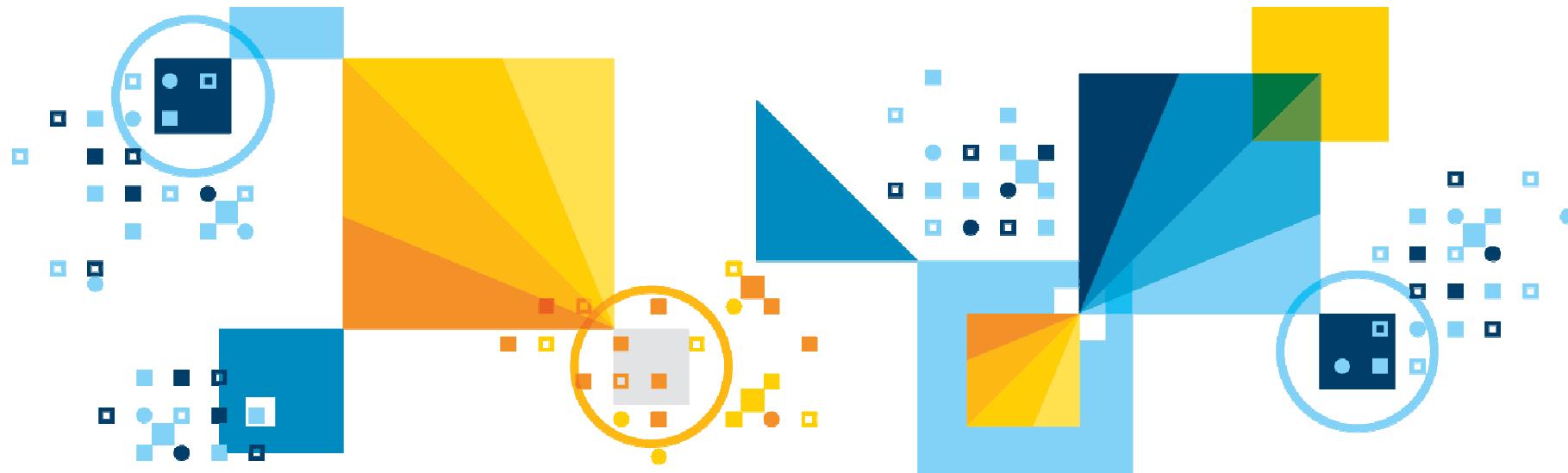


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2016-06-07

DB2 Version 11.1 Overview



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New DB2 Capabilities

Petabyte Scale In-Memory Warehousing

Build or expand your operational warehouse with petabyte scale BLU Technology

Broader Analytical Horizons

Leverage enhanced analytical functions within BLU to broaden the workloads inside your DB2 warehouse

Protect your Data

Enterprise class data encryption to ensure the security for all your databases

Transact with Confidence

Manage your business critical systems with the confidence that DB2 will scale to large data and user volumes

Always there Business

Additional DB2 pureScale capabilities ensures your Business Systems are always up and available

Announcement Summary

- **DB2 Version 11.1 Announced on April 12th with eGA of June 15th**

- **End of Marketing for DB2 Version 10.5 (September 30th, 2016)**

- All DB2 Version 10.5 Editions and features/offerings
 - IBM DB2 Encryption Offering
 - IBM DB2 Business Application Continuity Offering
 - IBM DB2 BLU Acceleration In-Memory Offering
 - Performance Management Feature Version 10.5
 - Tools and DB2 Connect Version 10.5

- **End of Service for both DB2 Version 9.7 and 10.1**

- Effective End of Service date of September 30th, 2017
 - Direct direct upgrade from DB2 Version 9.7, 10.1, and 10.5 to V11.1
 - End of Service date is not applicable to SAP customers with an ASL as they have a different end of service period

Packaging Summary

- **DB2 Express Edition replaced by Workgroup Server Edition**
- **Workgroup and Enterprise Edition have additional capability**

- pureScale Standby Node Option
- Table partitioning, Encryption
- Multi-dimensional Clustering
- Limited Federation (DB2 & Informix)

- **Exclusions**

- Data Partitioning
- SQL Warehouse (SQW)
- BLU Acceleration, Compression, Materialized Query Tables (ESE includes)
- No MQ or CDC Replication

- **Workgroup Simple Limits**

- Authorized User (AUSI) , PVU, and Virtual Server
- 16 Cores
- 128 GB of memory with no database size limit

Metric	New Price	Workgroup	Express
PVU	100	158	68
AUSI	354	554	291
Virtual Server	14,100		7520
Sockets	18,800 – Only for existing customers		
A virtual server in prior releases was limited to 4GB of memory and 4 processor cores. The new limit is 128GB of memory and 8 processor cores.			
Prices are in US dollars and are subject to change.			

New DB2 Direct Editions

- New Delivery Mechanism for DB2 licenses
 - New license metrics to facilitate hybrid cloud deployments
 - Acquire the product directly online (Passport Advantage)
 - Option to deploy either on-premises or on cloud
- Two Versions depending on Requirements
 - DB2 Direct Standard Edition 11.1
 - Has database features of DB2 Workgroup Server Edition
 - DB2 Direct Advanced Edition 11.1
 - Has database features of DB2 Advanced Enterprise Server Edition
- Simplified license metric, the Virtual Processor Core sold as a monthly license charge
 - 1 VPC for every VPC available to a virtual Servers Operating System, **or 1 VPC for each physical core of a non-partitioned physical server**
 - If the number of VPCs is greater than the physical cores, then you only need to license the number of physical cores on the machine
 - Minimum of 2 VPCs per deployment (**1 VPC for idle/warm standby**)

Metric	Standard	Advanced
VPC Monthly	135	354

Prices are in US dollars and are subject to change.

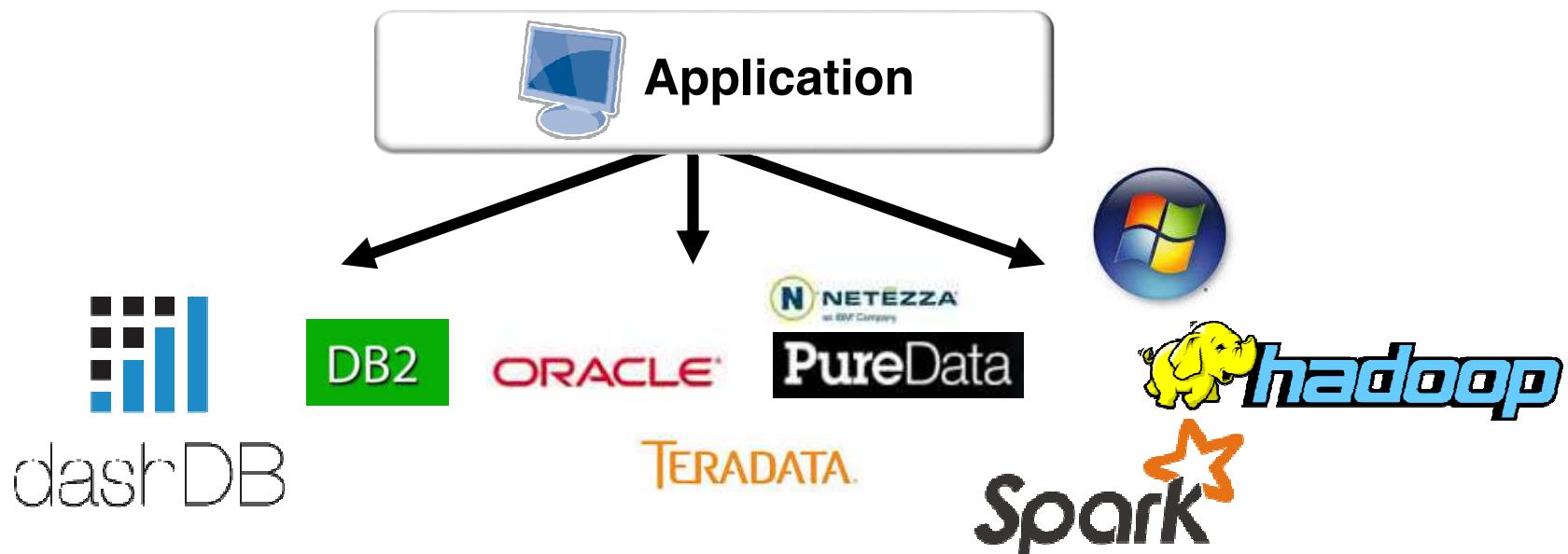
Federation Included in Advanced/Developer Packaging

- **Integrated support for homogeneous federation**

- Single install replacing any prior separate Infosphere Federation Server install
 - Support for upgrading from either a DB2 database product or Infosphere Federation Server

- **Additional Wrappers in Advanced Editions**

- DB2, PureData System for Analytics (PDA), Oracle, Informix, dashDB, SQLServer, BigSQL, SparkSQL, Hive, Impala, and other Big Data sources.



Encryption Included in Packaging

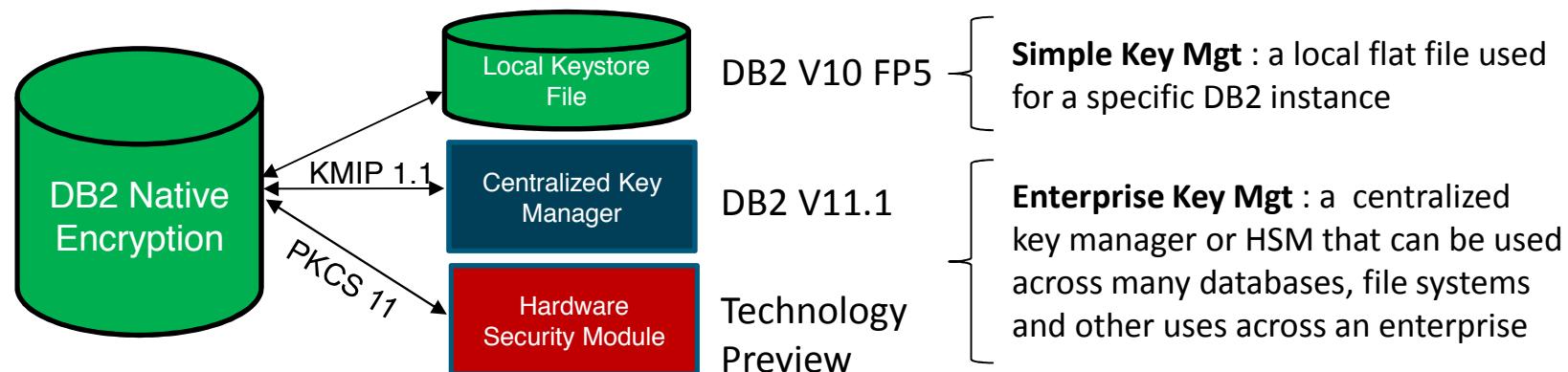
- **Encrypted flows between HADR primary and secondary**

- Simplified integration via SSL/TLS
 - Initial support on Linux x86



- **V11.1 adds support for KMIP 1.1 complaint centralized key managers**

- Validated on IBM's Security Key Lifecycle Manager (ISKLM)



