

# DB2 for Linux on z Systems

Central Ohio DB2 User Group (CODUG)

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May 13, 2016



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# History of DB2 for Linux for z Systems



- In 2000, **DB2 7.1** was one of the first software programs certified for use on Linux for System Z
- Ever since the IBM DB2 and Linux for System Z teams work together
- Quality, reliability, and performance **proven by hundreds of customers**
- In 2013 IBM delivered **DB2 10.5** for Linux on System Z
- In Q3 2014 **DB2 10.5 FP4** was delivered
- In December 2014, DB2 BLU Acceleration became available
- In Q4 2015 DB2 Early Access Program includes Linux on System z
- In December 2015, DB2 10.5 FP7 became available
- In June 2016, DB2 11.1 will become available

**16 years of Enterprise Linux® on System z®**

A simple idea that changed the world

*running DB2*



2000

2003

2006

2009

2012

2016

# Mizuho Bank, Ltd.

IBM z Systems technology running a Linux operating system helps bank reduce operating costs

**Designed for continuity and scalability, the solution provided the foundation Mizuho needed for its Linux environment to develop and deploy new services faster and more reliably.**

**IBM z Systems technology provides the scalability and stability Mizuho needs to run an active-active system for its Linux environment at half the cost and deliver business continuity for its customers.**

**Mizuho updated online and mobile applications, keeping user satisfaction high and expanding its online presence by gaining scalability and sustainability.**

## Solution components

### Systems

- IBM z Systems™ running Linux®
- IBM zEnterprise® EC12
- SUSE Linux Enterprise Server for System z

### Software

- IBM DB2® for Linux
- IBM DB2® High-Availability Disaster Recovery
- IBM InfoSphere® Data Replication (Q Replication)

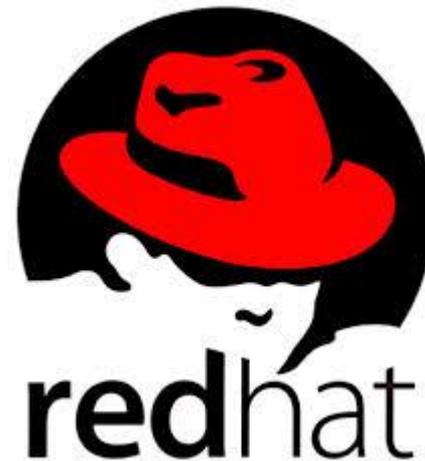
IBM z Systems technology running a Linux and an IBM DB2 data server helps Mizuho provide reliable and visionary services.

***“We now deliver innovative financial services and avoid, or instantly recover from, system failures, promoting business continuity and increasing customer satisfaction,”***

says Masahiko Kato, division head of IT and system general division 1 at Mizuho.

## Choose from 2 Linux for z System Distributions

- IBM is committed to open standards Linux
- DB2 is **optimized to run on current SuSE and Red Hat Linux** distributions
- Interested in Ubuntu? Let me know.



- Required levels (or later) for DB2 vNext
  - SLES 12
  - RHEL 7.1

# DB2 LUW : One Database Platform for All Business Applications

- Administration
- Development
- Performance Management
- Data Warehouse Management
- Data Server  
Manager
- Configuration Management
- Advanced Recovery Tools
- Host Connectivity

### Advanced Application Functionality

NoSQL ✓

Spatial

Analytics ✓

HADOOP Extensibility ✓

MongoDB API ✓

Industry Standard API's ✓

### Advanced Data Functionality

Oracle Compatibility ✓

JSON/Graph Store ✓

Pure XML ✓

Fine grained Security ✓

Workload Management ✓

Continual Data Ingest/Access ✓

Temporal Data ✓

In Memory BLU Acceleration ✓

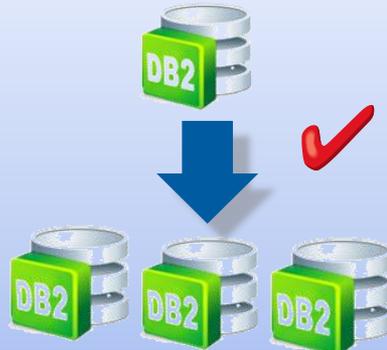
Autonomic Management ✓

Intelligent Compression ✓

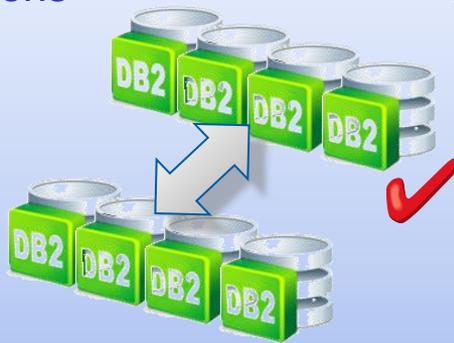
### Enterprise Data Platform for all Business Applications



