IBM LinuxONE™

Open Source & ISV Ecosystem Enablement for LinuxONE and IBM z

LinuxCon, Seattle Washington

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Agenda

- LinuxONE and IBM z Overview
- LinuxONE and IBM z Open Source & ISV Ecosystem & Content
- Recent Performance Measurements
- Scalable Financial Trading Analysis and Insights Demo
- Enabling access to the Open Source Products
- Enabling access to the “Open Access Community Cloud”

We are still working through this and learning along the way … and will continue to seek guidance & prioritization from our customers!

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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

55 percent

of all enterprise applications need the mainframe to complete transactions

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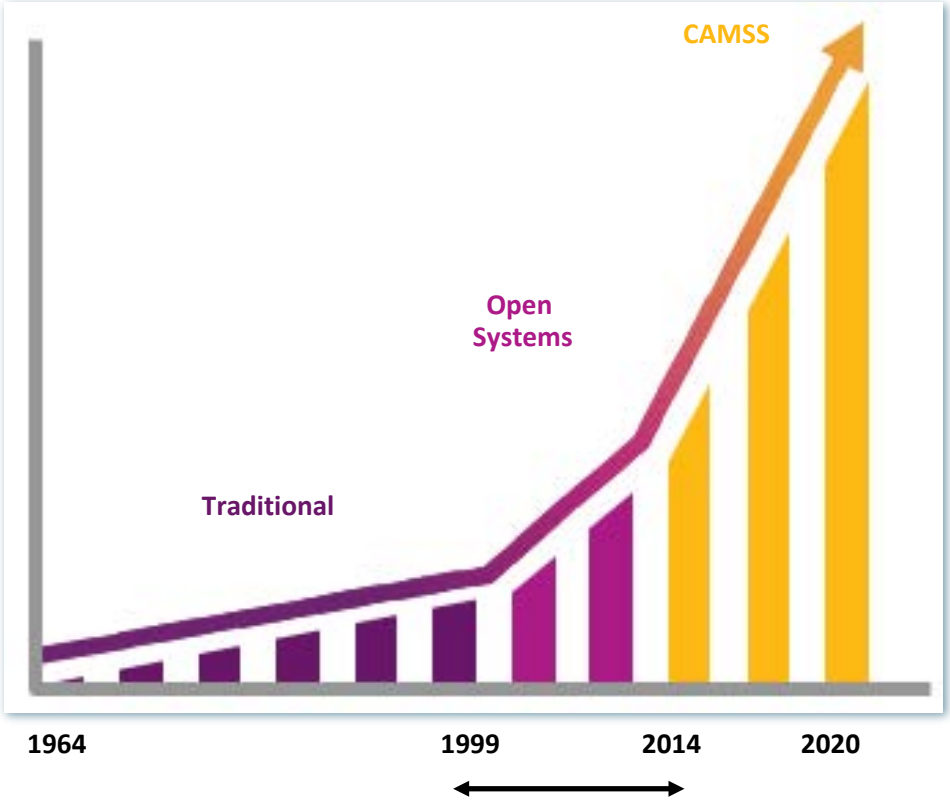
New marketplace dynamics will drive hyper growth opportunity for the IBM Mainframe



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

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

CAMSS[2] 2015–2020
- On/Off Premise, Hybrid Cloud
- Big Data & Analytics
- Enterprise Mobile Apps
- Security solutions

15 years of Enterprise Linux® on z Systems™

- **Open Source LinuxONE and IBM z ecosystem enablement**

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

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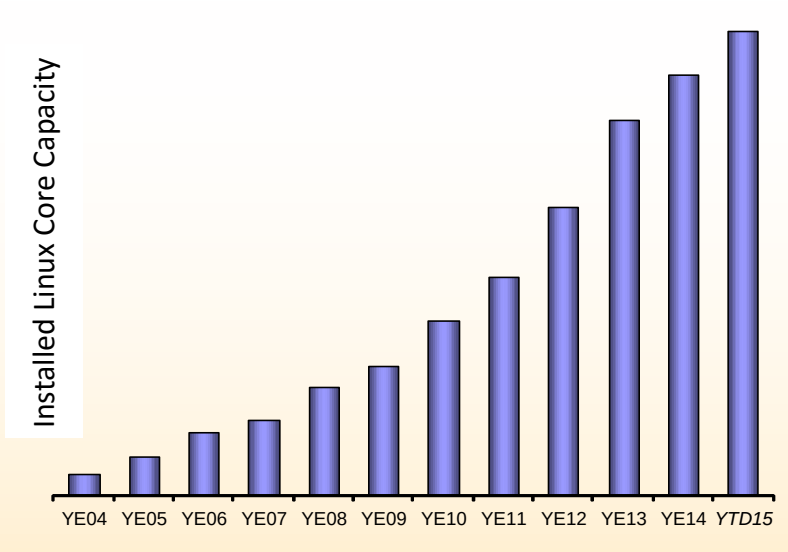
Linux on IBM z as of 2Q2015

Installed Linux capacity ~45% CAGR last 10 years

- 27% of total installed capacity[1] run Linux
- Linux core[2] capacity increased 16% from 2Q14 to 2Q15
- 40% of customers have Linux cores
- 80% of the top 100 customers running Linux on the mainframe[3]
- 67% of new accounts run Linux

Installed Capacity Over Time



1. Capacity or MIPS: Millions of Instructions per Second or the metric z uses to measure client workload
2. Linux core or IFL: Integrated Facility for Linux or the terminology used to describe a processor core. z13 has on average 7 cores/CPU chip
3. Top 100 is based on total installed MIPS

http://www-03.ibm.com/systems/z/os/linux/success/

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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 & OPEN

- Freedom & Agility
- Standards based
- Speed to Innovate
- Developer Productivity
- Community Collaboration
- Open source SW & applications

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**

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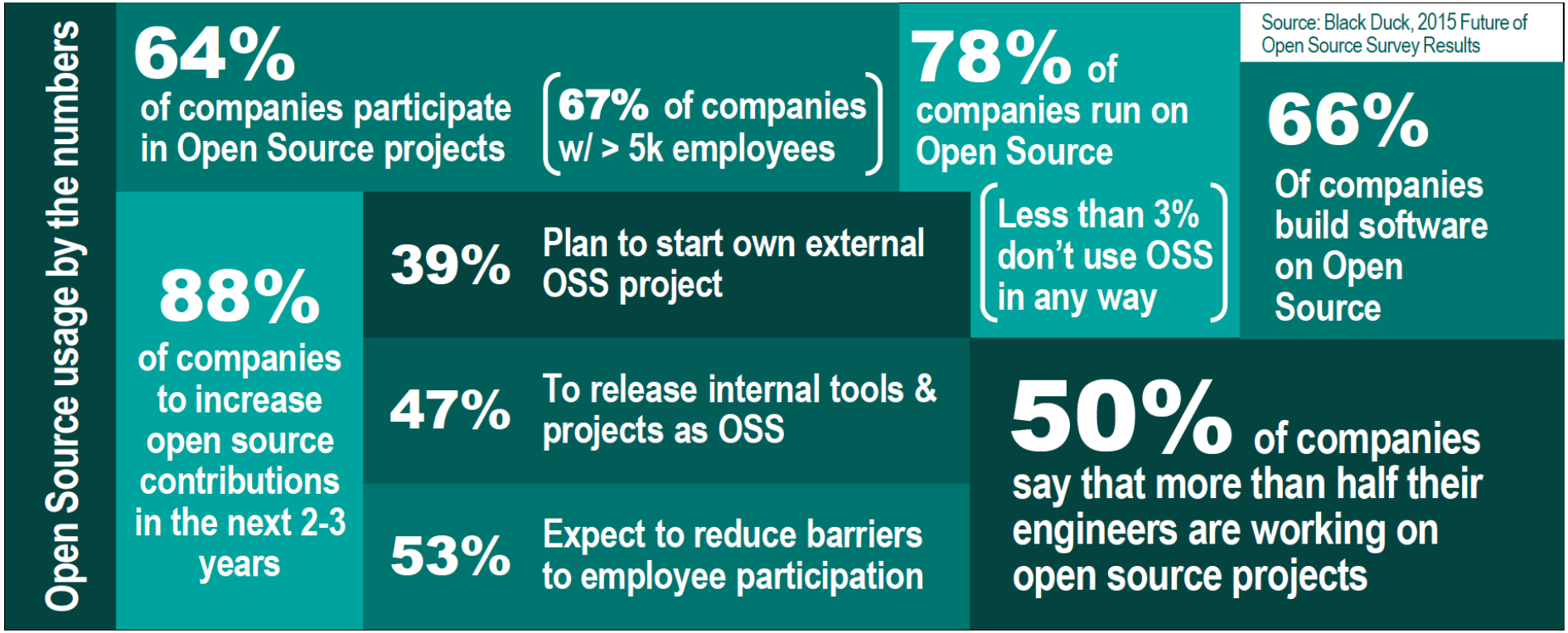
Open Source in the Enterprise