- **Direct support for PKCS11 Hardware Security Modules (HSMs)**

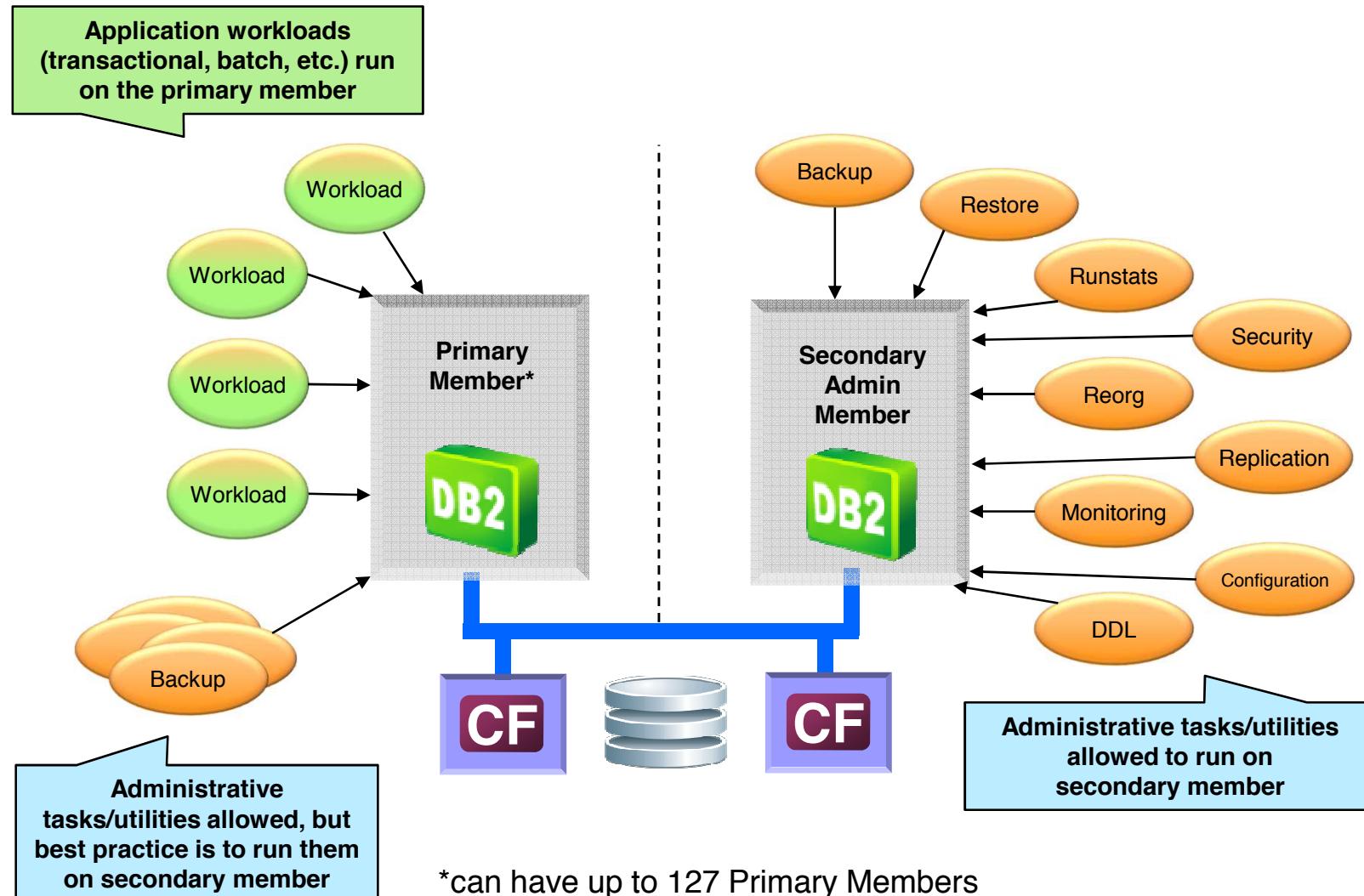
- Validation to include SafeNet Luna & Thales nShield Connect+

DB2 pureScale Included in Packaging

- **Low cost active/passive licensing where one DB2 member has minimal licensing and the other DB2 member(s) fully licensed**
 - All application workloads are directed to the primary active member(s)
 - Sometimes referred to as the “primary” member
 - Utilities and admin tasks allowed on the secondary admin member
 - Admin member licensed as warm standby (e.g. 100 PVUs or 1 VPC)
 - Great for off-loading backups from primary members
- **DB2 pureScale active/active available in DB2 Advanced Editions, including new Direct Advanced Edition**



Licensing - DB2 pureScale Active/Passive Model



Operating Systems - Supported

▪ New Operating System Support

- Power Linux LE (Little Endian)
 - Red Hat Enterprise Linux (RHEL) 7.1+
 - SUSE Linux Enterprise Server (SLES) 12
 - Ubuntu 14.04 LTS



▪ Supported Operating Systems

- Intel 64-bit
 - Windows 7, 8.1, 10, Windows Server 2012 R2
 - Red Hat Enterprise Linux (RHEL) 6.7+, 7.1+
 - SUSE Linux Enterprise Server (SLES) 11SP4+, 12
 - Ubuntu 14.04 LTS
- AIX Version 7.1 TL 3 SP5+
- zLinux
 - Red Hat Enterprise Linux (RHEL) 7.1+
 - SUSE Linux Enterprise Server (SLES) 12



▪ pureScale support on AIX and Red Hat 7.2 (Power Linux LE & Intel 64)

Operating Systems - Discontinued

- In DB2 V11, the following operating systems (on any platform) are no longer supported for Client or Server:

- HP-UX
- Solaris
- Power Linux BE
- Inspur K-UX



- Migration

- Customers on these platforms will continue to be supported until the end-of-service date for DB2 V10.5 (last release that supports these platforms)
- Customer can migration to AIX from HP-UX and Solaris via a DB2 backup/restore.

Operating Systems - Virtualization

▪ IBM System z

- IBM Processor Resource/System Manager
- z/VM and z/KVM on IBM System z



▪ IBM Power

- IBM PowerVM and PowerKVM and IBM Workload Partitions on IBM Power Systems



▪ Linux X86-64 Platforms

- Red Hat KVM
- SUSE KVM



▪ VMWare ESXi

▪ Docker container support – Linux only



Microsoft
Hyper-V

▪ Microsoft

- Hyper-V
- Microsoft Windows Azure on x86-64 Windows Platforms only

▪ pureScale support on Power VM/KVM, VMWare, and KVM

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**
 - Upgrading from DB2 Version 10.5 Fix Pack 7, or later
 - 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)
- **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 DB2 pureScale
 - DB2 Version 10.5 Fix Pack 7, or later



INPLACE Table Reorganization

- **The manageability of large range partitioned tables has been improved**
 - A single partition of a partitioned table can now be reorganized with the INPLACE option if:
 - the table has no nonpartitioned indexes
 - ON DATA PARTITION is specified
 - Only one data partition can be reorganized at a time
 - INPLACE table reorganization can be run only on tables that are at least three pages in size

New options for the ADMIN_MOVE_TABLE

▪ REPORT

- The REPORT option can be used to monitor the progress of table moves
- Calculates a set of values to monitor the progress of a single or multiple table moves
- Focus is the COPY and REPLAY phase of a running table move
- To get values for all table moves, tabschema and tablename must be NULL or the empty string

▪ TERM

- The TERM option can be used to terminate a table move in progress
- Terminates a running or table move
- TERM will force off the application running the table move, roll back all open transactions and set the table move to a well defined operational status
- From here, the table move can be canceled or continued

Remote Storage Option for Utilities

- **Remote storage is now accessible from:**

- INGEST, LOAD, BACKUP, and RESTORE
 - Accessed through the use of storage access aliases

- **Supported Storage**

- IBM® SoftLayer® Object Storage
 - Amazon Simple Storage Service (S3)

NO TABLESPACE Option for Backup Database

▪ DB2 History File

- Contains information about log file archive location, log file chain etc.
- If you use snapshot backups you want to have current information about log file location to perform point in time recovery (RECOVER command)
- For RECOVER you need a current version of the history file
- NO TABLESPACE backup allows you to create a current and consistent backup of the history file in a convenient way
- If you use COMPRESS option of the BACKUP command, the created backup image is small

▪ BACKUP with NO TABLESPACE option

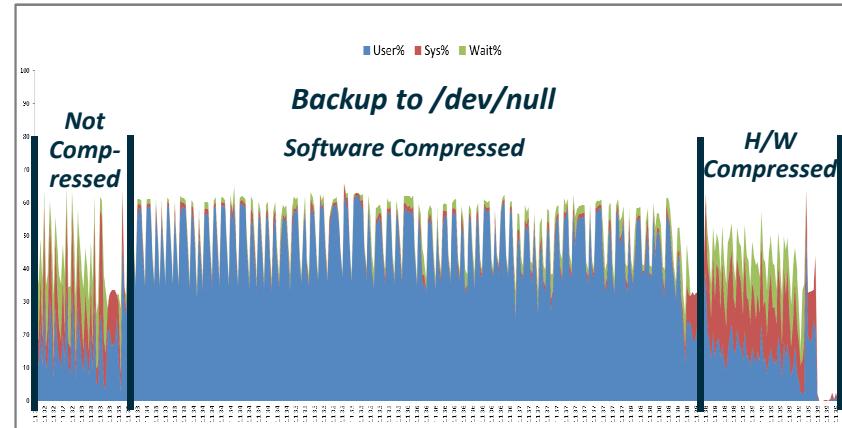
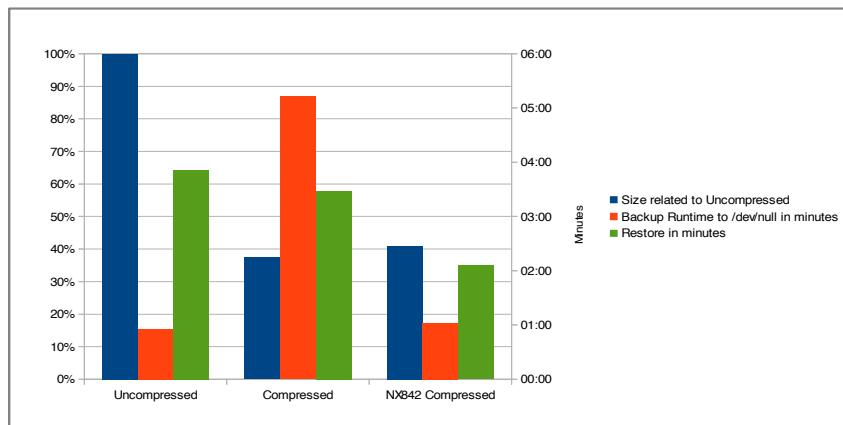
- A NO TABLESPACE backup does not contain tablespaces
- A no tablespace backup is used to restore the history file by using the HISTORY FILE option with the RESTORE DATABASE command
- HISTORY FILE keyword is specified to restore only the history file from the backup image

DB2 Support for the NX842 Accelerator

- DB2 backup and log archive compression now support the NX842 hardware accelerator on POWER 7+ and POWER 8 processors
- DB2 BACKUPs require the use of a specific NX842 library
 - `backup database <dbname> compress comprlib libdb2nx842.a`
- Backups can be compressed by default with NX842
 - Registry variable **DB2_BCKP_COMPRESSION** has to be set to **NX842**
 - Use the following backup command format:
 - `backup database <dbname> compress`
- Log archive compression is also supported
 - Update the database configuration parameter **LOGARCHCOMPR1** or **LOGARCHCOMPR2** to **NX842**
 - update database configuration for <dbname> using **LOGARCHCOMPR1 NX842**
 - Note: These two parameters can still take different values

DB2 Backup Compression Performance Results

- Preliminary results from early system testing
- About 50% DB2 backup size reduction compared to uncompressed
- Factor 2x less CPU consumption compared to DB2 compression
 - Very significant reduction in CPU consumption
 - Very significant reduction in elapsed time
 - Maintains almost all of the compression storage benefits