Massive scale /  
24x7 OLTP Platform



Multi-tenant Enterprise  
Platform



Active / Active 24x7  
Massive Data Scale Warehouse

### Deployment Options

Customer Infrastructure Optimised Deployment

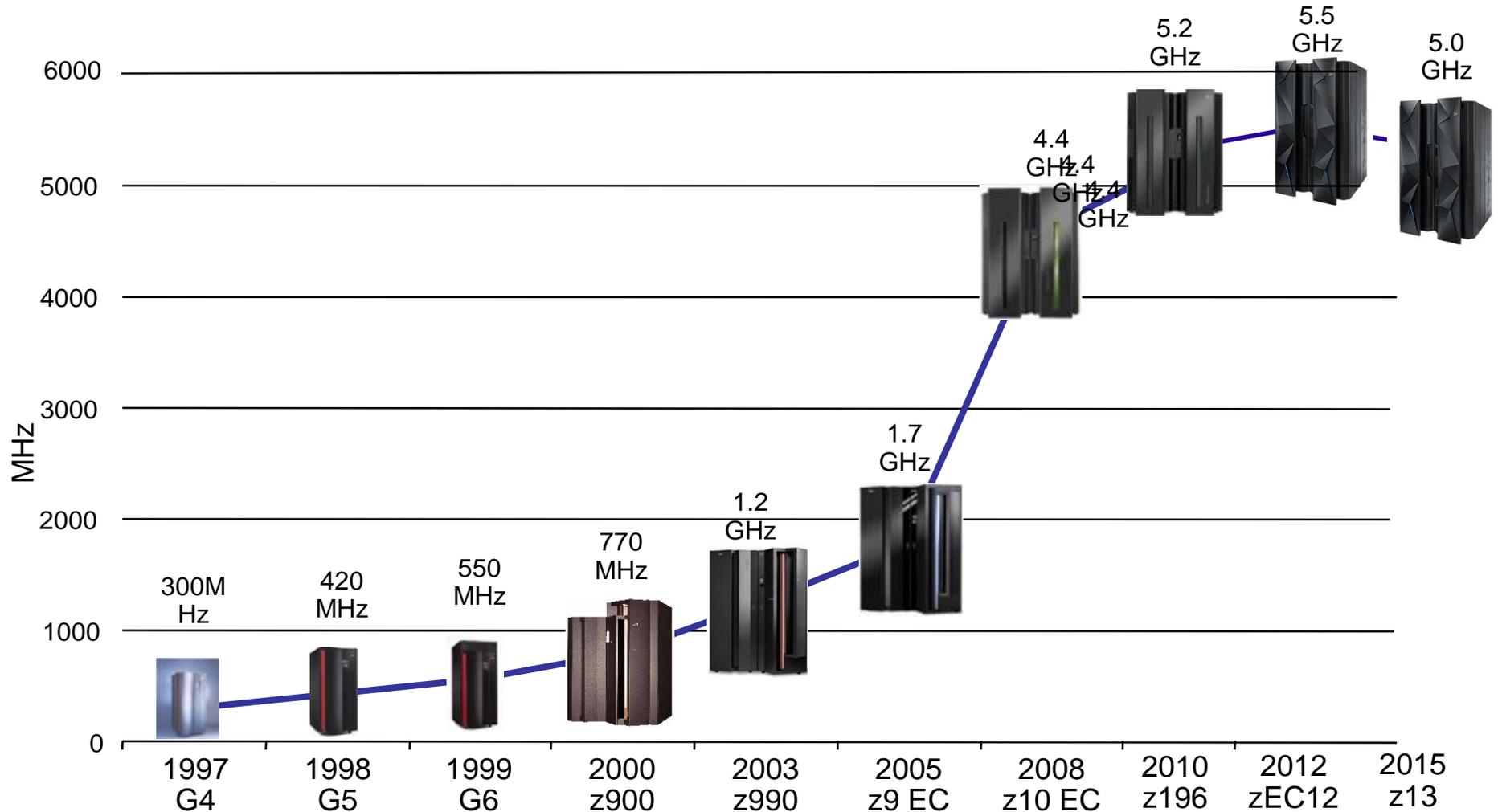


✓ Available for Linux on z Systems

# DB2 for Linux on z Systems

- **DB2 LUW for Linux on z Systems is**
  - **“Just” DB2 for LUW**
  - 99.9%+ the same code
  - 99.9%+ the same look/feel
  - 99.9%+ the same skills
  
- **DB2 LUW for Linux on z Systems has the same 98%+ Oracle Compatibility**
  - PL/SQL
  - Datatypes
  
- **DB2 LUW is not identical to DB2 for z/OS, but**
  - Common client infrastructure
    - SparkSQL DataFrame API
    - JCC/ODBC/CLI
    - Perl/PHP/Python/Ruby ...
  - Optim database tooling (Data Server Manager etc.)
  - Exceptionally similar DDL/DML/DCL

# z13 Continues the Mainframe Heritage



# IBM z Systems

Designed for digital business

# IBM LinuxONE™

Linux unleashed

Technology currency and  
new workload expansion

New clients and  
new footprints



# IBM LinuxONE Announcements: August 2015

## IBM LinuxONE SYSTEMS

IBM LinuxONE  
Emperor™

IBM LinuxONE  
Rockhopper™



## IBM LinuxONE SOLUTIONS



Mobile Analytics Cloud DevOps

## IBM LinuxONE Elastic Pricing

## Open Source & ISV Ecosystem

Distributions	Hypervisors	Languages	Runtimes	Management	Database	Analytics
<p><u>Supported Versions</u></p>						
<p><u>Community Versions</u></p>						

## IBM LinuxONE Community Cloud

Open Mainframe Project

Open Source Contribution

# IBM LinuxONE Rockhopper, Emperor

## Key Client Value Proposition

## Specifications

### Rockhopper L10, L20

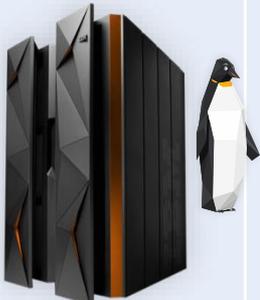


Machine Type 2965

- Expands the entry points into the LinuxONE family through new innovations, new partnerships, and a growing ecosystem
- Optimized with enterprise-grade Linux for open source software, enhanced scalability, with business continuity to support cloud
- Resiliency analytics recognizes patterns and prevents outages
- Transformed economics with new elastic pricing usage-based consumption model and investment protection

- Single frame
- Up to 20 LinuxONE cores
- Processor speed 4.3GHz, SMT2
- 40 Logical Partitions (LPARs)
- Up to 4TB total system memory
- RAIM memory design
- Up to 256 Power PC cores in I/O subsystem
- Up to 16 PCIe Gen3 Fanouts @ 16 GBps each
- 3 Logical Channel Subsystems (LCSSs)

### Emperor L30, L63, L96, LC9, LE1



Machine Type 2964

- Enterprise-class performance, scale, security, and availability
- Enables customers to run a wide ecosystem of Linux applications on an architecture with a set of unmatched attributes, technologies, design practices, and capabilities
- Resiliency analytics recognizes patterns and prevents outages
- Transformed economics with new elastic pricing usage-based consumption model and investment protection

- Dual frame
- Up to 141 LinuxONE cores
- 2 spare processors + Up to 24 SAPs
- Processor speed 5.0GHz, SMT2
- 85 Logical Partitions (LPARs)
- Up to 10TB total system memory
- RAIM memory design
- Up to 640 Power PC cores in I/O subsystem
- Up to 40 PCIe Gen3 Fanouts @ 16 GBps each
- 6 Logical Channel Subsystems (LCSSs)

