table>

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LinuxONE and IBM z Systems
Open Source and ISV Ecosystem Community

- One stop shop to find out what is available
  - https://ibm.com/developerworks/community/groups/community/lozopensource/

- Information on all open-source software
  - Recipes for building the software on LinuxONE and IBM z Systems
  - Pointers to binaries if available
  - Other related news and information

- Build recipes and how-tos on GitHub
  - https://github.com/linux-on-ibm-z/docs/wiki/

- Open to every one interested in LinuxONE and IBM z Systems
  - Users can post questions/comments
  - Provide feedback to the Open Source and ISV Ecosystem team

- We look forward to hearing from you!
### Where to get packages

<table>
<thead>
<tr>
<th>Assets</th>
<th>Where to get it?</th>
</tr>
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<tbody>
<tr>
<td>Apache Geode</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-Apache-Geode-1.0.0">https://github.com/linux-on-ibm-z/docs/wiki/Building-Apache-Geode-1.0.0</a></td>
</tr>
<tr>
<td>Apache HTTP</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-Apache-HTTP-server">https://github.com/linux-on-ibm-z/docs/wiki/Building-Apache-HTTP-server</a></td>
</tr>
<tr>
<td>AntLR</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-AntLR">https://github.com/linux-on-ibm-z/docs/wiki/Building-AntLR</a></td>
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<tr>
<td>Cassandra</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-Cassandra">https://github.com/linux-on-ibm-z/docs/wiki/Building-Cassandra</a></td>
</tr>
<tr>
<td>Ceilometer client</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-Python-Ceilometer-client">https://github.com/linux-on-ibm-z/docs/wiki/Building-Python-Ceilometer-client</a></td>
</tr>
<tr>
<td>Chef client &amp; server</td>
<td><a href="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-client-12.1.2</a></td>
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<tr>
<td></td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-Chef-server-12.0.4">https://github.com/linux-on-ibm-z/docs/wiki/Building-Chef-server-12.0.4</a></td>
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<tr>
<td>CouchDB</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-CouchDB">https://github.com/linux-on-ibm-z/docs/wiki/Building-CouchDB</a></td>
</tr>
<tr>
<td>Docker Compose</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-Docker-Compose">https://github.com/linux-on-ibm-z/docs/wiki/Building-Docker-Compose</a></td>
</tr>
<tr>
<td>Docker Distribution</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-Docker-Distribution-2.0.1">https://github.com/linux-on-ibm-z/docs/wiki/Building-Docker-Distribution-2.0.1</a></td>
</tr>
<tr>
<td>Docker Swarm</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-Docker-Swarm">https://github.com/linux-on-ibm-z/docs/wiki/Building-Docker-Swarm</a></td>
</tr>
<tr>
<td>Doxygen</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-Doxygen">https://github.com/linux-on-ibm-z/docs/wiki/Building-Doxygen</a></td>
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<td>Fluentd</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-Fluentd">https://github.com/linux-on-ibm-z/docs/wiki/Building-Fluentd</a></td>
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<tr>
<td>Go (GCCGO)</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-gccgo">https://github.com/linux-on-ibm-z/docs/wiki/Building-gccgo</a></td>
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<tr>
<td>Logstash</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-Logstash">https://github.com/linux-on-ibm-z/docs/wiki/Building-Logstash</a></td>
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<td>MariaDB</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-MariaDB-10.0">https://github.com/linux-on-ibm-z/docs/wiki/Building-MariaDB-10.0</a></td>
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<td>Maven</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-Maven">https://github.com/linux-on-ibm-z/docs/wiki/Building-Maven</a></td>
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<td>MongoDB</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-MongoDB">https://github.com/linux-on-ibm-z/docs/wiki/Building-MongoDB</a></td>
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<td>MySQL</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-MySQL">https://github.com/linux-on-ibm-z/docs/wiki/Building-MySQL</a></td>
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<tr>
<td>Node.JS</td>
<td><a href="https://nodejs.org/download/">https://nodejs.org/download/</a></td>
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<tr>
<td>oCaml Interpreter</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-oCaml-interpreter">https://github.com/linux-on-ibm-z/docs/wiki/Building-oCaml-interpreter</a></td>
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<tr>
<td>PostgreSQL</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-PostgreSQL-9.4-on-SLES12">https://github.com/linux-on-ibm-z/docs/wiki/Building-PostgreSQL-9.4-on-SLES12</a></td>
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<td><a href="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-RHEL7</a></td>
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<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-PostgreSQL-9.4-on-SLES11">https://github.com/linux-on-ibm-z/docs/wiki/Building-PostgreSQL-9.4-on-SLES11</a></td>
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<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-PostgreSQL-9.4-on-RHEL6">https://github.com/linux-on-ibm-z/docs/wiki/Building-PostgreSQL-9.4-on-RHEL6</a></td>
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<td>Protobuf</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-ProtoBuf">https://github.com/linux-on-ibm-z/docs/wiki/Building-ProtoBuf</a></td>
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<tr>
<td>Puppet</td>
<td><a href="https://github.com/linux-on-ibm-z/docs/wiki/Building-Puppet">https://github.com/linux-on-ibm-z/docs/wiki/Building-Puppet</a></td>
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</tbody>
</table>
| Python     | https://github.com/linux-on-ibm-z/docs/wiki/Building-Python-2.7.9  
                  https://github.com/linux-on-ibm-z/docs/wiki/Building-Python-3.4.3                                                                 |
| RabbitMQ   | https://github.com/linux-on-ibm-z/docs/wiki/Building-RabbitMQ-on-SLES  
                  https://github.com/linux-on-ibm-z/docs/wiki/Building-RabbitMQ-on-RHEL                                                                 |
| Ruby-on-Rails | http://guides.rubyonrails.org/getting_started.html                                                                 |
| Ruby       | https://github.com/linux-on-ibm-z/docs/wiki/Building-Ruby                                                                                   |
| Snappy-Java | https://github.com/linux-on-ibm-z/docs/wiki/Building-Snappy-Java                                                                           |
| V8         | https://github.com/linux-on-ibm-z/docs/wiki/Building-V8-libraries                                                                          |
| Xerces-C   | https://github.com/linux-on-ibm-z/docs/wiki/Building-Xerces                                                                               |
| XMLSec     | https://github.com/linux-on-ibm-z/docs/wiki/Building-XMLSec                                                                               |
ISV Relationships