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LinuxONE and IBM z
Open Source & ISV Ecosystem CoC

Stakeholders	z Clients	ISVs, Biz Part. & 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 & Environment	Database & Messaging	Cloud Infrastructure	Big Data & Analytics

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Open Source & ISV Linux SW Capability

Ported - verified
Work in progress

Tier 1: Foundation Packages*

- **Porting work**: for some packages, compilers, bug fixes, build script changes are required
- "**Dockerize**" all ports
- Working to get more engaged within these communities

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

Various sources of input: e.g. BlueMix, Github stats, feedback from: direct client input, IBM client reps, on going research

** Content and priority are subject to change*

Open Source & ISV Linux SW Capability

Ported - verified
Work in progress

Tier 2: Popular Tools and Applications*

- Most packages just work on LinuxONE and IBM z Systems without porting effort, especially if written in Java or supported languages, and RHEL/SLES are among supported distros.
- "**Dockerize**" all ports
- Working to get more engaged within these communities

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

Validating packages per customer request

** Content and priority are subject to change*

LinuxONE and IBM z
Open Source & ISV Ecosystem Community

- One stop shop to find out what is available
  - https://www.ibm.com/developerworks/community/groups/community/lozopensource/
- Information on all open-source software
  - Recipes for building the software on LinuxONE and IBM z
  - 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
  - Users can post questions/comments
  - Provide feedback to the Open Source & ISV Ecosystem team
- **We look forward to hearing from you!**

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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, today 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," stated Patrik Sallner, CEO of MariaDB. "With Linux on IBM z 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***

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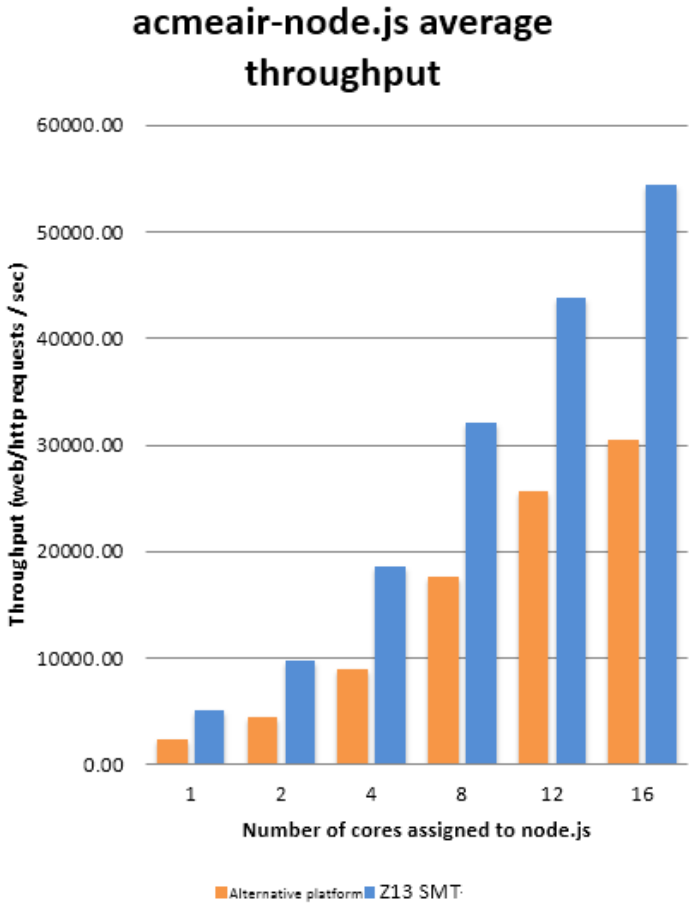
Industry leading runtime capabilities with node.js

- New Release compatible with Joyent Node.js v0.12 https://nodejs.org/download/
- High Performance JavaScript for LinuxONE and IBM z
  - 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



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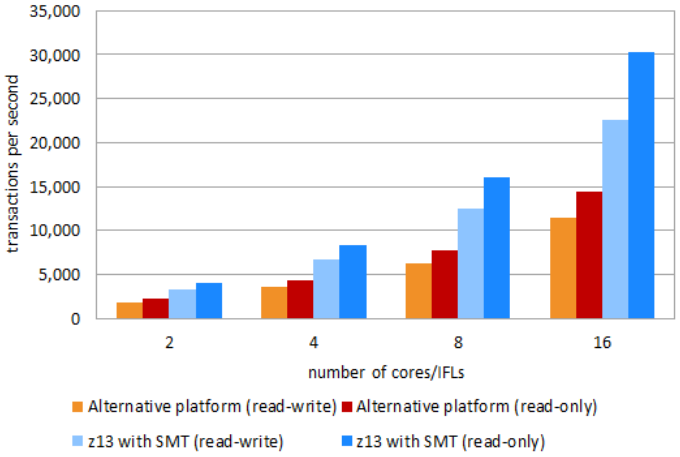
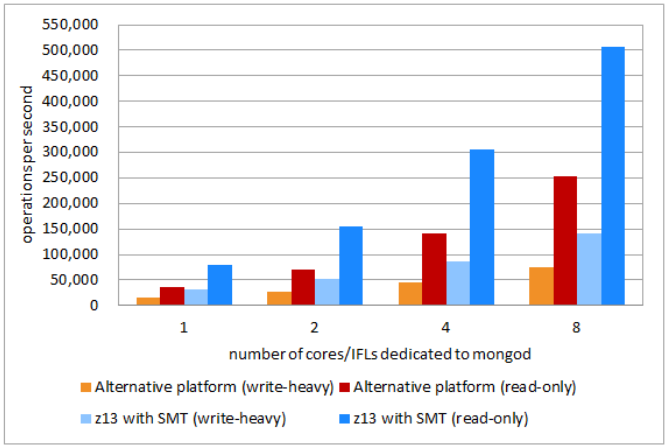
Open Technology SQL/NoSQL Data serving performance