# IBM DB2 with BLU Acceleration for Linux on z Systems



## What is BLU Acceleration

1. Next generation database
  - Super **fast** (query performance)
  - Super **simple** (load-and-go)
  - Super **small** (storage savings)
2. **Seamlessly integrated**
  - Built **seamlessly** into DB2
  - **Consistent** SQL, language interfaces, administration
  - Dramatic simplification
3. Hardware **optimized**
  - Memory optimized
  - CPU-optimized
  - I/O optimized

# What is DB2 with BLU Acceleration?

- **State-of-art technology for analytic queries in DB2 LUW**
  - Column-Organized Database
    - Data processed based on column instead of traditional row
    - Smaller Data and Faster Processing
  - Dynamic In-Memory Processing
    - Scan, locate and Cache data in memory even if data exceeds memory
  - Parallel Vector Processing
    - Provide multi-core and multiple data parallelism over different processors
  - Actionable Compression
    - Data being processed remains compressed (no need to uncompressed)
    - Deep, massive Compression
  - Data Skipping
    - Skip over the irrelevant data to access only necessary information
  - Easy to use
    - Load and Go – Data is ready for query in record time
    - No significant tuning – db2set DB2\_WORKLOAD=ANALYTICS



### Business challenge

Growing fast, Brazilian credit union system Sicoob must cope with extra transactions at short notice. How could it combat the increased IT complexity that resulted without impacting service quality?

### Transformation

Selecting IBM® z Systems™ as its strategic platform, Sicoob migrated and consolidated member databases to IBM DB2® LUW with BLU Acceleration® running in a Linux environment on the mainframe.

#### Business benefits:

## Supports

business growth at a larger scale to respond to market changes

## Up to 20x

faster analytics leads to real-time actions

## 35%

database compression reduces storage costs

# Sicoob

## Unleashing new growth and operational efficiency with an infrastructure transformation

Credit Unions System for Brazil (Sicoob) is the largest credit union system in Brazil, offering banking and credit services to more than 2.5 million people. Sicoob's customers are also its owners, so the financial returns benefit their communities rather than enriching shareholders.

*"IBM solutions help us to ensure consistently excellent service across all of our channels."*

Gustavo Mala Aguiar  
Leader of Information Technology  
Sicoob

Share this



**adapts to:**

- Any size RAM
- Any number of CPUs and cores
- Any number of disks, or SSDs

## Create

- Single parameter to configure entire database for BLU:

```
db2set DB2_WORKLOAD=ANALYTICS
```

- Create the database, table spaces, bufferpools, and tables

- Tip: Useful to define “mem\_percent”

```
db2 "create database mydb autoconfigure using  
    mem_percent 95 apply db and dbm"
```

```
db2 "create table mytable (c1 integer not null, ...)"
```

## Load your data

- Same as before - no new syntax!

```
db2 "load from file.dat of del replace into mytable"
```

## Go!

- Begin running your workload

```
db2 "select SUM(SALES) from mytable where  
    PURCHASEDATE > '20140101' group by CITY"
```

## DB2 BLU on Performance Test (from 2015)

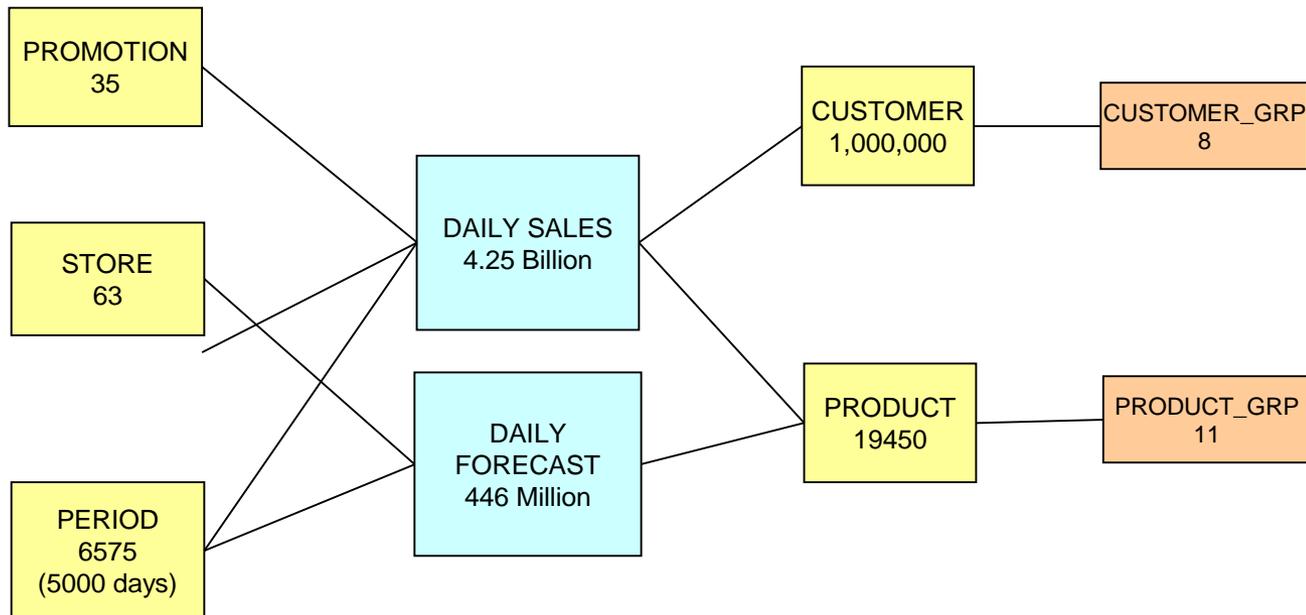
- **Workload Used: 2TB POPS database**
  
- **System Used for Evaluation:**
  - zEC12 and z13
    - Dedicated LPAR with 36 IFLs with 192GB RAM
    - SLES 11 SP3
  - System z DASD
    - 120 X 146GB 15K RPM, RAID-5 with 16 X 8GB FC
    - 184GB sized LUNs with 4.7TB total storage
  
- **Software Details:**
  - DB2 10.1 FP1 and DB2 10.5 FP5 (initial GA of DB2 BLU for zLinux)
  - Key database configuration details
    - Bufferpool: 122GB
    - Shared sort heap threshold: 76GB
    - Sort heap: 15GB
    - Default degree of parallelism: ANY