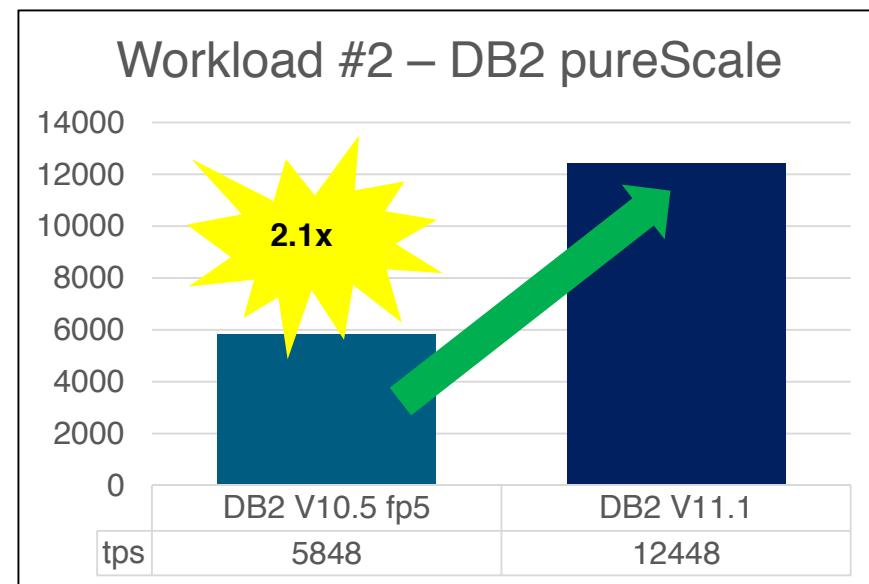
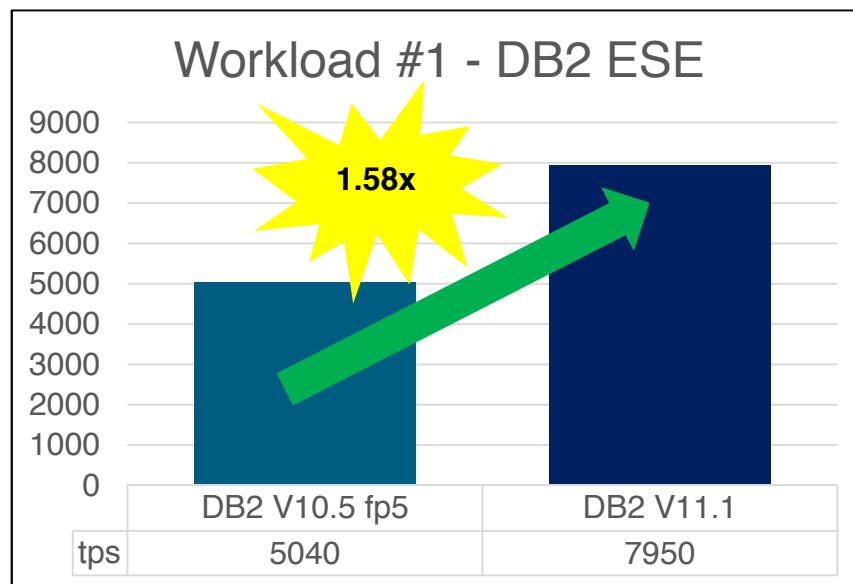


Internal Tests at IBM Germany Research & Development

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.

Improved Performance for Highly Concurrent Workloads

- Streamlined bufferpool latching protocol implemented in DB2 V11
 - Reduces contention which can develop on large systems with many threads
 - Particularly helpful with transactional workloads



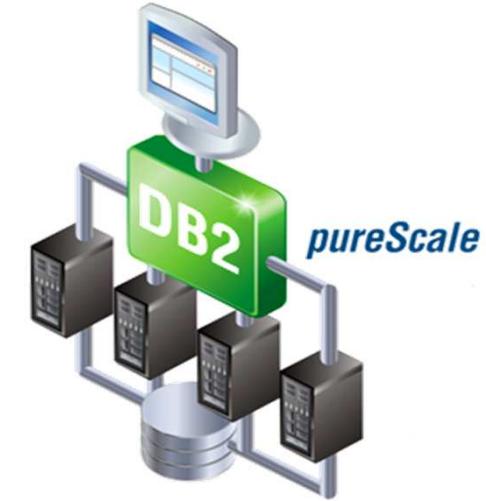
- Workload 1 based on an industry benchmark standard
- POWER7 32c, 512 GB

- Workload 2 implements a warehouse-based transactional order system
- 4 members, 2 CFs with 16c, 256 GB

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DB2 V11 pureScale Feature Enhancements

- Installation, Upgrades and Deployments
- Power Linux Little-Endian (LE) support
- Linux Virtualization Enhancements
- HADR Enhancements
- GDPC Enhancements
- Performance Enhancements
- Unified Workload Balancing
- Manageability Improvements
- Registry, Catalog Changes & Deprecated functionality
- Text Search support



DB2 pureScale: Simplified Install and Deployment

▪ Fast Up and Running

- Up and running in hours compared to competitive cluster databases



▪ Install re-engineering includes:

- “Push-Button” install for pureScale clusters
 - Socket complexity reduced by at least 40%
 - Smarter defaults, intuitive options, parallel & quick pre-deployment host validation
- 30-step native GPFS setup reduced to simple 4-step DB2 install process
 - Also easier conversion to GPFS replication post-deployment using db2cluster
- Increased Resiliency for aborted/partial installations
 - Clean rollback for re-installation

▪ Additional assistance via:

- Simplified documentation
- Enhanced pre-checking of storage, tiebreaker devices, network adapters, firmware libraries
- Intuitive and user-friendly errors & warnings

Simplified pureScale Storage Replication Deployment



	Today	DB2 Version 11.1
1	Takes ~8 native GPFS commands to create a replicated file system with the standard three redundancy groups.	1 db2cluster command
2	Takes ~24 native GPFS commands to <u>convert</u> a non-replicated FS to a replicated FS.	2 db2cluster commands (one for conversion and one for adding storage)
3	Takes ~8 native GPFS commands to <u>add a new disk</u> to an existing replicated FS	1 db2cluster command
4	Takes ~7 native GPFS commands to <u>remove a disk</u> from existing replicated FS	1 db2cluster command

Linux Virtualization Enhancements

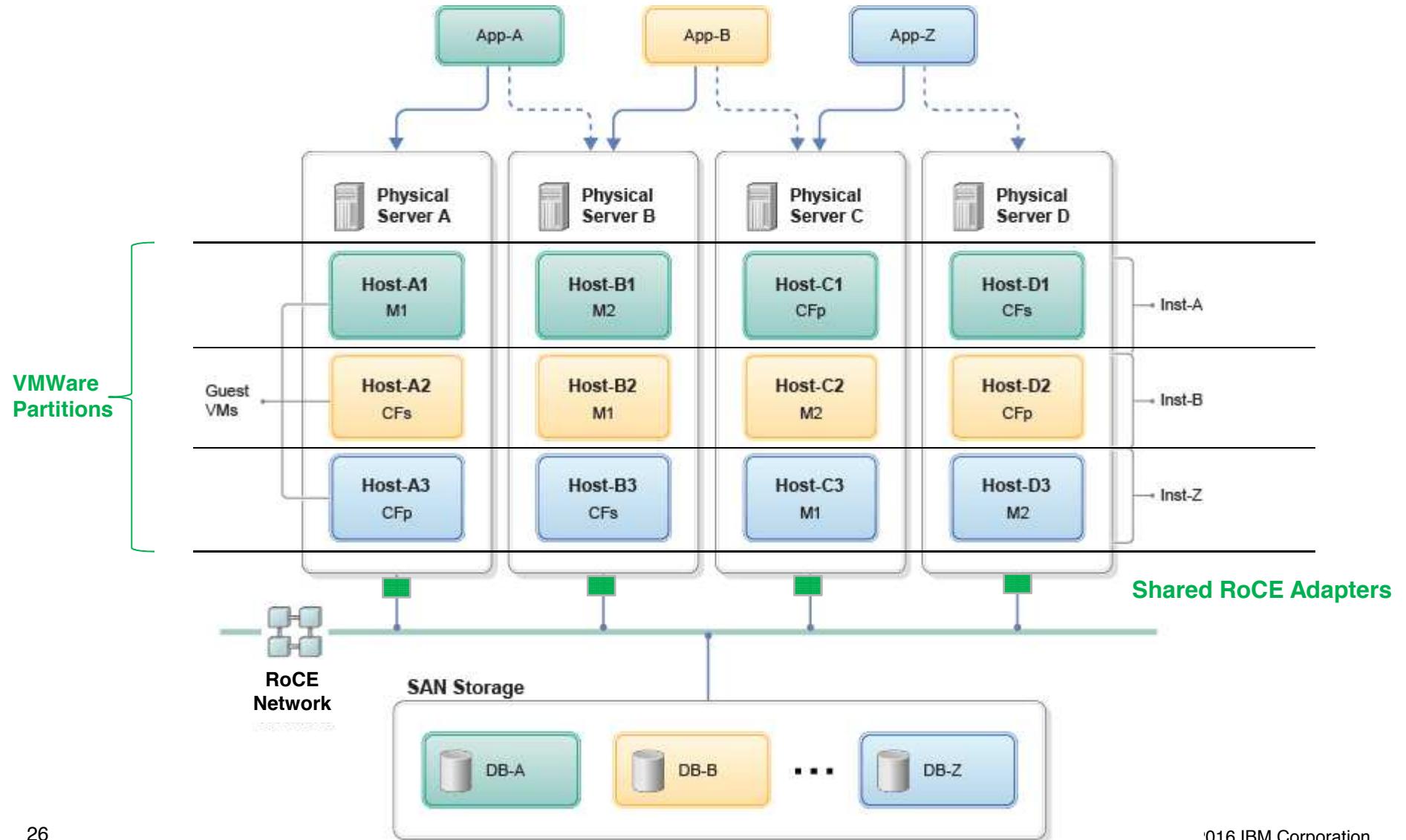
- **RDMA over Converged Ethernet (RoCE) support added in VMWare**

- RoCE SR-IOV for RHEL 7.2 only
 - Allows a single adapter to be shared across multiple partitions

- **Single-Root I/O Virtualization (SR-IOV)**

- Standard that enables one PCI Express (PCIe) adapter to be presented as multiple separate logical devices (Virtual Functions) to virtual machines
 - Allow the virtual machines to run native RoCE and achieve near wire speed performance.
 - Can be enabled on Mellanox ConnectX-3/ConnectX-3 Pro/Connect X-3 VPI adapters for Ethernet

VMWare RoCE Adapter Sharing Example



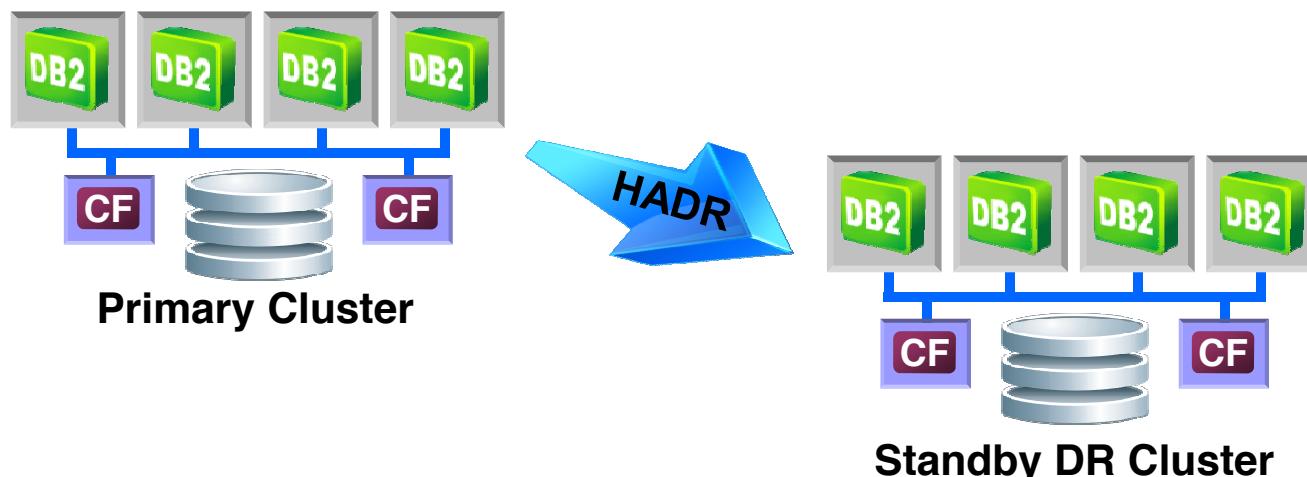
HADR Support for SYNC and NEARSYNC Mode

- **Support for SYNC and NEARSYNC has been added to pureScale**

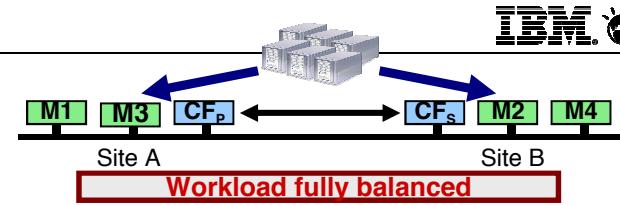
- This enhancement combines the continuous availability of DB2 pureScale with the robust disaster recovery capabilities of HADR providing an integrated zero data loss (i.e. RPO=0) disaster recovery solution
- HADR peer window (hadr_peer_window) is not supported