“2ndQuadrant is excited by combining the world’s most advanced open source database, PostgreSQL, with the world’s most efficient, trusted and secure server, the IBM z13. The results of up to 2x throughput performance far exceed our goal, and we are pleased to partner with IBM for supporting IBM’s customers.”
Simon Riggs, CTO & Founder, PostgreSQL Development at 2ndQuadrant

“Chef, the leader in automation for DevOps, ... announced it is collaborating with IBM to deliver integration between the Chef 12 Client & Chef 12 Server and IBM’s enterprise Linux mainframe offering, Linux on z Systems. “We’re experiencing rapid and accelerating adoption of Chef within the enterprise, making integration with IBM z Systems an important feature for our platform ...”
Matt Ray, Director of Partner Integration, Chef

“We are committed to make MongoDB available on all major platforms and are excited to add support for IBM z Systems’ Enterprise Grade Linux and LinuxOne Platform. This announcement is a leap forward for customers who want to deploy modern, mission-critical applications built with MongoDB and take advantage of the performance, scalability and security of IBM’s mainframe hardware products.” Eliot Horowitz CTO & Founder, MongoDB

“Docker is very pleased to be working with IBM to enable the Docker container capability for LinuxONE and IBM z Systems.” Ben Golub, CEO of Docker

“IBM’s z Systems mainframes power some of the most mission critical services available. ... Having Puppet run on IBM z Systems not only helps realize these benefits in a mainframe environment, but speaks to the ubiquitous and flexible nature of open source Puppet.”
Nigel Kersten, CIO of Puppet Labs

“As the ONE default database platform for leading Linux distributors, ..., MariaDB is excited to support IBM LinuxONE. With Linux on IBM z Systems growing at twice the rate of the Linux market overall, there is clear customer demand for open source solutions on IBM’s highly scalable and secure platform. These qualities align perfectly with MariaDB’s true open source model, which leverages Community innovations ..., for on-premise, hybrid and cloud applications.” Patrik Sallner, CEO, MariaDB Corporation

“It’s exciting to see the investment IBM is making into our open source technologies — Elasticsearch, Logstash and Kibana — with Linux on z Systems. This further expands the reach of our technologies in enterprises with mission critical deployments on mainframe systems.”
Shay Banon, CTO & co-founder of Elastic
Industry leading runtime capabilities with Node.js

- **New Release compatible with Joyent Node.js v0.12**
  - [https://nodejs.org/download/](https://nodejs.org/download/)
- **High Performance JavaScript for LinuxONE and IBM z Systems**
  - 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 2.1x more RESTful web interactions with AcmeAir in node.js with Apache JMeter benchmark setup
  - Up to 81% better performance on z13 vs. zEC12 Ver. 1.1 with Octane
Open Technology SQL/NoSQL Data serving performance

**MariaDB 10.1.5**
1.8x to 2.1x throughput improvement on Sysbench Benchmark

**MongoDB 3.0.4 (WiredTiger, no sharding)**
1.9x to 2.1x throughput improvement on YCSB Benchmark

**PostgreSQL 9.4**
1.6x to 2.2x throughput improvement on pgBench Benchmark

Consolidate multiple MongoDB servers in one instance by leveraging up to 8TB in LPAR
Apache Spark