# The POPS Workload

- **POPS = Proof of Performance and Scalability**

- Derived from a Red Brick benchmark
- Good representation of a “double star” schema data mart
- 36 queries including fact-to-fact table joins

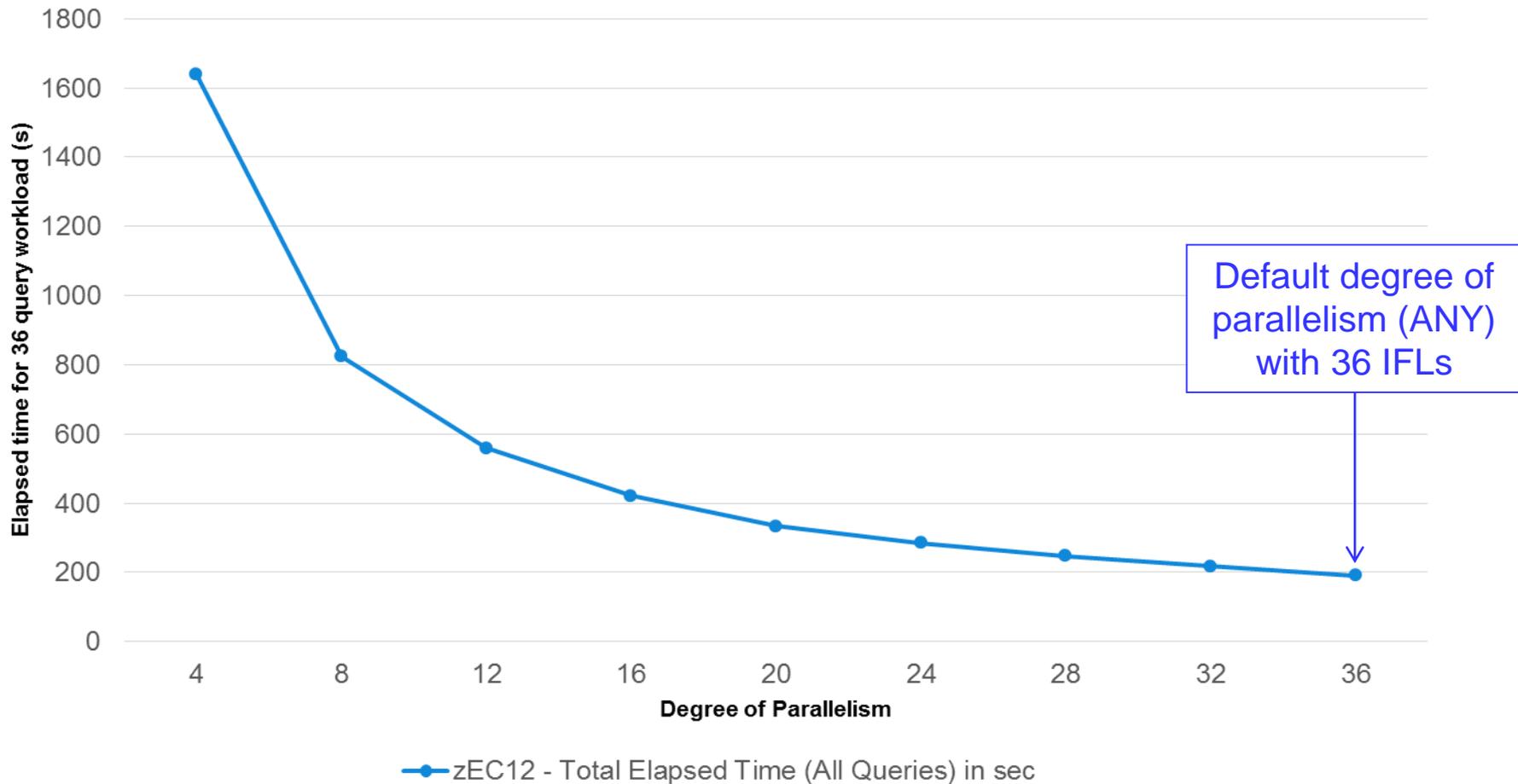
- **Schema with row counts:**



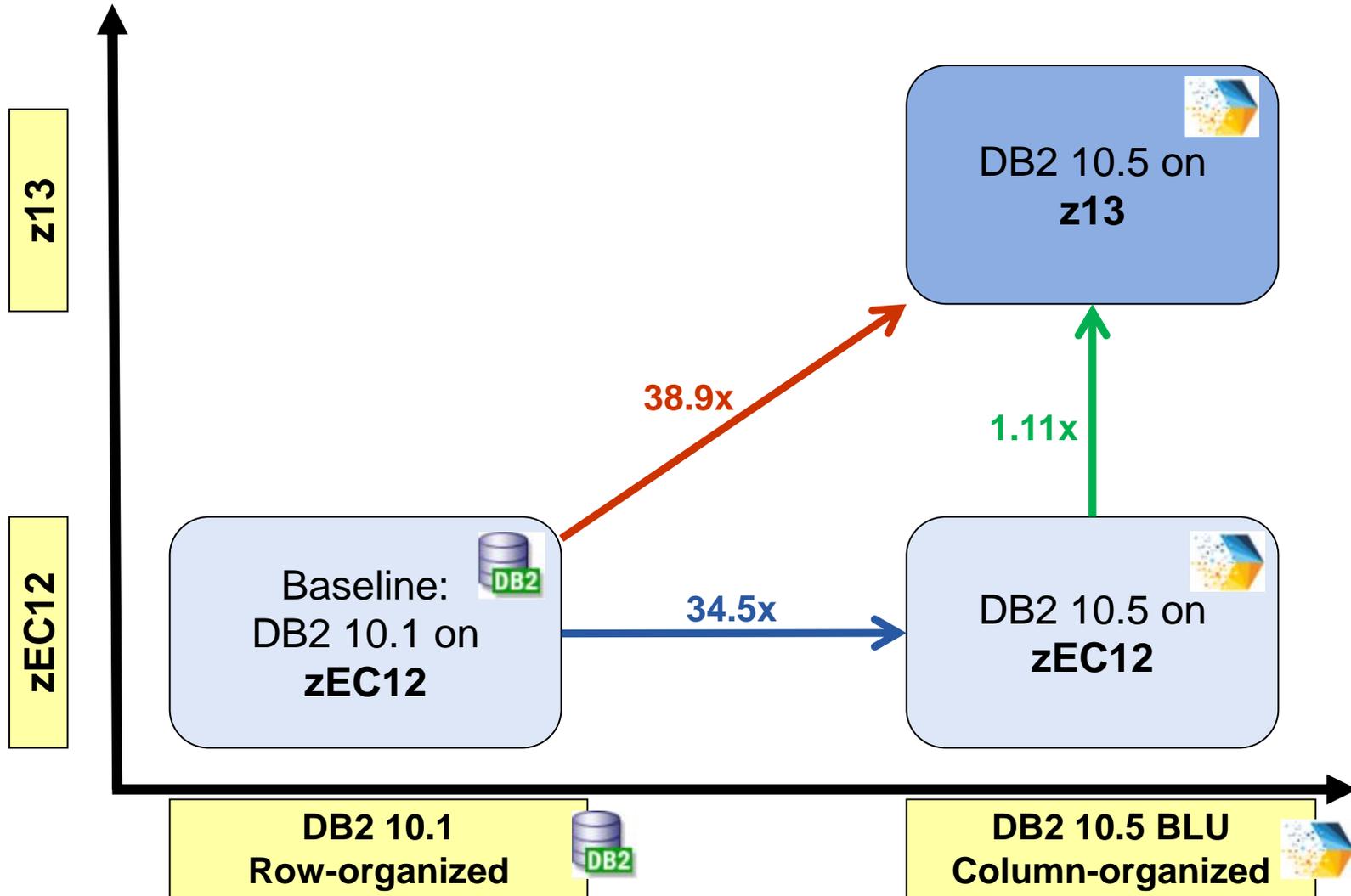
- **In this performance study we used a 1000-day scale representing approximately 2TB of raw input data**