MariaDB 10.1.5



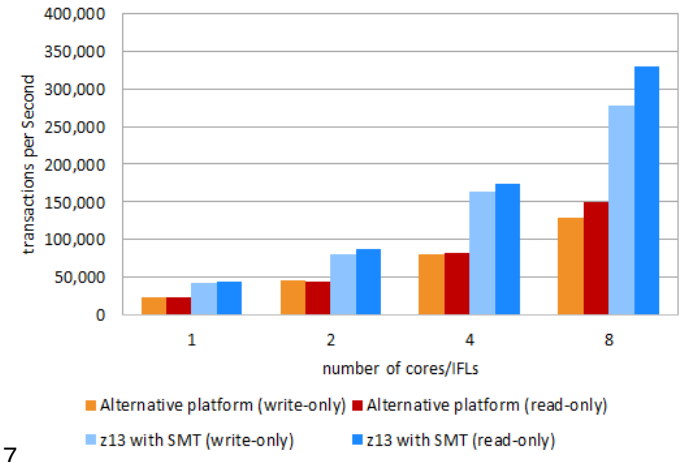
1.8x to 2.1x throughput improvement on Sysbench Benchmark

MongoDB 3.0.4 (WiredTiger, no sharding)



1.9x to 2.1x throughput improvement on YCSB Benchmark

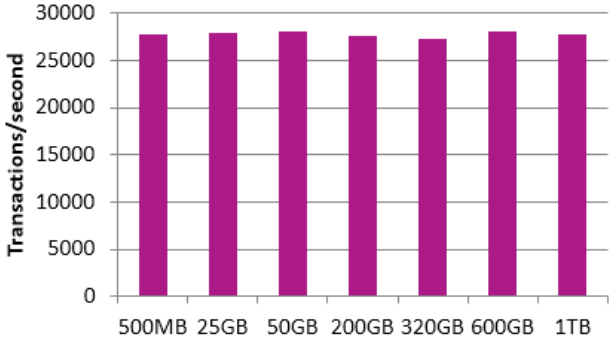
PostgreSQL 9.4



1.6x to 2.2x throughput improvement on pgBench Benchmark

Extreme Scale Up

AcmeAir throughput vs. collection size



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

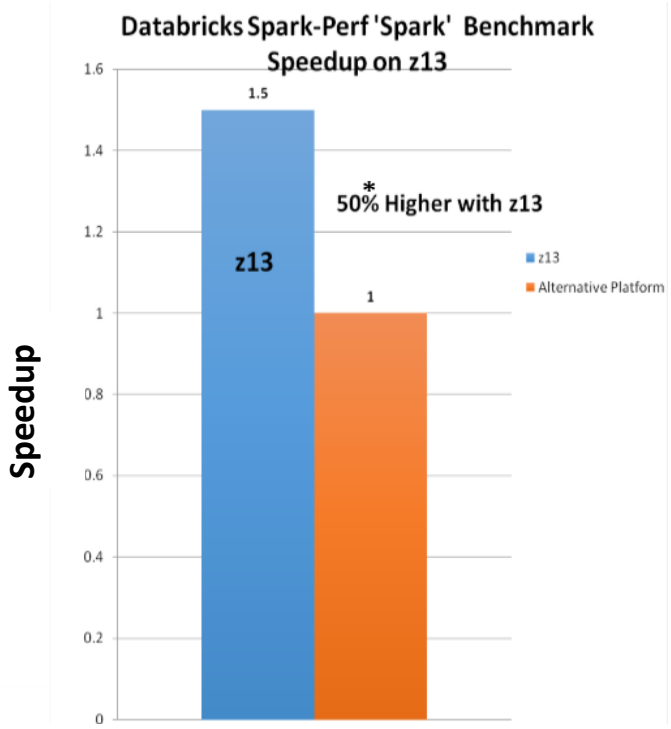
–Maintain throughput and response times of < 5ms

–Processing 2B+ documents

–Avoid the overhead, cost and complexity of sharding

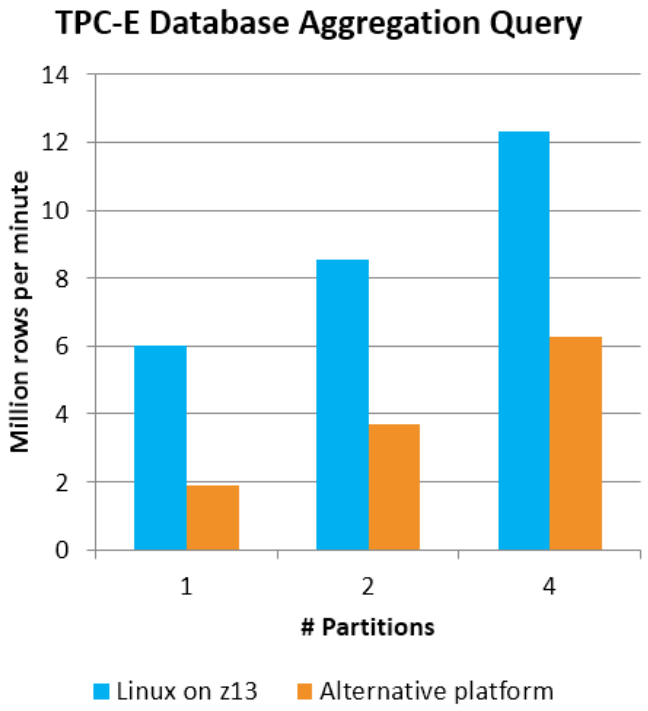
Spark

- 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



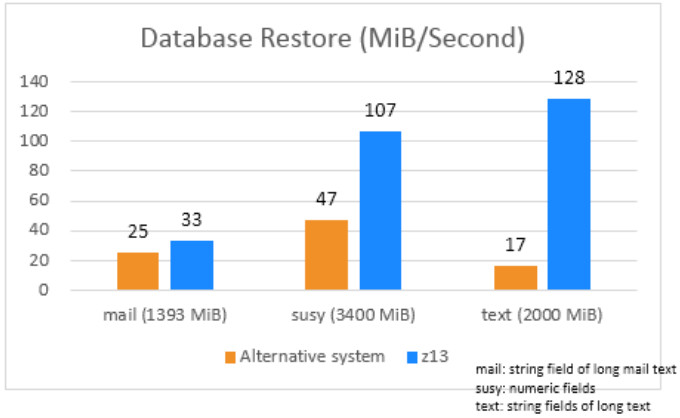
*Composite Mean Across 8 'Spark' Core Benchmarks

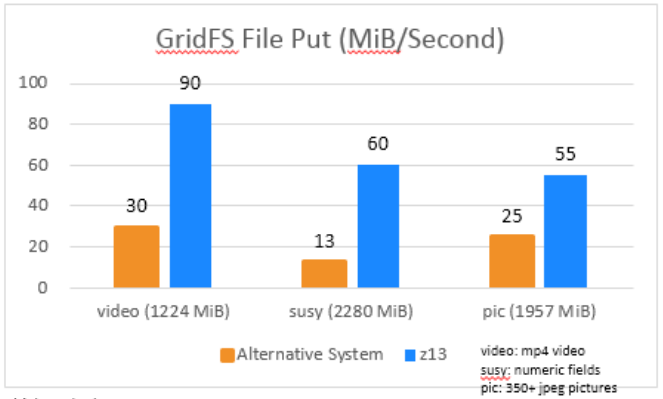
- Co-locate Spark with non IBM Database on LinuxONE outperforms running Spark off-platform up to **3x** for aggregation analytical query
  - e.g. Operational Analytics for a Brokerage running reports on top of OLTP Trading data