- **HADR support with pureScale now includes:**

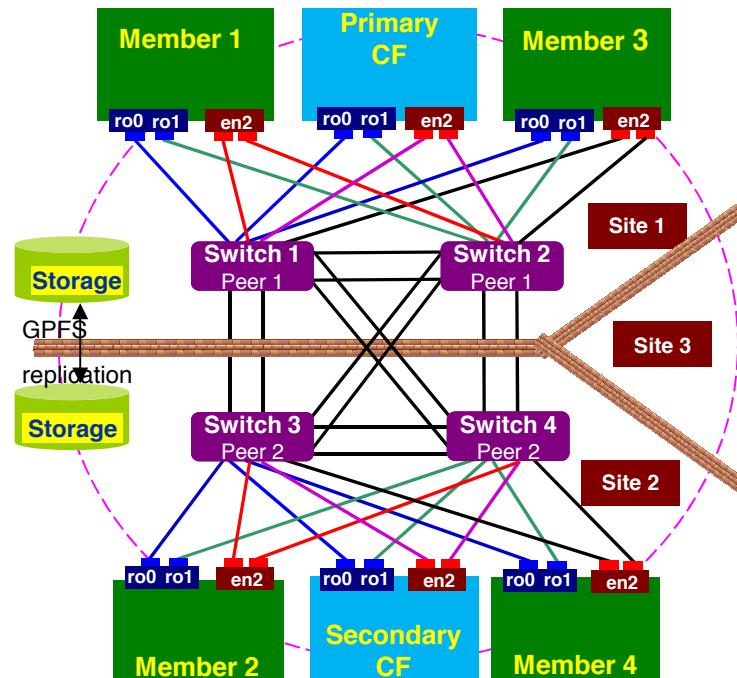
- SYNC, NEARSYNC, ASYNC and SUPERASYNC modes
- Time delayed apply, Log spooling
- Both non-forced (role switch) and forced (failover) takeovers



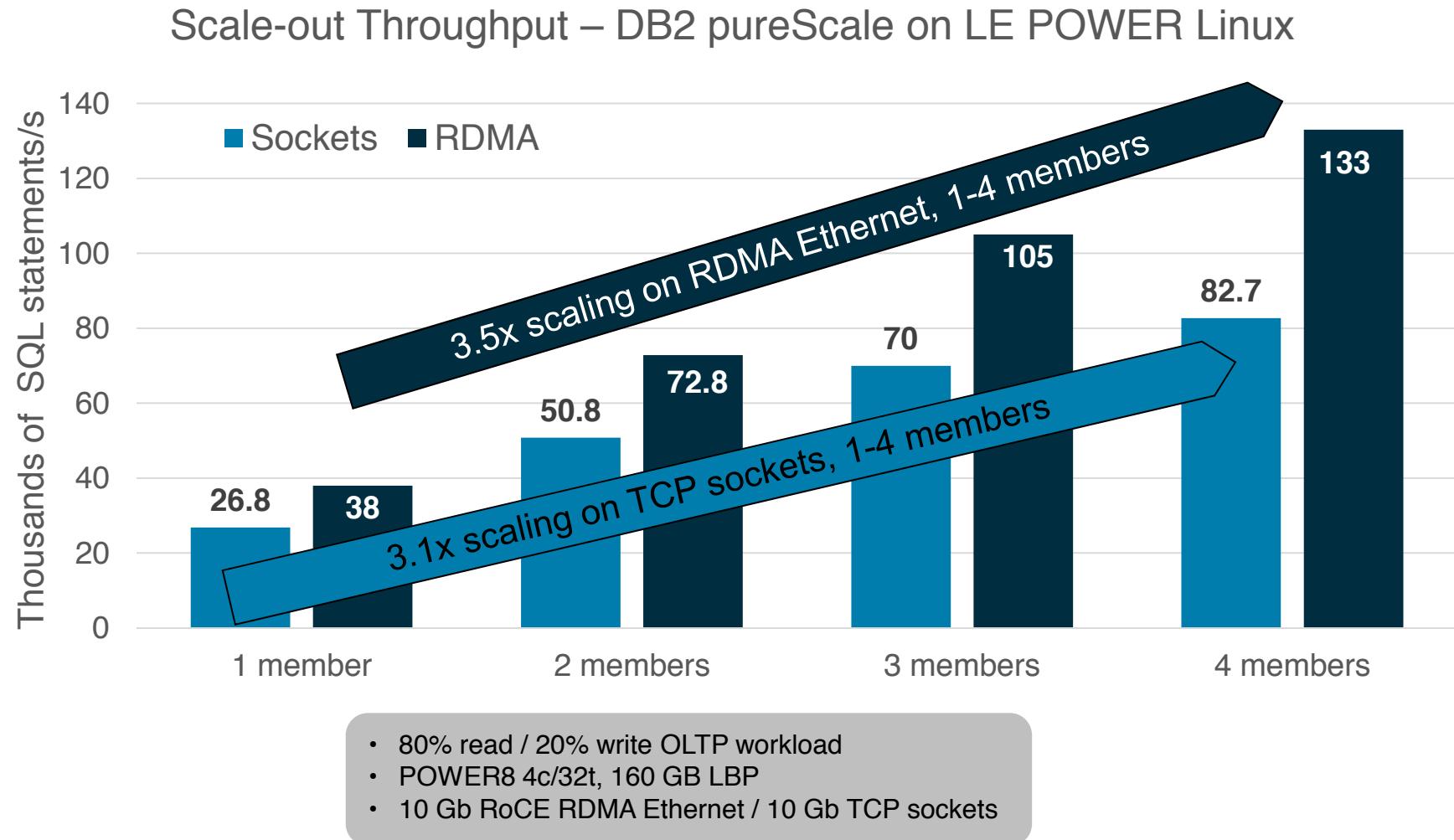
GDPC Support Enhancements



- DB2 V11 adds improved high availability for Geographically dispersed DB2 pureScale clusters (GDPC) for both RoCE & TCP/IP
 - Multiple adapter ports per member and CF to support higher bandwidth and improved redundancy at the adapter level
 - Dual switches can be configured at each site to eliminate the switch as a site-specific single point of failure (i.e. 4-switch configuration)



Horizontal Scaling with DB2 pureScale on POWER Linux



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Improved Table TRUNCATE Performance in pureScale

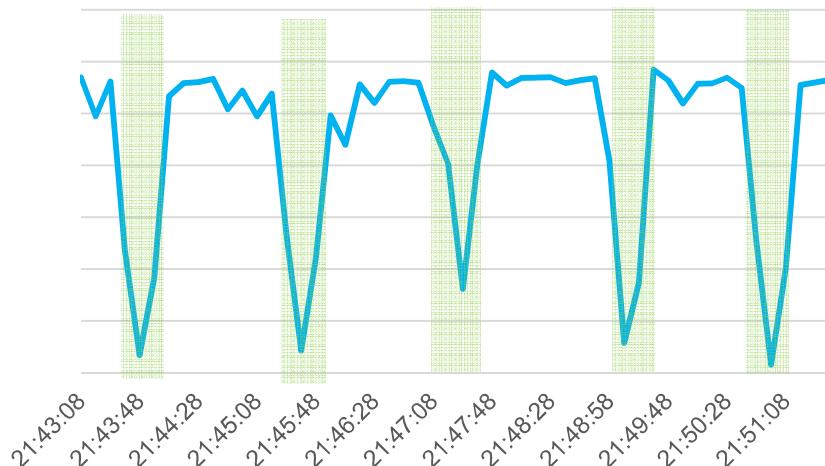
▪ More efficient processing of Global Bufferpool (GBP) pages

- Speeds up truncate of permanent tables especially with large GBP sizes
- Helps DROP TABLE and LOAD / IMPORT / INGEST with REPLACE option
- Enables improved batch processing with these operations

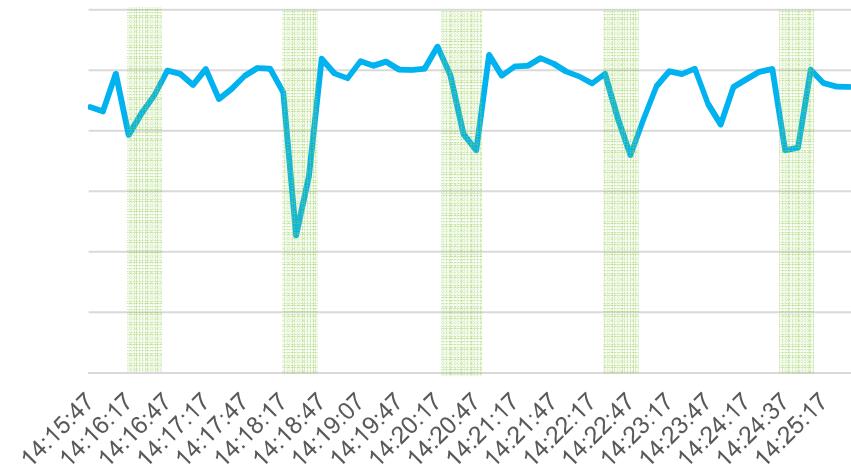
▪ Example

- Workload with INGEST (blue) and TRUNCATE (green) of an unrelated table
- DB2 v11.1 has much smaller impact on OLTP workload than DB2 10.5 fp5

Application throughput - DB2 v10.5 fp5



Application throughput – DB2 v11.1



Unified Workload Balancing with pureScale

- **Version 11.1 extends the configuration options for member subsets allowing the user to explicitly define alternate members for a subset**