## BLU Performance Scales Well With Increased CPU Counts

- Measured on zEC12 with 36 IFLs, 192GB RAM, DS8800 DASD



# High Level Summary of Improvement



## Detailed Results - DB2 10.1 vs DB2 10.5 (BLU)

- DB2 10.5 with BLU Acceleration (column-organized) is **34-38x** faster than DB2 10.1 (row-organized) for the same workload/database

	Average workload elapsed time	BLU Acceleration benefit	z13 uplift
DB2 10.1 row-organized	6589.97s		
DB2 10.5 column-organized - zEC12	190.92s	34.5x	
DB2 10.5 column-organized - z13	169.57s		11.2%

- The systems were configured identically and had identical optimizer plans for all queries.
- Average system resource utilization (as reported by nmon)

	zEC12		z13
	Row	Columnar	Columnar
user	15.6%	97.4%	Tbc
system	0.9%	0	Tbc
wait	22.4%	0	tbc

## Database Size Comparison

- **Column-organized database created with BLU Acceleration is 4.7x smaller than the same row-organized database**
- **BLU offers significant storage savings with improved compression and no requirement for secondary indexes**

	Column-organized (BLU) database	Row-organized (static compression) database
Raw data size	2000GB	2000GB
Compressed table size	400GB	1103GB
Primary index size	0.2GB	258GB
Secondary index size	N/A	527GB
<b>Total database size</b>	<b>401GB</b>	<b>1888GB</b>

# BLU Database Is Query-Ready Faster Than Ever Before

Load Comparison (in minutes) -- Daily_Forecast Table		
	DB2 10.1 Row-organized	DB2 10.5 Column-organized
Total load time	23.13	17.23
Setup phase	0.83	0.03
Analyze phase	N/A	2.50
Load phase	10.02	14.63
Build phase	12.28	0.07
Collecting statistics	15.88	17.28
Build time for additional indexes	15.60	N/A
Total time for table to be query-ready	54.61 minutes	<b>34.51 minutes</b>
Loaded, compressed size	31.5GB	<b>9.3GB</b>

**3.4x smaller and loaded  
1.58 times faster!**

# BLU Database Is Query-Ready Faster Than Ever Before

Load Comparison (in minutes) -- Daily_Sales Table		
	DB2 10.1 Row-organized	DB2 10.5 Column-organized
Total load time	1185.32	461.97
Setup phase	0.02	0.03
Analyze phase	N/A	7.83
Load phase	441.57	453.87
Build phase	743.73	0.23
Collecting statistics	332.80	173.15
Build time for additional indexes	1267.00	N/A
Total time for table to be query-ready	2785.12 minutes	<b>635.12 minutes</b>
Loaded, compressed size	1071.6GB	<b>391.7GB</b>

**2.7x smaller and loaded  
4.4 times faster!**

# DB2 Version 11.1 Highlights ( GA: June, 2016)

## Core Mission Critical Workloads : Extending DB2 Leadership

### Comprehensive Enterprise Security



#### Enterprise Encryption

- Centralized Key Managers (KMIP)

### Availability 2<sup>nd</sup> only to DB2 for zOS



#### Simple Fast Deployment

- Up and running in hours

#### Even Greater Availability

- Zero data loss DR with HADR

- More online management

#### More Platforms Supported

- Power Linux (LE)
- Virtualization for RDMA (x86)

### Significant Core Database Advances



#### Very Large Database Performance

- Higher user throughput

#### Simpler, Faster, More Online Upgrades

- Faster, no need for offline backup
- Streamlined HADR upgrade
- DB2 Version 9.7 direct to 11.1

## Warehousing Workloads : Most Consumable, Most Scalable In-Memory Warehousing Platform

### Massive Scale Warehousing at In-Memory Performance



#### MPP BLU Scalability

- PB scale in-memory warehousing

### Next Gen In-Memory Performance, Function & Workloads



- **Faster ELT/ETL performance**
- **More Query Workloads Optimised**
- **More Function supported**
  - Generated Columns
  - RCAC
  - OLAP + BLU Perf