HW Compression

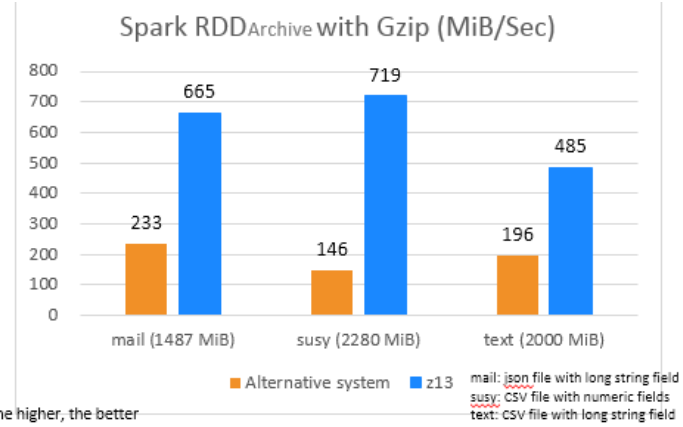
- Up to **7.5x** reduction in elapsed-time to compress database: MongoDB, containing large documents
- Up to **4.5x** reduction in elapsed time when using MongoDB GridFS to put files (>16M document or binary file) – zEDC vs. SW gzip compression



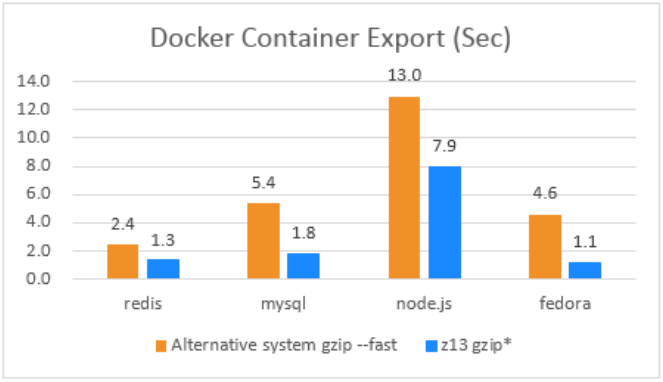


The higher, the better

- 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. SW gzip



The higher, the better



The lower, the better

* Uses zEDC GenQWE gzip or gunzip.

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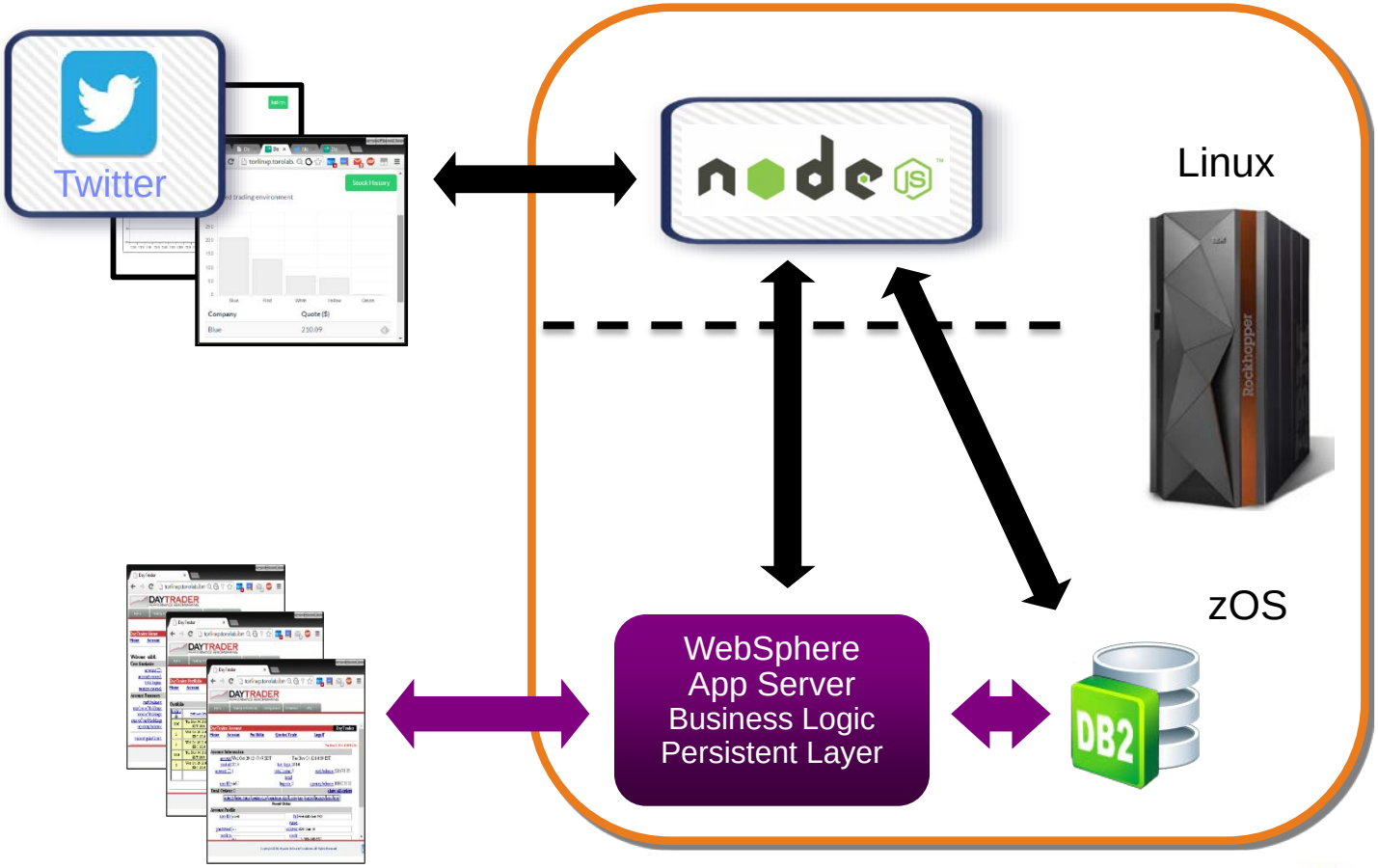
SOE & SOR in a box

Agility = Capability + Speed



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

2.5x Better Throughput & Response Time

to **DB2 on z/OS**

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Putting it all together – All enabled by Open Source running LinuxONE and IBM z Systems: *LinuxCon Demo: "Scalable Financial Trading Analysis & Insights"*