- Up to **1.5x** faster insights for real-time analytics using Spark’s core primitives
- Up to **1.5x** more data processed for model building leading to real-time insights with higher accuracy within a given batch window

Co-locate Spark with non IBM Database on LinuxONE outperforms running Spark off-platform up to **3x** for aggregation analytical query

- e.g. Operational Analytics for a Brokerage running reports on top of OLTP Trading data

![Graph showing speedup comparison between z13 and alternative platform](image)

*Composite Mean Across 8 ‘Spark’ Core Benchmarks

![Graph showing TPC-E Database Aggregation Query](image)

**Million rows per minute**

<table>
<thead>
<tr>
<th># Partitions</th>
<th>Linux on z13</th>
<th>Alternative platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>
Hardware Compression

- Up to 7.5x reduction in elapsed-time to compress database: MongoDB, containing large documents
- Up to 4.5x reduction in elapsed time when using MongoDB GridFS to put files (>16M document or binary file) – zEDC vs. software gzip

- Up to 4.9x better throughput archiving Spark RDD on z13 with zEDC vs. software gzip compression
- Up to 4x reduction in elapsed time to compress Docker containers on z13 with zEDC vs. software gzip
Systems of Engagement and Systems of Record in a box

**Agility = Capability + Speed**

Co-locate Node.js on z Systems vs. alt platform

2.5x Better Throughput and Response Time to DB2 on z/OS

WebSphere App Server
Business Logic
Persistent Layer

Twitter

Linux

z/OS

DB2
Putting it all together – LinuxCon Demo: “Scalable Financial Trading Analysis & Insights”

Input Data
- Historical S&P 500 Index
- News Feed
- Sentiment Analysis
- Trade Transactions
- Geospatial Analysis

Visualization Dashboard

Open Source Content
- MongoDB
- Spark
- MariaDB
- PostgreSQL
- Apache Kafka
- Docker
- Chef
- NGINX

https://www.youtube.com/watch?v=VWBNolwGEjo

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Just Awesome Results!
Scalability, Performance, Security, Availability

MongoDB, MariaDB, Postgres
up to 2x faster

Compression Spark RDD 4.9x faster
Docker Persistence 4x faster

Encryption 28x faster

Node.js up to 2x faster

Spark Analytics up to 3x faster

“LinuxONE system using Node.js and MongoDB can handle over 30 Billion web events

“Each DB node on LinuxOne with a scale-up footprint, for example, a 1 TB, 2 Billion+ documents, 460,000 reads/writes/second. No Sharding required. Sustained throughput and response time.
Package Manager ➔ Repositories ➙ RPM Packages

IBM Open Source ecosystem team
- Experiment with packaging and port RPMs to Linux on z Systems
- Use community build technology internally
- Upstream RPM spec changes to community repositories
- Enable community to build on z Systems

Open source content within distros enables Linux on z Systems customers ease of access and support and encourages net new workload to come to the platform
Strategy for maintaining currency

- Contribute platform fixes upstream and enable fully automated continuous integration in the community development process
  - Contribute documentation improvements to help people develop/build on z Systems
  - Catch bugs early! Don’t leave them until distribution testing
  - Help distributions produce official packages for these projects

- Interim solution: IBM-internal automated integration of open-source software on z Systems
  - Jenkins periodically checks out and builds upstream code, runs regression tests
  - IBM team reports failures to community and contributes fixes
IBM LinuxONE Community Cloud

Goal: Remote access to LinuxONE and IBM z Systems

- **ISVs**
  - Available for ISV through PartnerWorld
  - Hosted by IBM in Dallas, Böblingen, and Beijing
  - Port, test, benchmark key applications
  - Available now

- **Clients**
  - Remote access environment free of charge for limited time
  - Client Sandbox for Proof of Concept work to verify and test new apps and try new technologies
  - Available now

- **Students and Developers**
  - Free access to Developers, Students, and Entrepreneurs
  - Hosted by Partnership Universities: Syracuse University and Marist College
  - Get a LinuxONE virtual machine in minutes
  - Available November 2015
Future directions

- Continue to aggressively port foundational and popular software
  - Help open-source projects optimize their code on IBM z Systems hardware
- Simplify access to open-source software for LinuxONE and IBM z Systems
  - An online system for packaging software for LinuxONE and IBM z Systems, and distributing them to clients
- Seek partnerships with ISVs for IBM z Systems client Enterprise support
- Collaborate with distributions to expand coverage for IBM z Systems
- Work to enabled and encourage IBM z Systems presence in communities
Jim Elliott
z Systems Consultant
zChampion and Linux Ambassador
IBM Systems

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