### Enhanced Compatibility



#### Multi-Lingual SQL Advances

- Postgres SQL

#### Support for European Languages

- Codepage 819

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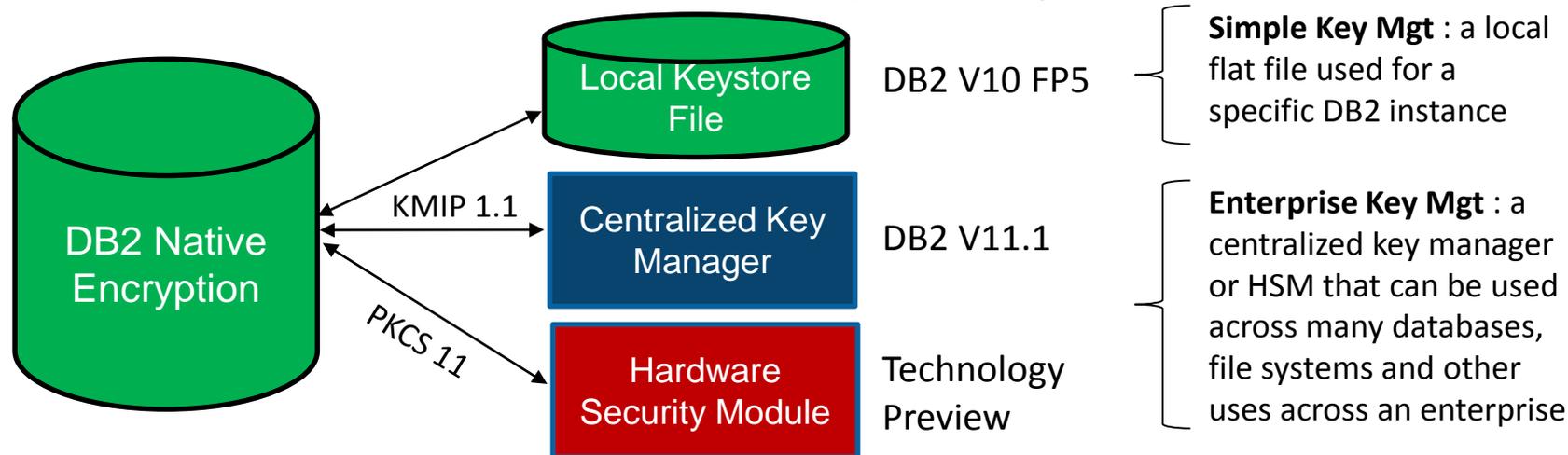
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# Encryption and Enterprise Key Management

## ■ V11.1 adds support for KMIP 1.1 compliant centralized key managers

- Initially validated on IBM Security Key Lifecycle Manager (ISKLM)



## ■ Example configuration changes

### Local Keystore

```
update dbm cfg using keystore_type pkcs12
update dbm cfg using keystore_location /home/thomas/keystores/localkeystore.p12
```

### Centralized KMIP Key Manager

```
update dbm cfg using keystore_type kmip
update dbm cfg using keystore_location /home/thomas/keystores/isklm.cfg
```

*Indicates KMIP protocol will be used to interact with key manager*

*Location of configuration file containing host, port and other details of centralized key manager*

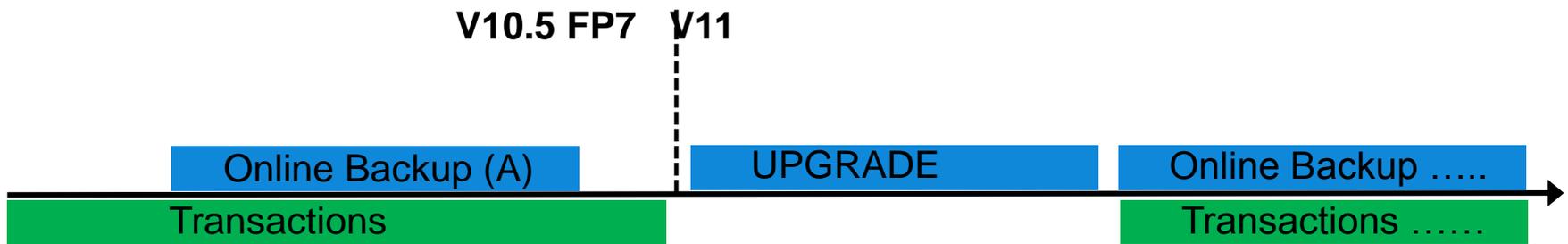
# Streamlined Upgrade Process

- **Upgrade directly from Version 9.7, 10.1 and 10.5 (3 releases back)**
- **Ability to roll-forward through database version upgrades**
  - Users are no longer required to perform an offline backup of existing databases before or after they upgrade
  - A recovery procedure involving roll-forward through database upgrade now exists
  - Applies to all editions and configurations except Database Partitioning Feature (DPF)
  - Pre-req: must start from DB2 Version 10.5 Fix Pack 7, or later
- **HADR environments can now be upgraded without the need to re-initialize the standby database after performing an upgrade on the primary database**
  - Applies to all editions except pureScale
  - Pre-req: must start from DB2 Version 10.5 Fix Pack 7, or later



## UPGRADE without Offline Backup

- No more need to take an offline backup to ensure recoverability across upgrade !
- Example scenario :



### Recovery Procedure Overview:

1. Re-install V10.5 FP7 (or higher)
2. Restore online backup (A)
3. Rollforward to a desired point-in-time just before the Error
  - Receive SQL2463N or SQL2464N indicating the start of upgrade
4. Re-install V11
5. Continue Rollforward