Input Data

S&P DOW JONES INDICES

Historical S&P 500 Index

YAHOO! AlchemyAPI An IBM Company

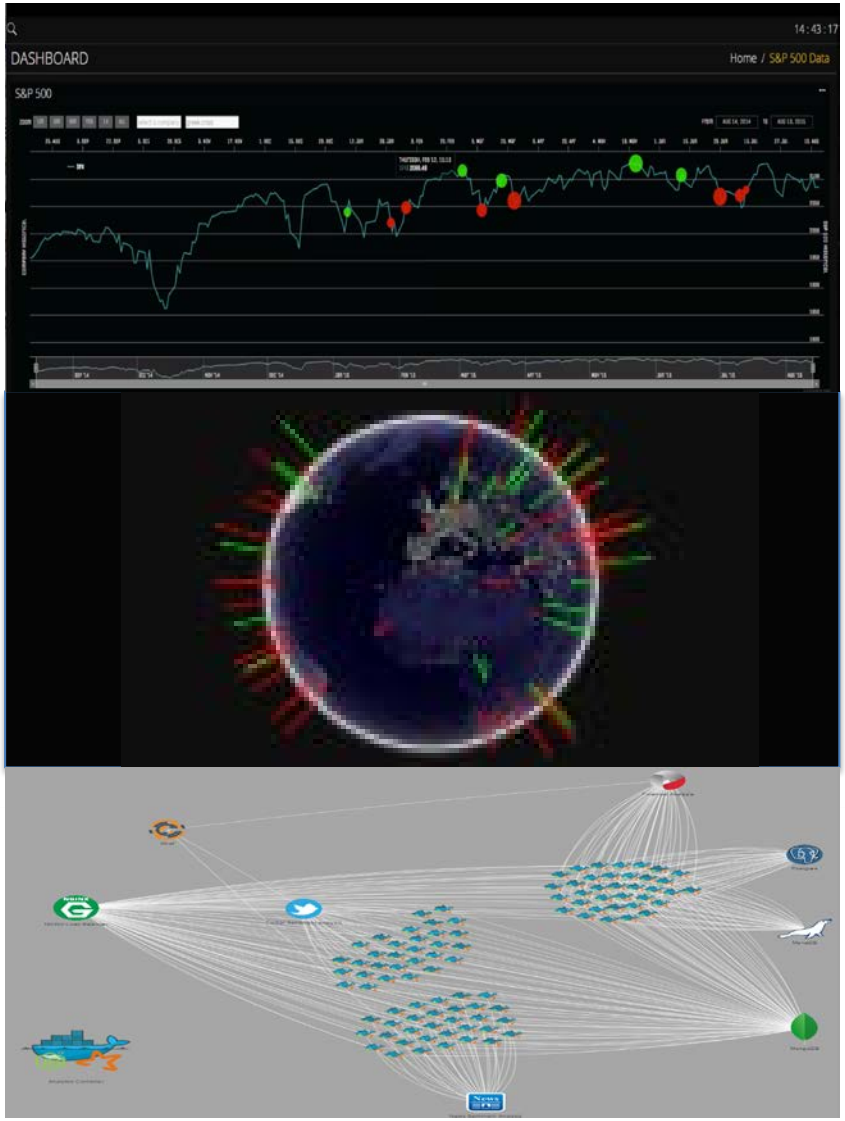
News Feed

Sentiment Analysis

Trade Transactions

Geospatial Analysis

Visualization Dashboard



Open Source Content