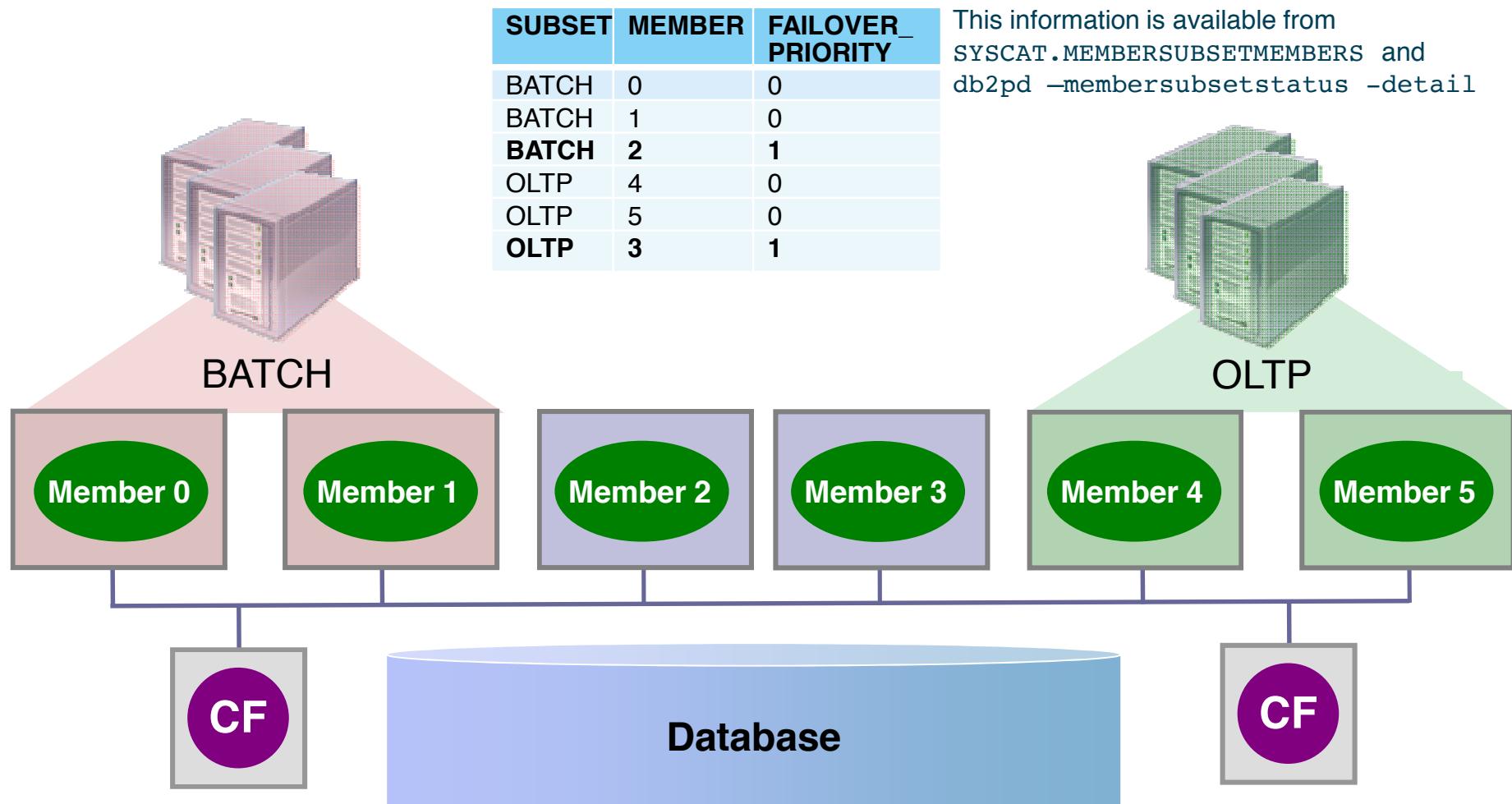
- This allows users currently using client affinity to move their configuration to using member subsets and failover priority so that they can exploit the new benefits such as dynamic server side reconfiguration
 - Simplification to setting up client affinity with having control at the Server vs client – no need to update db2dsdriver.cfg

- **Failover priority for member subsets added**

- You can explicitly define the members that are part of the alternate member list by using the FAILOVER_PRIORITY attribute in the WLM.Alter_MEMBER_SUBSET procedure
 - Members with a failover priority of 0 (the default priority) are considered primary members and members with failover priority 1-254 are considered alternative members
 - The number of primary members in the subset defines the minimum number of members to service an application
 - If FAILOVER_PRIORITY is not specified, default priority of 0 is used

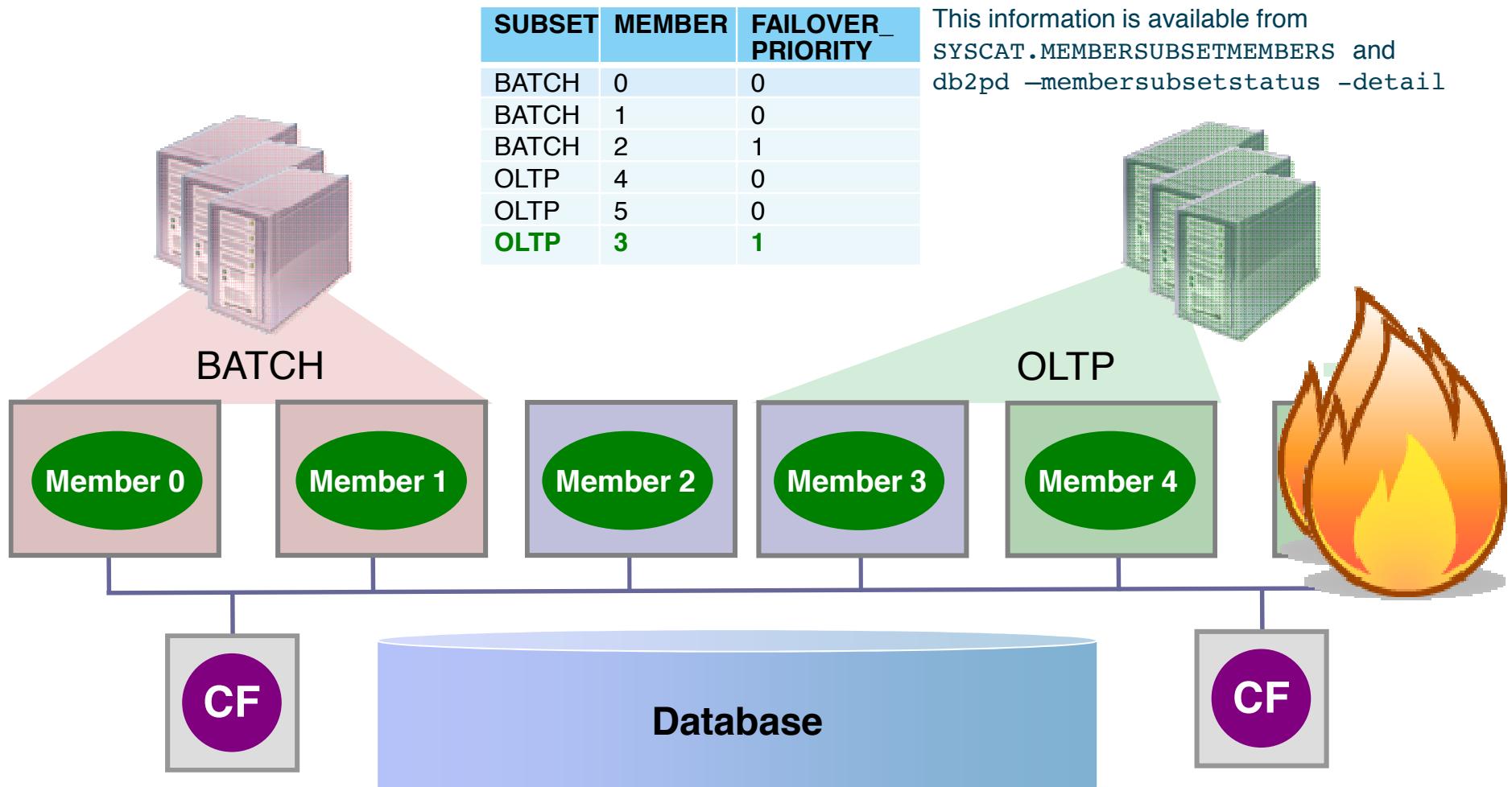
Member Subsets : FAILOVER PRIORITY

```
CALL SYSPROC.WLM_ALTER_MEMBER_SUBSET('BATCH', NULL, '(ADD 2 FAILOVER_PRIORITY 1)');
CALL SYSPROC.WLM_ALTER_MEMBER_SUBSET('OLTP', NULL, '(ADD 3 FAILOVER_PRIORITY 1)');
```



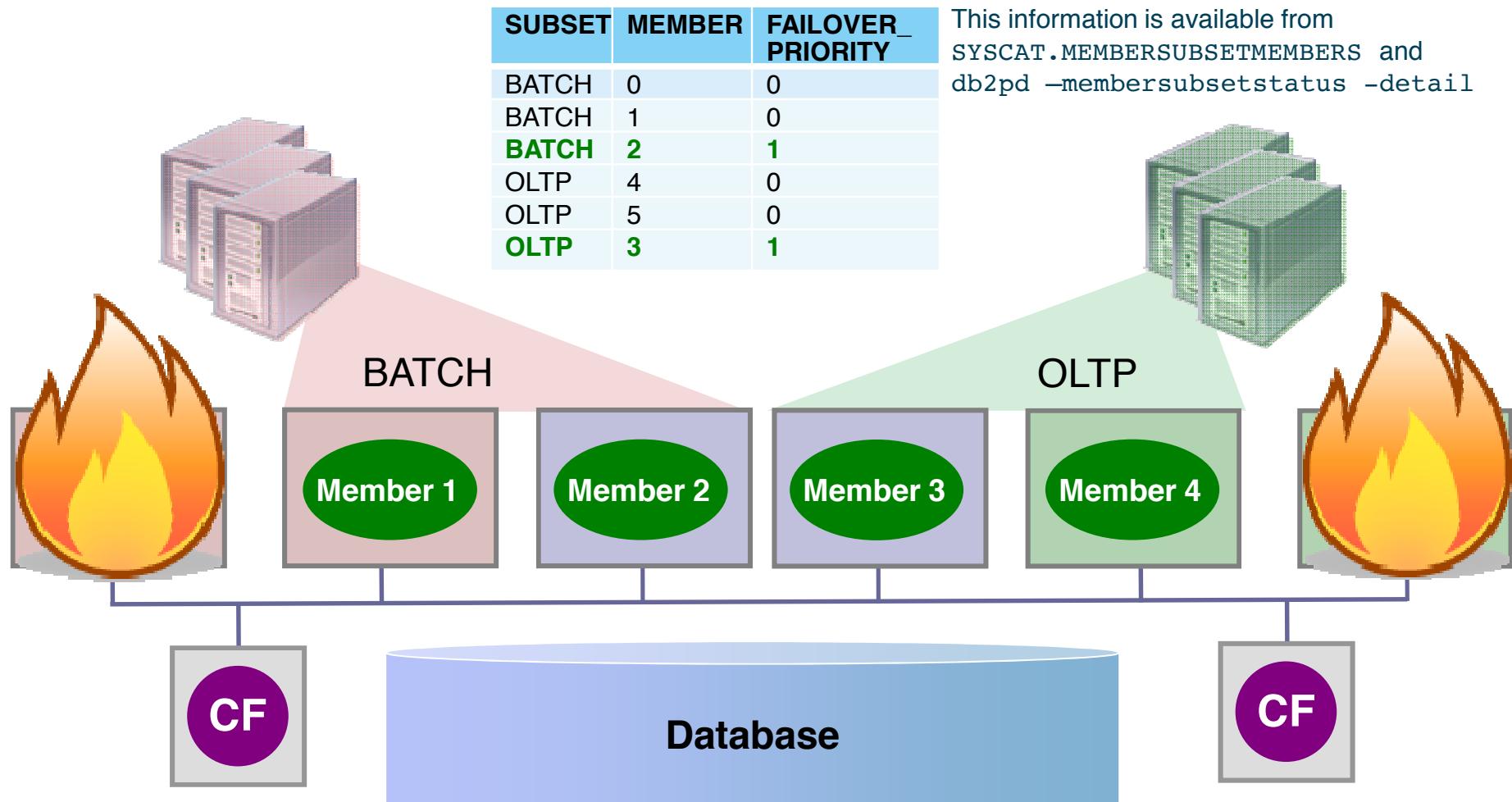
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```