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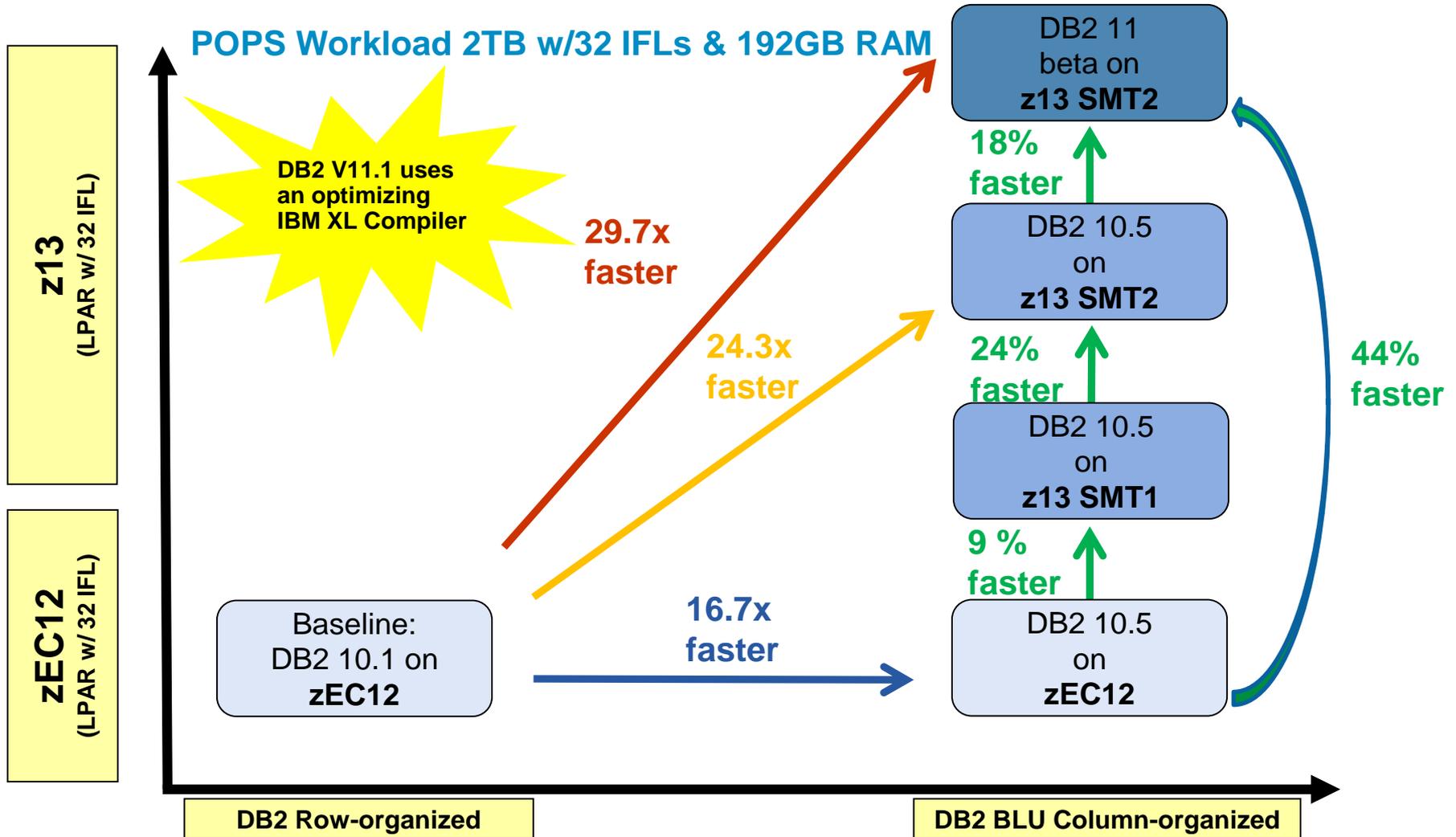
- Codepage 819

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## New SQL and DB2 BLU Enhancements

- **Extended SQL Support**
  - **Additional Netezza, Oracle & Postgres Compatibility Support**
  
  - **Massively Parallel Processing (MPP)**
  - **Performance Improvements**
  - **Security Enhancements (RCAC)**
  - **SQL functions optimized for BLU**
-

# Tuned for Linux on z13 Mainframe Systems

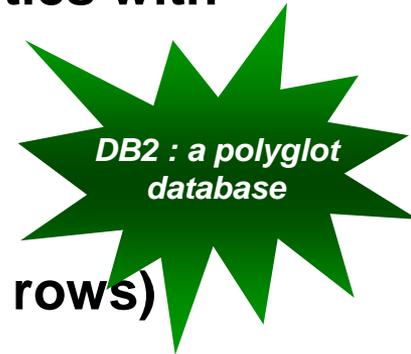


Performance is based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput or performance that any user will experience will vary depending upon many factors, including considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve results similar to those stated here.

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# Optimized SQL Support for Columnar Tables

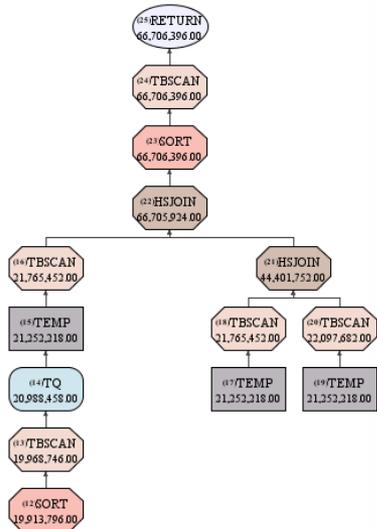
- **SQL OLAP improvements for deeper in-database analytics with column-organized tables**
- **Additional Oracle Compatibility Support**
  - Wide rows
  - Logical character support (CODEUNITS32)
- **DGTT support (except not logged on rollback preserve rows)**
  - Parallel insert into not-logged DGTT from BLU source
- **IDENTITY and EXPRESSION generated columns**
- **European Language support (Codepage 819)**
- **NOT LOGGED INITIALLY support**
- **Row and Column Access Control (RCAC)**
- **ROWID Support**
- **Faster SQL MERGE processing**
- **Nested Loop Join Support**



# Columnar Engine Native Sort + OLAP Support

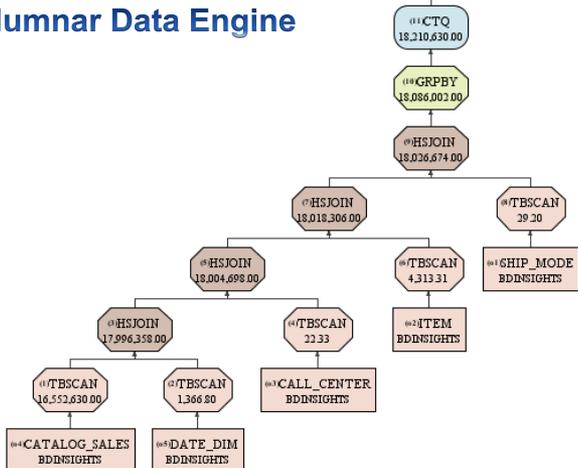
- Access Plan Difference with Native Evaluator support