mongoDB

Spark

MariaDB

PostgreSQL

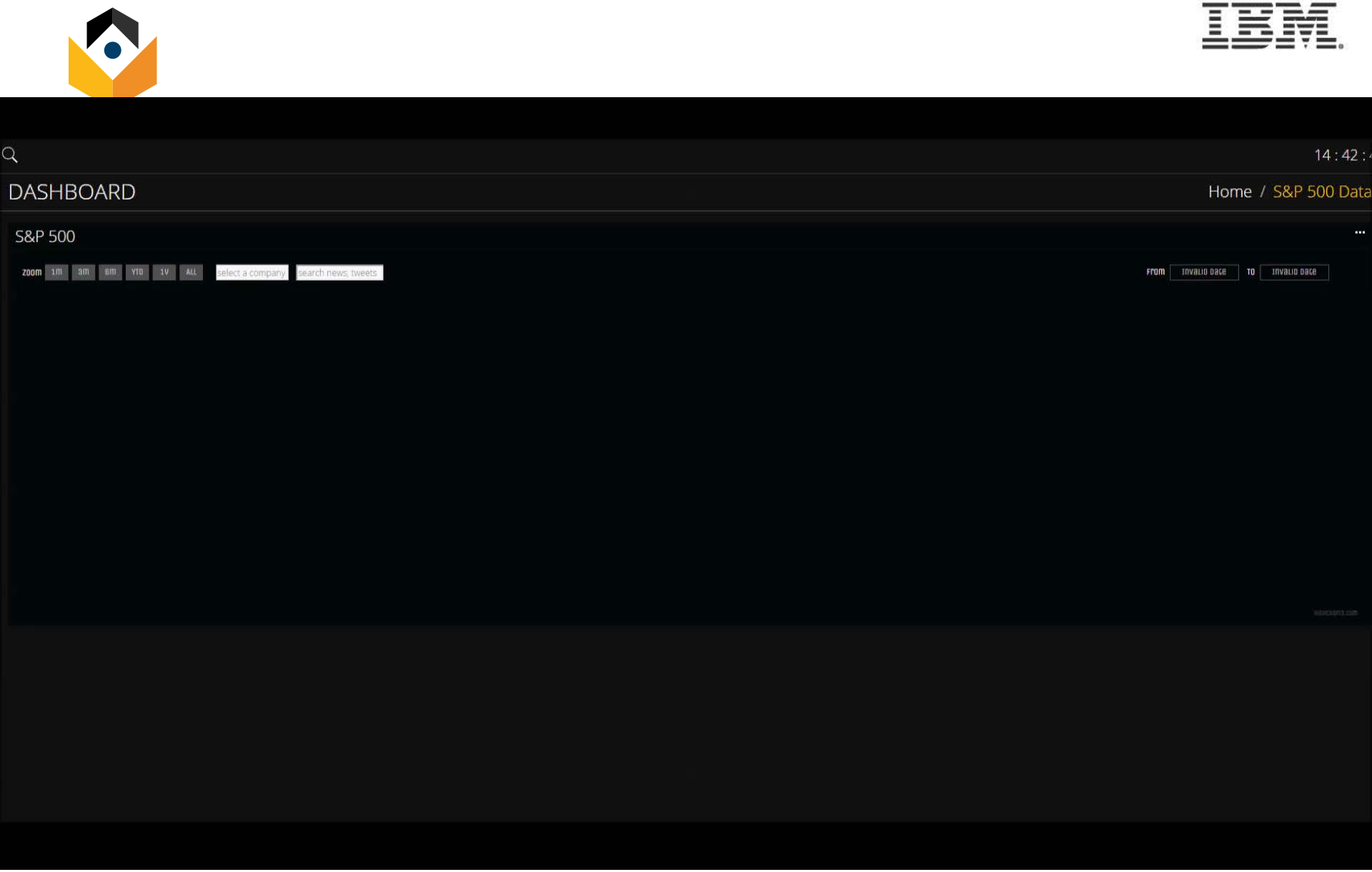
node.js

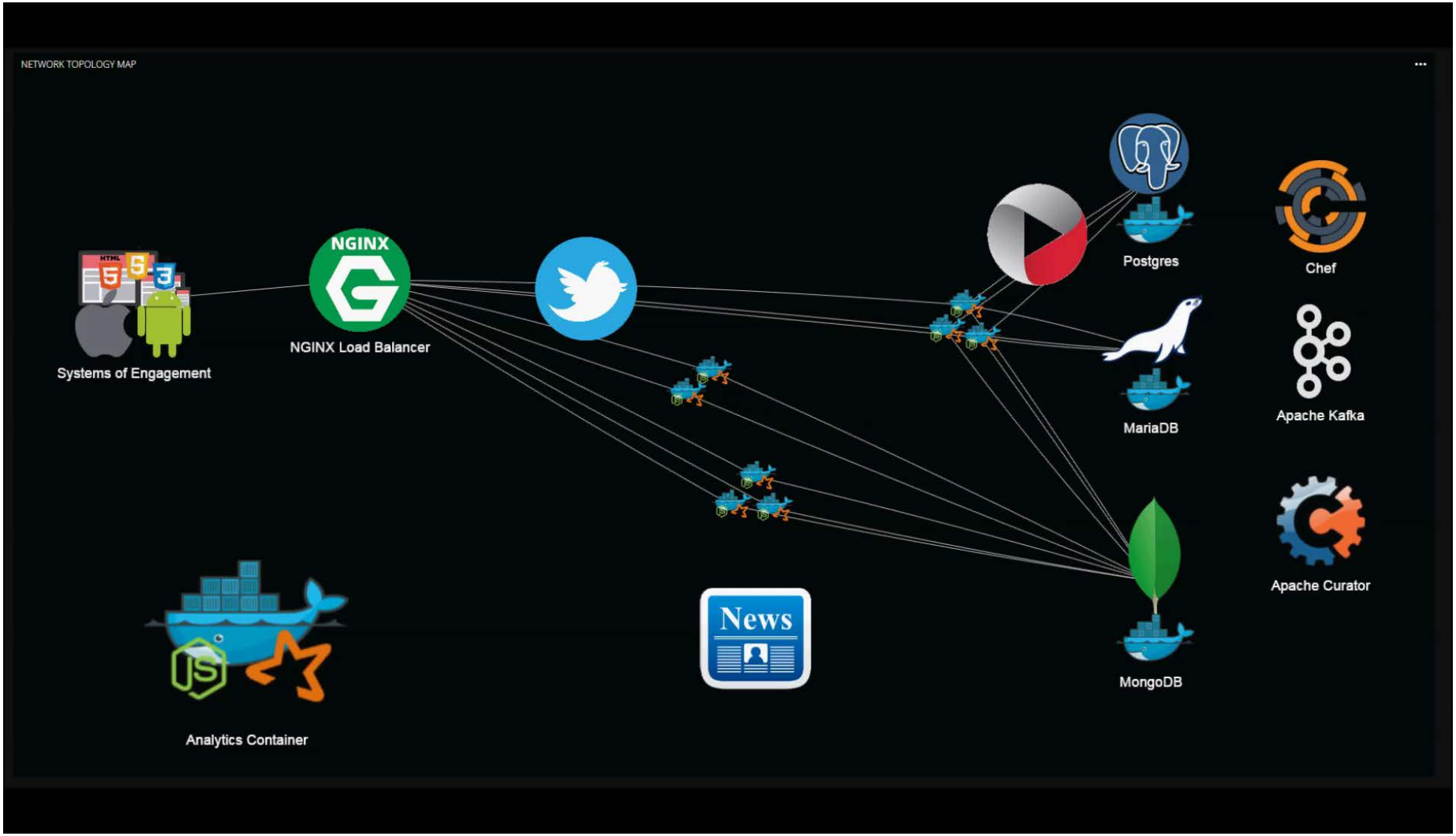
docker

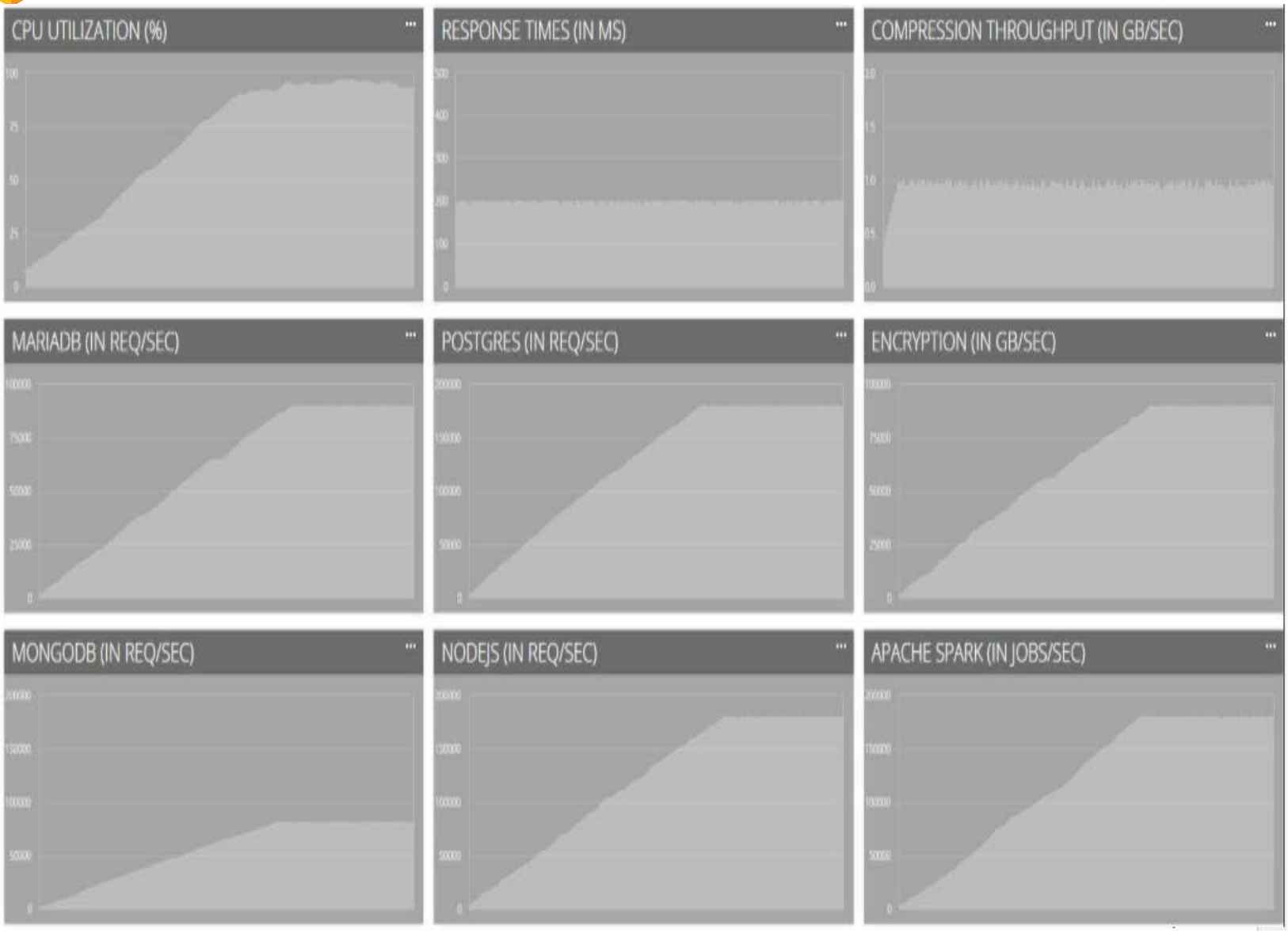
Apache Kafka
A high-throughput distributed messaging system.