Member Subsets : FAILOVER PRIORITY

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CALL SYSPROC.WLM_ALTER_MEMBER_SUBSET('OLTP', NULL, '(ADD 3 FAILOVER_PRIORITY 1)');
```



DB2 pureScale Health Check

- **Unified health check tool for a DB2 pureScale cluster**

- Post-installation command:
 - db2cluster –verify
 - Validations performed include, but are not limited to, the following:
 - Configuration settings in peer domain and GPFS cluster
 - Communications between members and CFs
 - Replication setting for each file system
 - Status of each disk in the file system

DB2 BLU Highlights

- Massively Parallel Processing (MPP)
- Performance Improvements
- Extended SQL Support
- Additional Oracle Compatibility Support
- SQL functions optimized for BLU
- Security Enhancements
- Improvements in Automatic Dictionary Creation

What is MPP?

Which home is going to be built first?



MPP = Massively Parallel Processing

**Breaking up very large, complex tasks into smaller pieces
that can be worked on by multiple resources in parallel**

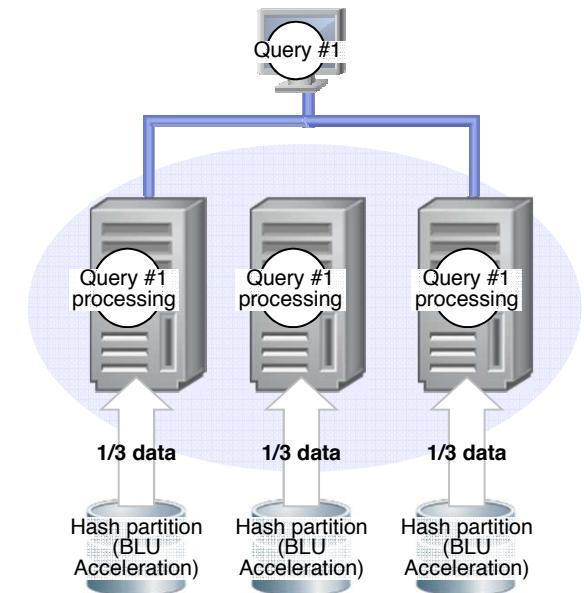
BLU Acceleration: MPP Scale Out

▪ Technology

- Pervasive SMP & MPP Query Parallelism
- Inter-partition query parallelism simultaneous with intra-partition- parallelized, memory-optimized, columnar, SIMD-enabled, BLU processing

▪ Value Proposition

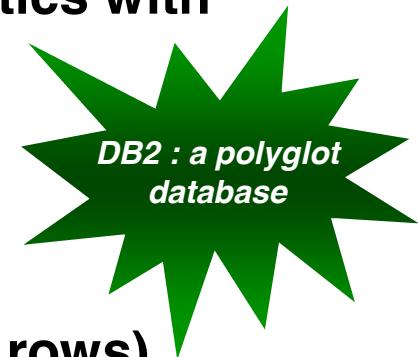
- Improve Response Time
 - All servers contribute to the processing of a query
- Massively Scale Data
 - Significantly beyond current practical limits
- Streamline BLU Adoption
 - Add BLU Acceleration to existing data warehouses



DB2 10.5 BLU Capacity	DB2 V11.1 BLU Capacity
10s of TB	1000s of TB
100s of Cores	1000s of Cores

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**
- **Nested Loop Join Support**

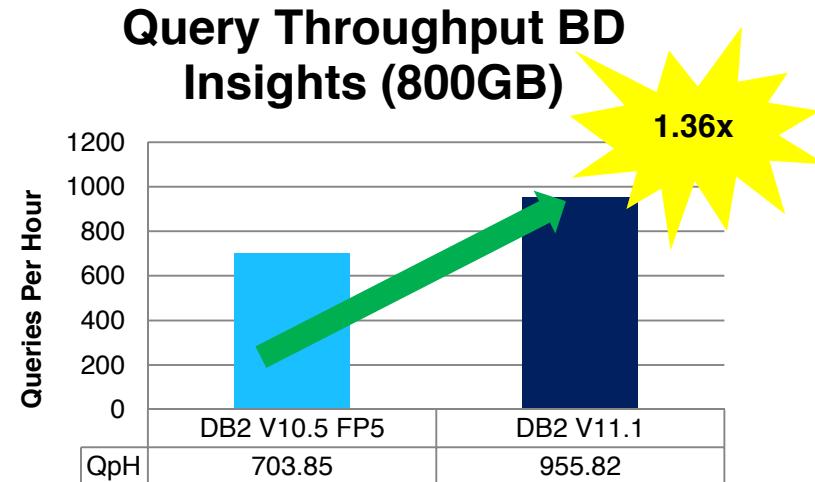


Performance Improvements

- **BLU Acceleration includes a number of performance improvements in the columnar engine**
 - Faster SQL MERGE processing
 - Nested Loop Join Support
 - Industry Leading Parallel Sort
 - Improved SORTHEAP utilization
 - Query Rewrite Improvements
 - Push-down of a number of SQL & OLAP functions into the BLU engine
 - Optimized SQL support for BLU

Demonstrating BLU Single Instance Improvement

▪ DB2 V11.1 on Intel Haswell EP



Reasons for Improvement

Native BLU Evaluation

- Native Sort
- Native OLAP (usually combined with sort)