DB2 V10.5



Row Data Engine

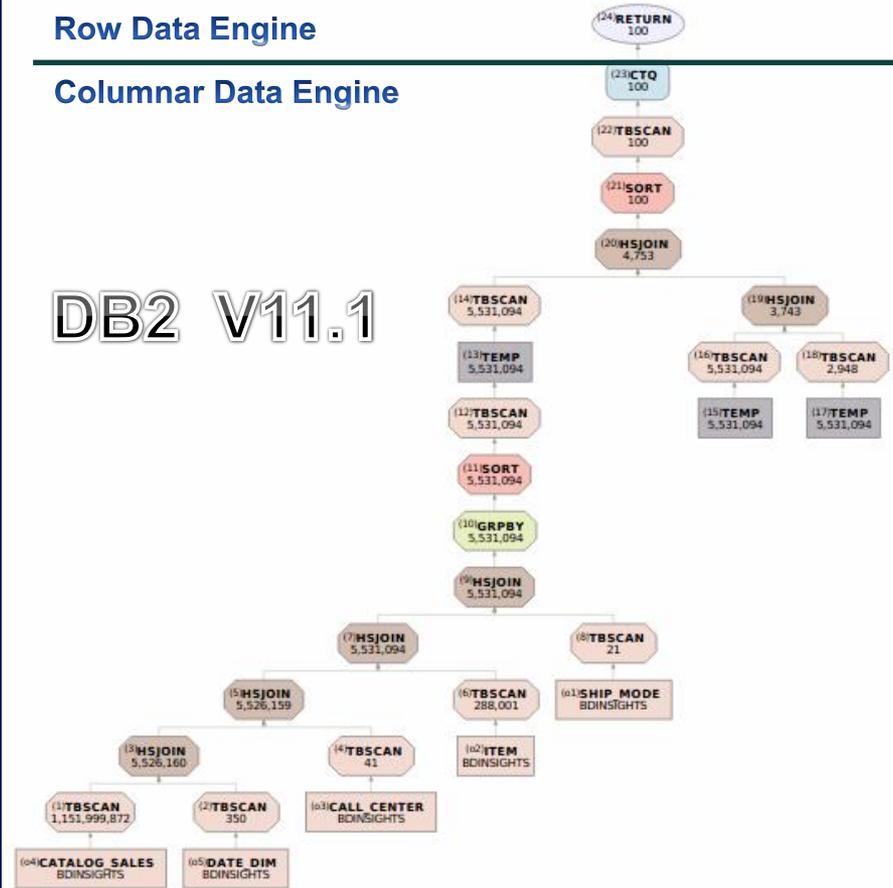
Columnar Data Engine



Row Data Engine

Columnar Data Engine

DB2 V11.1



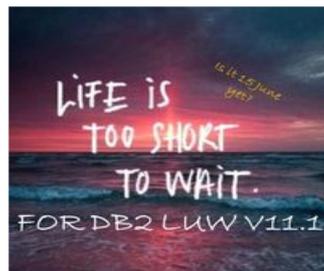
# Summary of DB2 for Linux on z Systems

- **DB2 LUW is a mature full function product**
  - Many years of development/testing/deployment
  - Nearly every capability is available on zLinux
  
- **DB2 LUW is high performance**
  - Regular testing on latest System hardware (OLTP and BI)
  
- **DB2 10.5 is production ready and available on zLinux**
  - DB2 10.5 FP7 is available and production ready
    - Including BLU Acceleration
  
- **DB2 BLU run' s extremely well on z13 / LinuxONE**
  - Fast, Small, Simple
  
- **DB2 11.1 Announce GA June 2016**
  - Most significant “uplift” in core DB2 binary for z Systems in many years
  - Extend DB2 Leadership Core Mission Critical Workloads
  - Massive Scale Warehouse at In-Memory Performance

## The DB2Night Show #177: Sneak Peek Overview of What's New in DB2 LUW V11.1

April 16, 2016, 10:36 pm

Posted by scott in DB2 LUW  
Rating: 5/5 | Votes : 3



[Learn more about IBM DB2 V11.1 on IBM.com](#)

### What's New in DB2 LUW V11.1 - Overview

**Special Guests:**  
**Matt Huras,**  
**Chief Architect DB2 LUW**

**Berni Schiefer,**  
**IBM Fellow**

97% of our audience learned something! A new version of DB2 LUW is born! V11.1 will be generally available mid-June 2016. Almost 75% of our HUGE live studio audience indicated that they were very excited about the new features and capabilities becoming available in V11. V11 includes many enhancements for BLU, Analytics, OLTP, pureScale, security, SQL, and more! Please learn from, and enjoy, the replay...

### Show Host Scott Hayes Commentary

Matt and Berni really don't need an introduction - most everyone knows them from IDUG or IBM conferences. I really enjoyed hosting them as our guests because you can hear their enthusiasm and excitement in their voices. No doubt, they, and the rest of their LUW team members, have a lot to be proud of in this new version. Personally, I'm thrilled that BLU Column Organized Tables can now be used with DPF, EEE, or MPP (MPP is the current favorite IBM acronym) multi-partitioned databases. It would have been nice if this capability was offered in V10.5, but I gather this markedly improved performance capability is deserving of a new version number.

Matt and Berni would like to clarify the announcement for end of DB2 9.7 and 10.1 support. Support for 9.7 and 10.1 will end September of 2017, not 2016 as previously tweeted by some in our DB2 community. Whew!!! Okay everyone, hurry up, you've got 16 months! You'll also be happy to learn that there is an upgrade path directly from 9.7 to 11.1.

The goal of this V11.1 Overview show was to paint the big picture of "What's New." We have upcoming shows that take deeper dives into the details of V11.1 new features and functions. Make sure you sign up for these shows! Do it now! The links are right here...

### Upcoming Shows - Deep Dives on V11.1 New Features

- 29 April** - Guests John Hornibrook and David Kalmuk, IBM Canada  
Part 2 - V11.1 Deep Focus on **BLU and Analytics**: [REGISTER NOW](#)
- 13 May** - Guests Steve Rees and Keri Romanufa, IBM Canada  
Part 3 - V11.1 Deep Focus on **OLTP and pureScale**: [REGISTER NOW](#)

<http://www.dbisoftware.com/blog/db2nightshow.php?id=680>



Thank  
you