NGINX

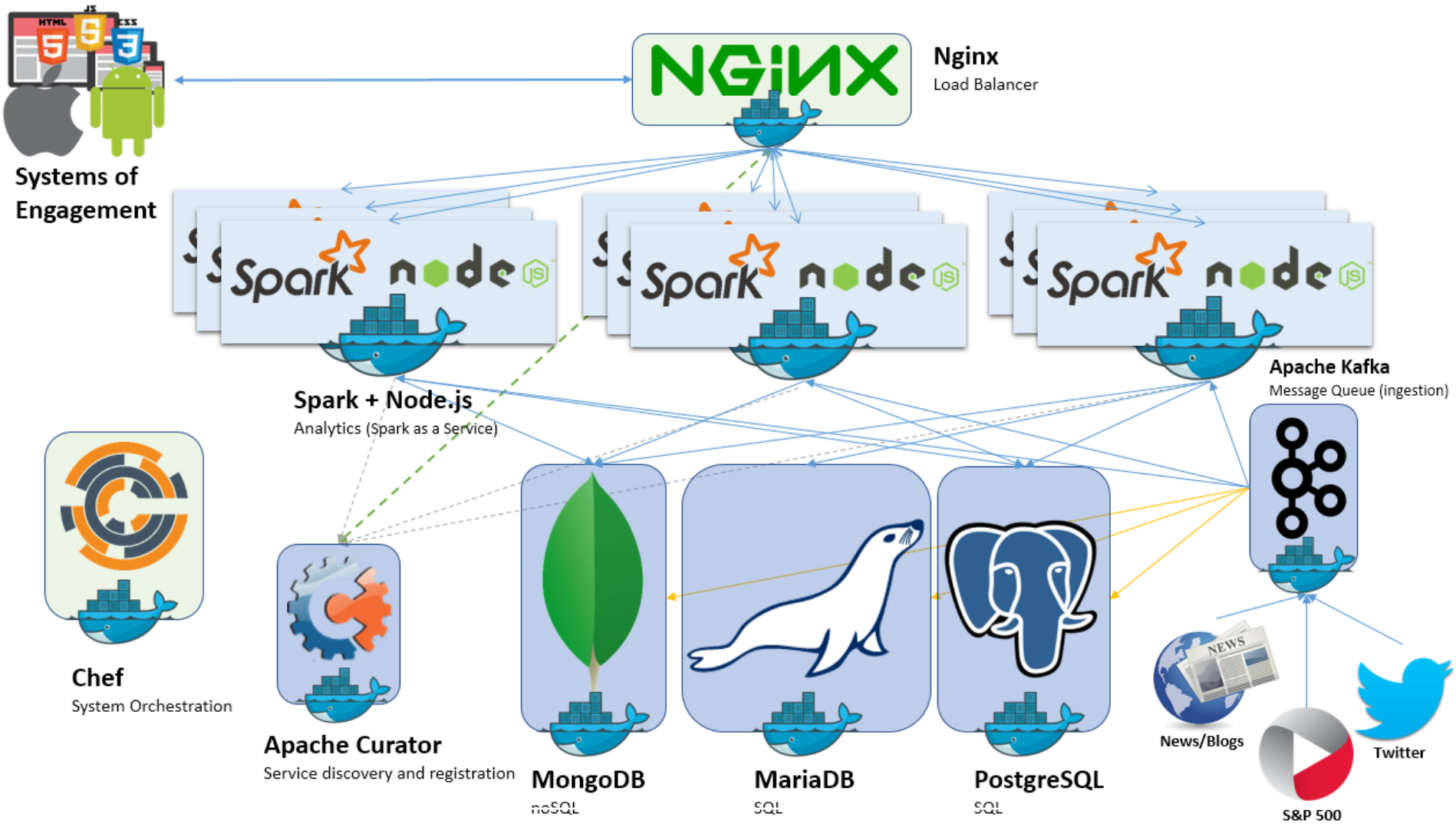
CHEF


14 : 42 :
DASHBOARD
Home / S&P 500 Data
S&P 500
zoom 1M 3M 6M YTD 1Y ALL
select a company
search news, tweets
From Invalid Date
To Invalid Date


NETWORK TOPOLOGY MAP
Systems of Engagement
NGINX
NGINX Load Balancer
Postgres
Chef
MariaDB
Apache Kafka
Apache Curator
MongoDB
News
Analytics Container


CPU UTILIZATION (%)
RESPONSE TIMES (IN MS)
COMPRESSION THROUGHPUT (IN GB/SEC)
MARIADB (IN REQ/SEC)
POSTGRES (IN REQ/SEC)
ENCRYPTION (IN GB/SEC)
MONGODB (IN REQ/SEC)
NODEJS (IN REQ/SEC)
APACHE SPARK (IN JOBS/SEC)

LinuxCon Demo Architecture



https://www.dropbox.com/s/3szus6vk77rg1nh/linuxcondemowithgraphs.mp4?dl=0

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 30Billion web events

"Each *DB node on LinuxOne with a scale-up footprint , for example, a 1TB, 2Billion+ documents, 460,000 reads/writes/second. No Sharding required. Sustained throughput and response time.*

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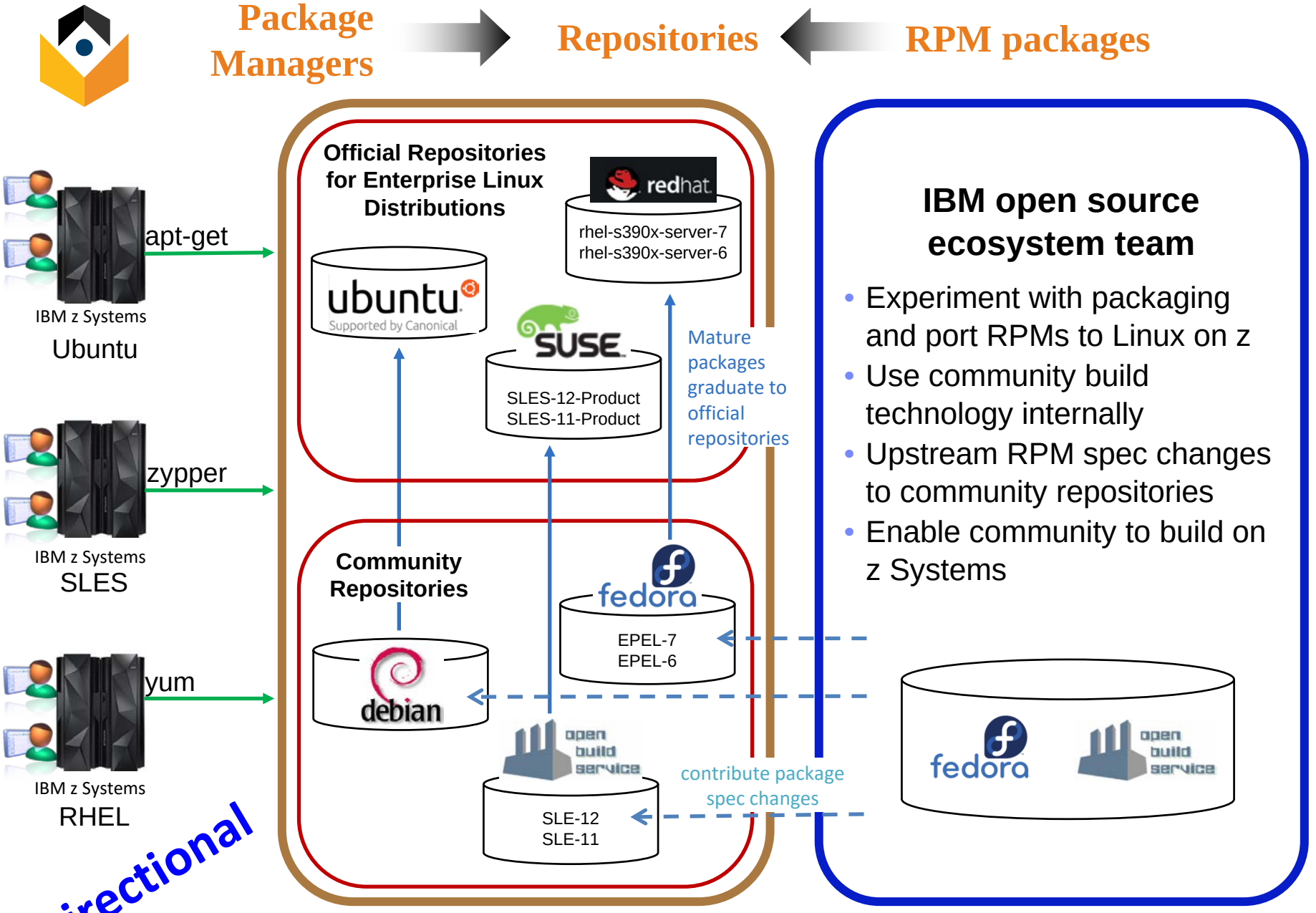

Open source content within distros enables z customers ease of access and support and encourages net new workload to come to the platform

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
  - 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
  - Jenkins periodically checks out and builds upstream code, runs regression tests
  - IBM team reports failures to community and contributes fixes