- Enables query plans to remain as much as possible within the columnar engine

Query Rewrite Improvements

- Find areas to improve degree determination and improve parallel use

Improved SORTHEAP Utilization

- SORTHEAP used for building hash tables for JOINs, GROUP BYs, and other runtime work
- Efficient use allows for more concurrent intra-query and inter-query operations to co-exist.

▪ Configuration Details

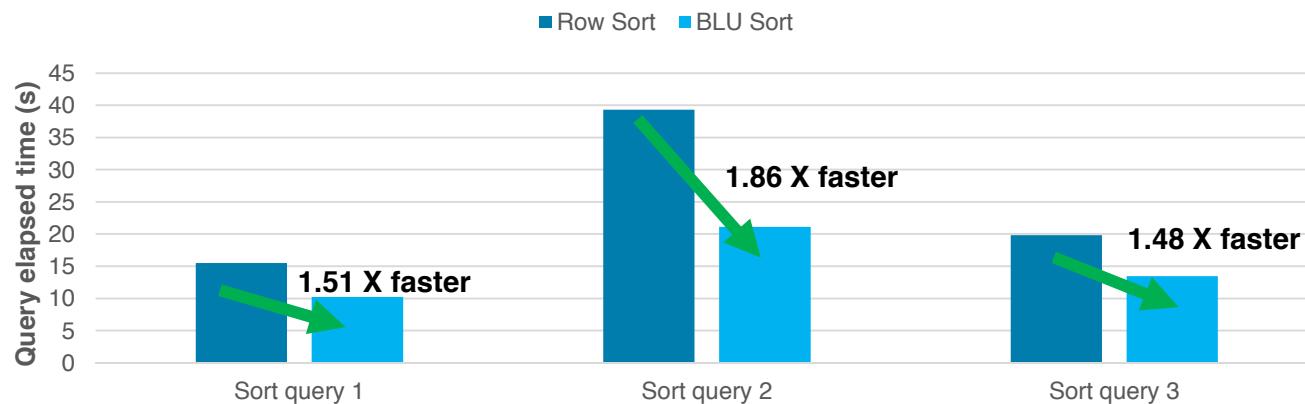
- 2 socket, 36 core Intel Xeon E5-2699 v3 @ 2.3GHz
- 192GB RAM
- BD Insights Internal Multiuser Workload 800GB

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BLU Sort on MPP Environment

- Enhancements can increase BLU Acceleration performance by as much as 1.86X

Row sort vs BLU sort



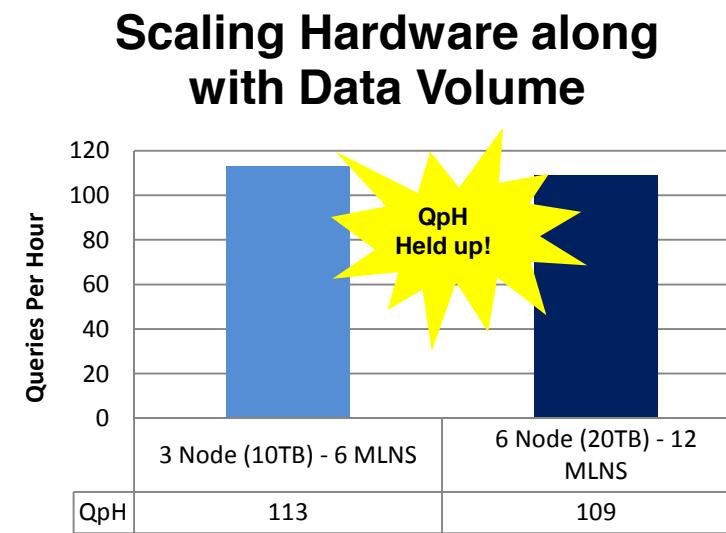
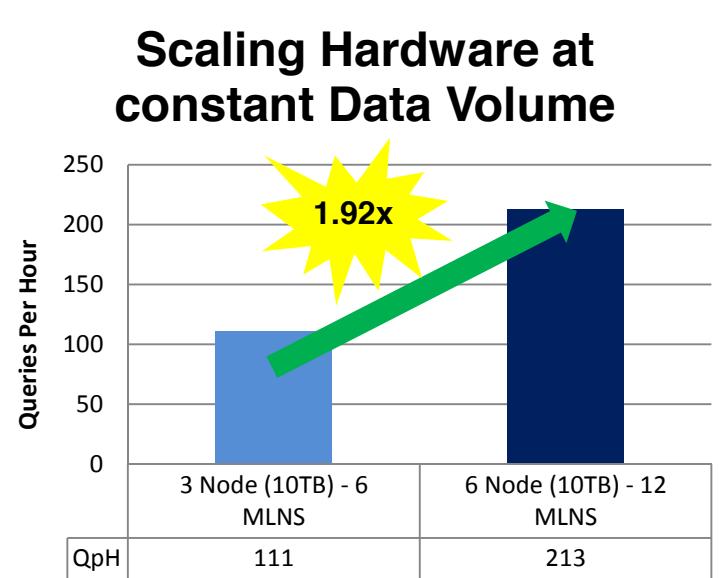
- Configuration Details

- BLU MPP with 1 physical node/4-MLNs and 8 cores per MLN
- 4-socket, 40 Cores Intel Xeon platform and 1 TB RAM
- Used Sort Target Workload 1 TB (an internal workload based on the TPC-DS schema), with 10-Million rows to sort for each scenarios
- Query scenarios involving single ORDER BY concentrating on sort operation

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.

Demonstrating BLU MPP Linear Scaling

- DB2 Version 11.1 on an IBM Power Systems E850 Cluster

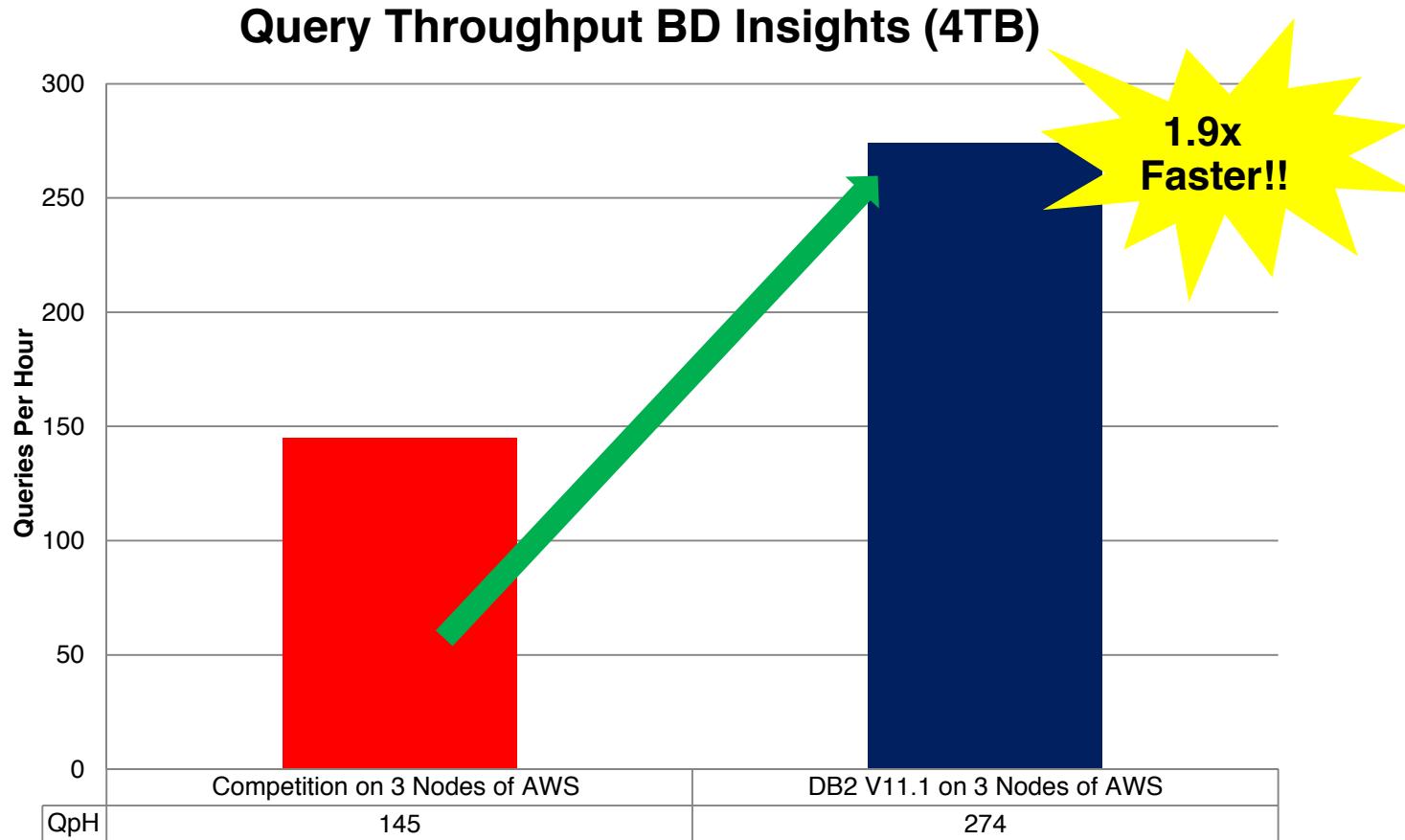


- Scaling was measured in two different ways
 - Doubling the hardware but keeping the database constant
 - Doubling the hardware and doubling the database size
 - Both tests used the BD Insights Heavy Analytics Internal Workload

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Outstanding BLU MPP Performance

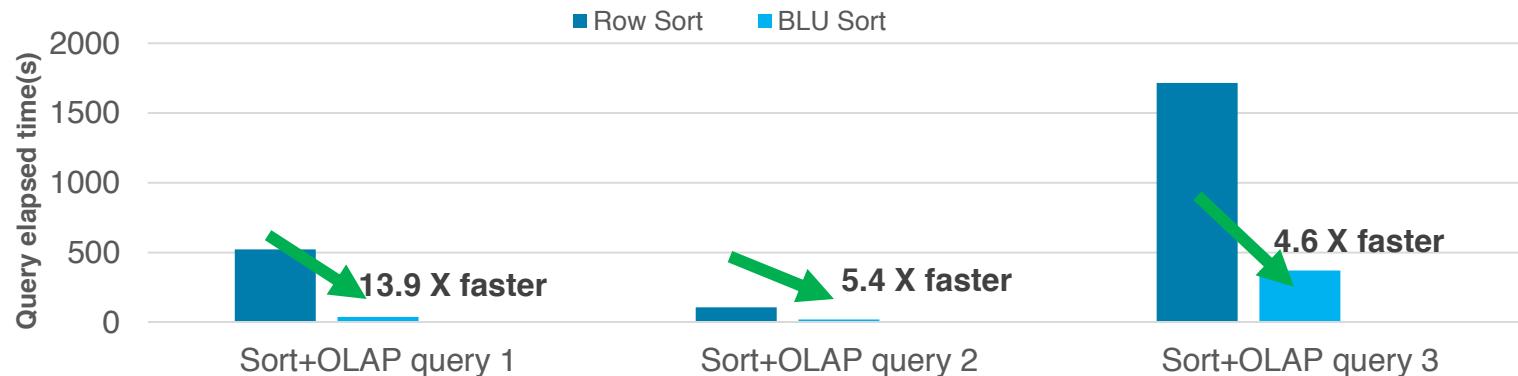
- 1.9x Higher Throughput with DB2 Version 11.1 vs. the Competition



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Industry Leading Parallel Sort

- **Leverages the latest sort innovations from IBM TJ Watson Research and DB2 Development**
 - Enhancements can increase BLU Acceleration performance by as much as 13.9X
- **BLU Sort+OLAP on SMP Environment**



- **Configuration Details**
 - On 4-socket Intel Xeon platform with 72 Cores and 742G RAM
 - 1 TB TPC-DS database
 - Query scenarios involving multiple sort and OLAP operations

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Columnar Engine Native Sort + OLAP Support

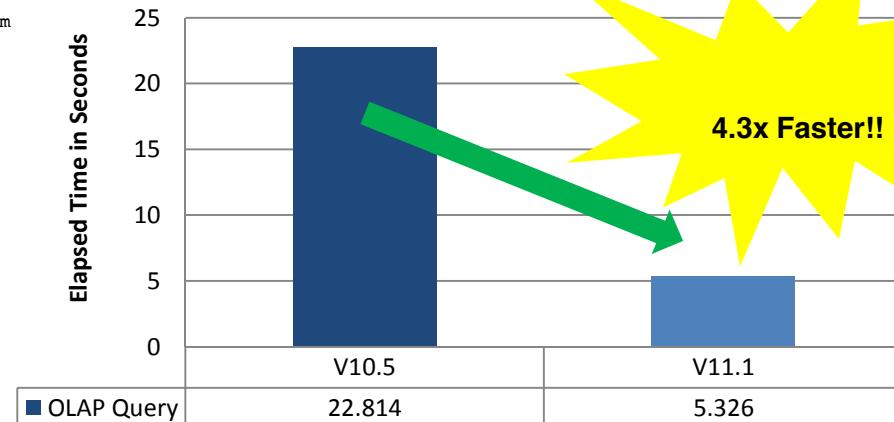
- No longer compensated on single instance DB2 V11.1

```
with v1 as(
  select i_category, i_brand, cc_name, d_year, d_moy, sm_type,
         sum(cs_sales_price) sum_sales,
         avg(sum(cs_sales_price)) over
           (partition by i_category, i_brand, cc_name, d_year)
             avg_monthly_sales,
         rank() over
           (partition by i_category, i_brand, cc_name
            order by d_year, d_moy) rn
  from BDINSIGHTS.item
    , BDINSIGHTS.catalog_sales BDINSIGHTS.date_dim, BDINSIGHTS.call_center
    , BDINSIGHTS.ship_mode
  where cs_item_sk = i_item_sk and cs_sold_date_sk = d_date_sk
    and cc_call_center_sk= cs_call_center_sk
    and cs_ship_mode_sk = sm_ship_mode_sk
    and d_year = 2000
  group by i_category
    , i_brand, cc_name , d_year , d_moy, sm_type),
v2 as(
  select v1.i_category, v1.i_brand, v1.cc_name, v1.d_year, v1.d_moy
    , v1.avg_monthly_sales, v1.sum_sales, v1.sm_type, v1_lag.sum_sales psum
    , v1_lead.sum_sales nsum
  from v1
    , v1 v1_lag , v1 v1_lead
  where v1.i_category = v1_lag.i_category
    and v1.i_category = v1_lead.i_category and v1.i_brand = v1_lag.i_brand
    and v1.i_brand = v1_lead.i_brand and v1.cc_name = v1_lag.cc_name
    and v1.cc_name = v1_lead.cc_name and v1.rn = v1_lag.rn + 1
    and v1.rn = v1_lead.rn - 1)
select *
  from v2
where d_year = 2000
  and avg_monthly_sales > 0
  and case when avg_monthly_sales > 0
            then abs(sum_sales - avg_monthly_sales) / avg_monthly_sales
            else null end > 0.1
order by sum_sales - avg_monthly_sales
    , cc_name
fetch first 100 rows only
```



OLAP Functions
rank, avg

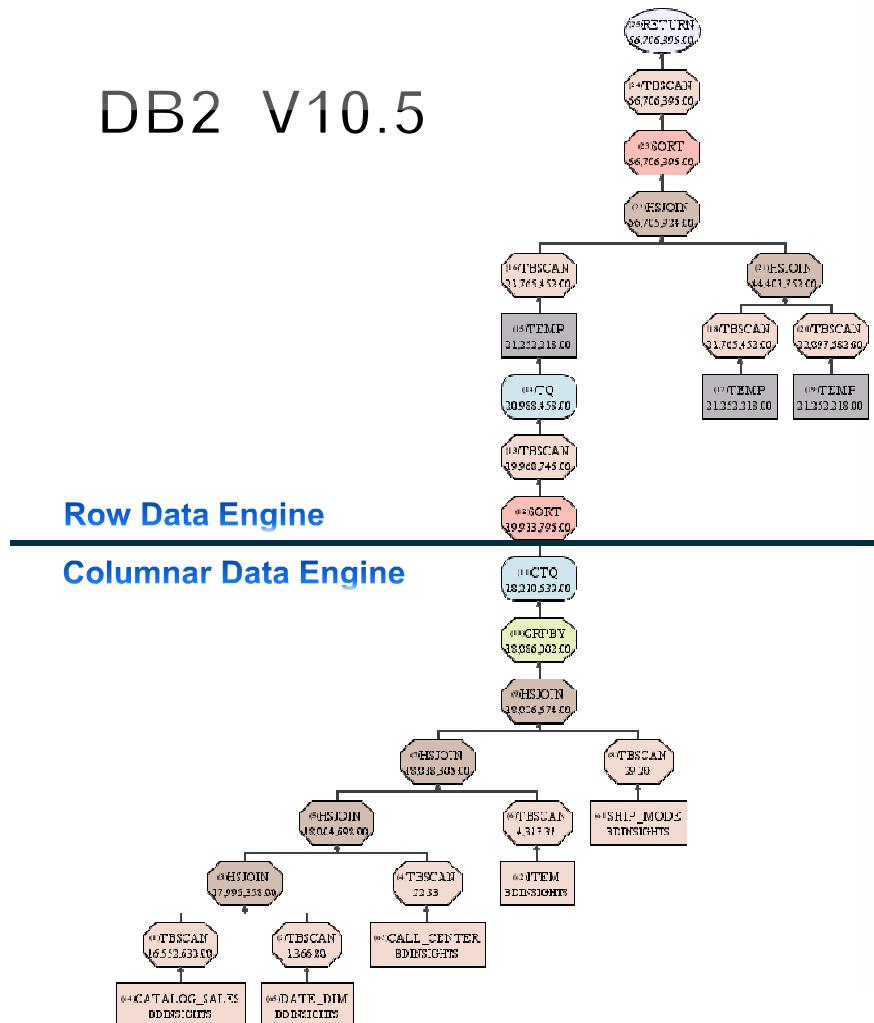
OLAP Query Elapsed Time (s)
(lower is better)



Columnar Engine Native Sort + OLAP Support

- Access Plan Difference with Native Evaluator support

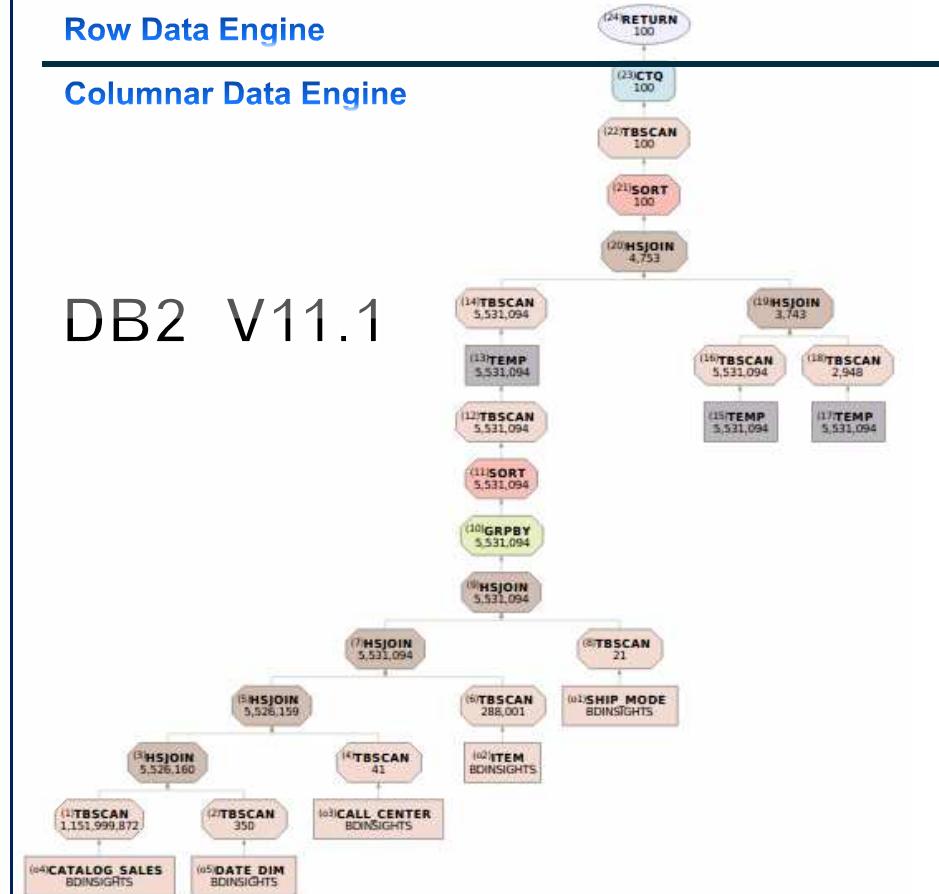
DB2 V10.5



Row Data Engine

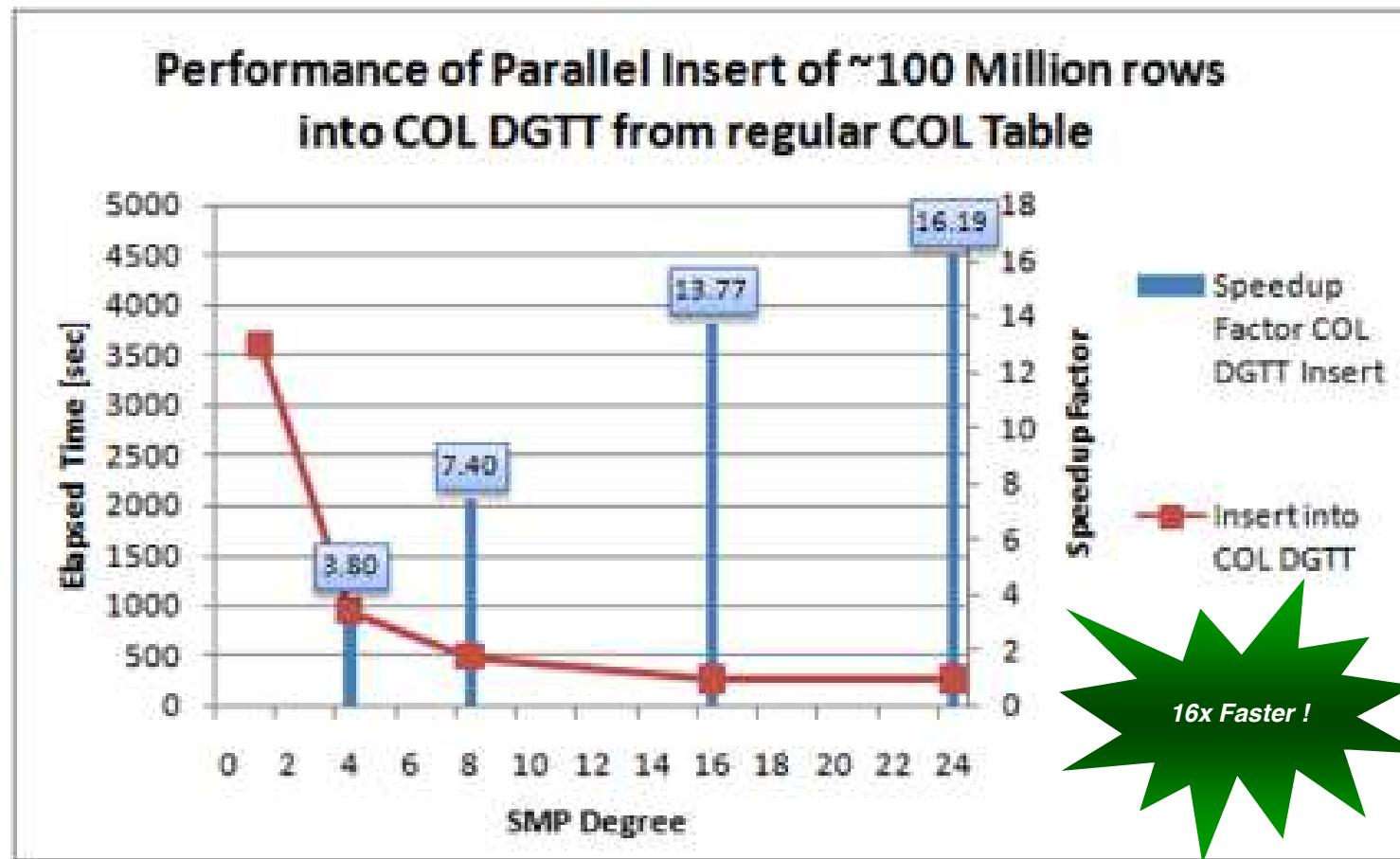
Columnar Data Engine

DB2 V11.1



BLU Acceleration: Massive Gains for ELT & ISV Apps

BLU Declared Global Temporary Table (not-logged DGTT) Parallelism



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SQL ENHANCEMENTS

BINARY and VARBINARY data

▪ BINARY and VARBINARY data types

- Allow binary string data to be stored and manipulated without the overhead of using a BLOB type
- A binary string is a sequence of bytes that are used to store as pictures, sound, or mixed media
- BINARY and VARBINARY data types are compatible with each other and are compatible with the BLOB data type
- Binary string data types are not compatible with character string data types, except those character strings that are defined as FOR BIT DATA
- Support for BINARY and VARBINARY data types enhances compatibility with other relational database management systems
- BINARY can contain 1-254 bytes
- VARBINARY can be up to 32672 bytes

New CREATE FUNCTION statement for aggregate UDFs

- **The new CREATE FUNCTION (aggregate interface) statement allows you to create your own aggregate functions**
 - An aggregate function returns a single value that is the result of an evaluation of a set of like values, such as those in a column within a set of rows
 - Use your choice of programming language
 - Four sections within the function are defined based on the stage of the aggregation process
 - INITIATE
 - ACCUMULATE
 - MERGE
 - FINALIZE

Support for the (+) Outer Join Operator

- Support for the outer join operator enhances cross-vendor support
- Queries can use the outer join operator (+) as alternative syntax within predicates of a WHERE clause
- The use of the Oracle compatibility mode is not required to enable this feature

COLLATION_KEY Function

▪ COLLATION_KEY

- The COLLATION_KEY function returns a VARBINARY string that represents the collation key of the expression argument, in the specified collation
- This function is used in SQL for ordering and comparison operations

▪ Format

- `COLLATION_KEY(expression, collation_name, [length])`

▪ Arguments

- Expression - An expression for which the collation key is determined
- Collation_Name - An expression that specifies the collation to use when the collation key is determined
- Length - An expression that specifies the length attribute of the result in bytes

▪ Example:

- The following query orders employees by their surnames by using the language-aware collation for German in code page 923
- ```
SELECT FIRSTNAME, LASTNAME FROM EMPLOYEE
ORDER BY COLLATION_KEY (LASTNAME, 'SYSTEM_923_DE')
```

# New Functions, Data Types and Columnar Optimization

| Date/Time      | Date/Time            | Statistics      | Bit Manipulation | Data Types | Strings            | OLAP Pushdown | OLAP Pushdown   |
|----------------|----------------------|-----------------|------------------|------------|--------------------|---------------|-----------------|
| DATE_PART      | ADD_YEAR             | COVARIANCE_SAMP | HASH             | INT2       | STRPOS             | RANK          | FIRST_VALUE     |
| DATE_TRUNC     | ADD_MONTHS           | STDDEV_SAMP     | HASH4            | INT4       | STRLEFT            | DENSE_RANK    | RATIO_TO_REPORT |
| AGE            | ADD_DAYS             | VARIANCE_SAMP   | HASH8            | INT8       | STRRIGHT           | ROW_NUMBER    | EXP             |
| LOCALTIMESTAMP | ADD_HOURS            | CUME_DIST       | TO_HEX           | FLOAT4     | REGEXP_COUNT       | LPAD          | LOG10           |
| NOW Function   | ADD_MINUTES          | PERCENT_RANK    | RAWTOHEX         | FLOAT8     | REGEXP_EXTRACT     | RPAD          | COLLATION_KEY   |
| THIS_QUARTER   | ADD_SECONDS          | PERCENTILE_DISC | INT2AND          | BPCHAR     | REGEXP_INSTR       | TO_CHAR       | LN              |
| THIS_WEEK      | DAYOFMONTH           | PERCENTILE_CONT | INT2OR           | BINARY     | REGEXP_LIKE        | INITCAP       | TO_NUMBER       |
| THIS_YEAR      | FIRST_DAY            | MEDIAN          | INT2XOR          | VARBINARY  | REGEXP_MATCH_COUNT | TO_DATE       | MOD             |
| THIS_MONTH     | DAYS_TO_END_OF_MONTH | WIDTH_BUCKET    | INT2NOT          | LOG        | REGEXP_REPLACE     | MONTHNAME     | SIN             |
| NEXT_QUARTER   | HOURS_BETWEEN        | COVAR_POP       | INT4AND          | RANDOM     | REGEXP_SUBSTR      | DAYNAME       | COS             |
| NEXT_WEEK      | MINUTES_BETWEEN      | STDDEV_POP      | INT4OR           |            | BTRIM              | POWER         | TAN             |
| NEXT_YEAR      | SECONDS_BETWEEN      | VAR_POP         | INT4XOR          |            |                    | Avg           | COT             |
| NEXT_MONTH     | DAYS_BETWEEN         | VAR_SAMP        | INT4NOT          |            |                    | COUNT         | ASIN            |
| NEXT_DAY       | WEEKS_BETWEEN        |                 | INT8AND          |            |                    | COUNT_BIG     | ACOS            |
| EXTRACT        |                      |                 | INT8OR           |            |                    | MIN           | ATAN            |
|                |                      |                 | INT8XOR          |            |                    | MAX           | TRUNCATE        |
|                |                      |                 | INT8NOT          |            |                    | SUM           |                 |

# Compatibility features for Netezza Performance Server

- **Use the SQL\_COMPAT global variable to activate the following optional NPS compatibility features**

- SET SQL\_COMPAT='NPS'

- **Compatibility Features**

- Double-dot notation
    - You can use double-dot notation to specify a database object
  - TRANSLATE parameter syntax
    - TRANSLATE (*char-string-exp*, *from-string-exp* ,*to-string-exp*)
  - NPS Operator Symbols
    - The operators ^ and \*\* are both interpreted as the exponential operator, and the operator # is interpreted as bitwise XOR
  - Grouping by SELECT clause columns
    - You can specify the ordinal position or exposed name of a SELECT clause column when grouping the results of a query
  - Routines written in NZPLSQL
    - The NZPLSQL language can be used in addition to the SQL PL language.

# DB2 Version 11.1 Highlights

## 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

- PostgresSQL

#### Support for European Languages

- Codepage 819