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IBM LinuxONE Community Cloud

GOAL: Give developers, ISVs and students remote access to LinuxONE & IBM z

ISVs

- Available for ISV through PartnerWorld
- Hosted by IBM in Dallas, Boeblingen and Beijing
- Port, test, benchmark key applications
- Available Now

Clients

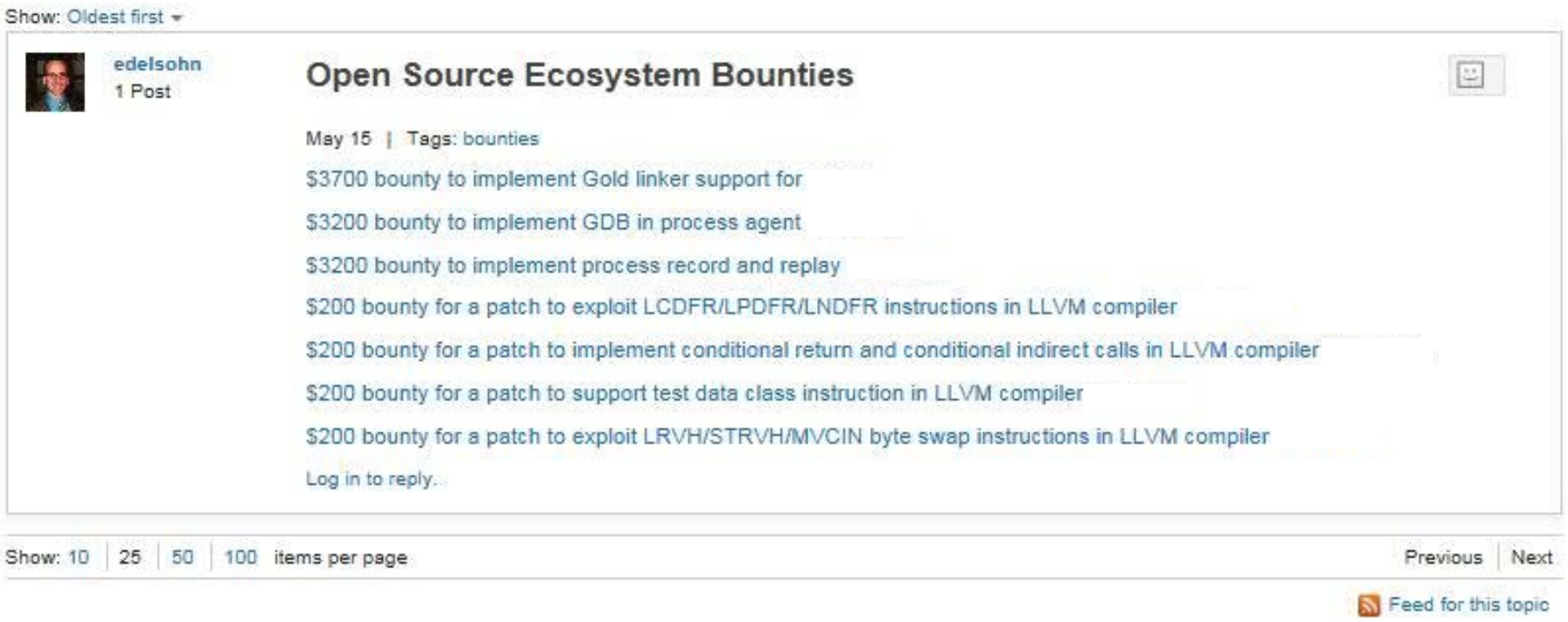
- Remote access environment free of charge for limited time
- Client Sandbox for Proof of Concept work to verify and test new apps and try new technologies
- Available Now

Students & Developers

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

Bounties for LinuxONE & IBM z

- Capture some bounties!
- Let us know if you have ideas for any new bounties



https://www.bountysource.com/teams/ibm/bounties

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Future directions

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

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Questions?

Thank you!

Dale Hoffman (daleh@us.ibm.com)
Marcel Mitran (mmitran@ca.ibm.com)

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Backup

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Acknowledgements

- None of this work would be possible without the outstanding contributions from our Linux on System z Open Source Ecosystem Leadership Team, our Linux on System z Performance teams , Research, various technical contributors, the CPO, and those who ensured we would have the test HW available
- Demo Core team: Mohammad Abdirashid, Elton Desouza, Donna Dillenberger, Dale Hoffman, Marcel Mitran, Eberhard Pasch, Otto Wohlmuth
- Performance Leadership Team: Tarun Chopra, Raj Krishnamurthy, Qi Liang, Moriyoshi Ohara, Hartmut Penner, Stefan Wirag
- Ecosystem Leadership Team: Bryan Chan, Cindy Lee, Enyu Wang, Cheryl Fraser
- Technical Contributors: Ivan Dovgan, David Petersen, Gong Su
- CPO: Avijit Chatterjee, David Rhoderick
- Demo test: Tom Rozmus, Joe Stein

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Where to get packages

IBM

Assets	Where to get it?
Apache Geode	https://github.com/linux-on-ibm-z/docs/wiki/Building-Apache-Geode-1.0.0
Apache HTTP	https://github.com/linux-on-ibm-z/docs/wiki/Building-Apache-HTTP-server
AntLR	https://github.com/linux-on-ibm-z/docs/wiki/Building-AntLR
Cassandra	https://github.com/linux-on-ibm-z/docs/wiki/Building-Cassandra
Ceilometer client	https://github.com/linux-on-ibm-z/docs/wiki/Building-Python-Ceilometer-client
Chef client & server	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
CouchDB	https://github.com/linux-on-ibm-z/docs/wiki/Building-CouchDB
Docker	http://www.ibm.com/developerworks/linux/linux390/docker.html
Docker Compose	https://github.com/linux-on-ibm-z/docs/wiki/Building-Docker-Compose
Docker Distribution	https://github.com/linux-on-ibm-z/docs/wiki/Building-Docker-Distribution-2.0.1
Docker Swarm	https://github.com/linux-on-ibm-z/docs/wiki/Building-Docker-Swarm
Doxygen	https://github.com/linux-on-ibm-z/docs/wiki/Building-Doxygen
Erlang	https://github.com/linux-on-ibm-z/docs/wiki/Building-Erlang
Fluentd	https://github.com/linux-on-ibm-z/docs/wiki/Building-Fluentd
Go (GCCGO)	https://github.com/linux-on-ibm-z/docs/wiki/Building-gccgo

Where to get packages

Assets	Where to get it?
Logstash	https://github.com/linux-on-ibm-z/docs/wiki/Building-Logstash
MariaDB	https://github.com/linux-on-ibm-z/docs/wiki/Building-MariaDB-10.0
Maven	https://github.com/linux-on-ibm-z/docs/wiki/Building-Maven
MongoDB	https://github.com/linux-on-ibm-z/docs/wiki/Building-MongoDB https://github.com/linux-on-ibm-z/docs/wiki/Building-MongoDB-3.0-on-RHEL-6-and-SLES-11
MySQL	https://github.com/linux-on-ibm-z/docs/wiki/Building-MySQL
Node.JS	https://nodejs.org/download/
oCaml Interpreter	https://github.com/linux-on-ibm-z/docs/wiki/Building-oCaml-interpreter
PostgreSQL	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-RHEL7 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-RHEL6

Where to get packages

Assets	Where to get it?
Protobuf	https://github.com/linux-on-ibm-z/docs/wiki/Building-ProtoBuf
Puppet	https://github.com/linux-on-ibm-z/docs/wiki/Building-Puppet
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

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