DB2 11 for z/OS
Technical Overview

DB2 for z/OS Customer Trends

- **Proliferation of mobile and other network-connected devices is driving increases in:**
  - **transaction workloads**
  - **data volumes**
  - **24x7 requirements**
- **Continued focus on cost containment and resource efficiency**

- **Competitive pressures continue to drive an increasing need for innovation, analytics, and data integration**

- **DB2 for z/OS has leading edge capabilities to support these requirements and DB2 11 makes important improvements**

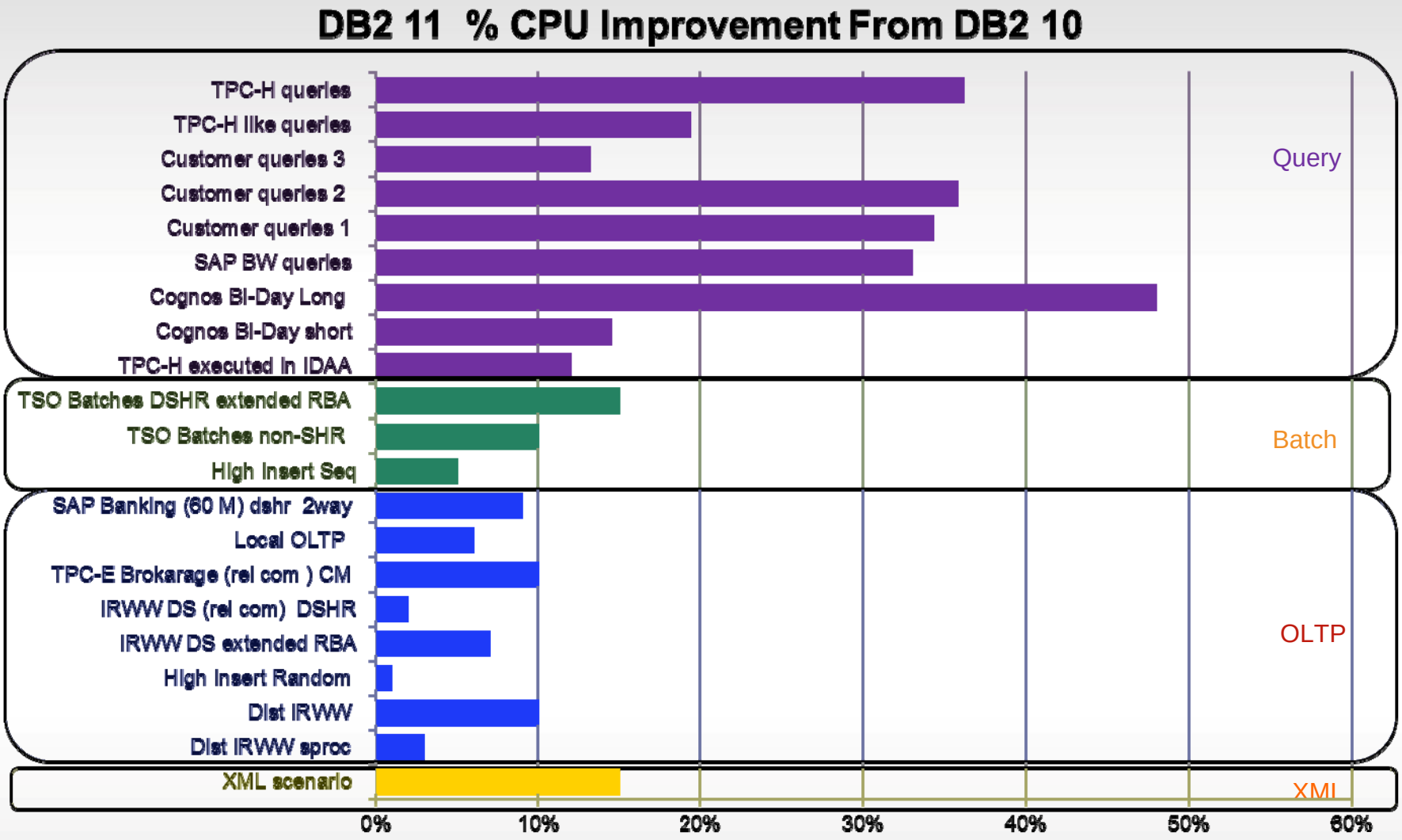
DB2 11 Major Themes

- **Out-of-the-box CPU Savings**
  - Improving efficiency, reducing costs, no application changes
  - Up to 10% for complex OLTP
  - Up to 10% for update intensive batch
  - Up to 40% for queries
  - Additional performance improvements through use of new DB2 11 features
- **Enhanced Resiliency and Continuous Availability**
  - Improved autonomics which reduces costs and improves availability
  - Making more online changes without affecting applications
  - Online REORG improvements, less disruption
  - DROP COLUMN, online change of partition limit keys
  - Extended log record addressing capacity - 1 yottabyte (or 1B petabytes)
  - BIND/REBIND, DDL break into persistent threads
- **Enhanced business analytics**
  - Expanded SQL, XML, and analytics capabilities
  - Temporal and SQLPL enhancements
  - Transparent archiving
  - Hadoop integration, NoSQL and JSON support
- **Simpler, faster DB2 version upgrades**
  - No application changes required for DB2 upgrade
  - Access path stability improvements
  - Product quality/stability – raised the bar

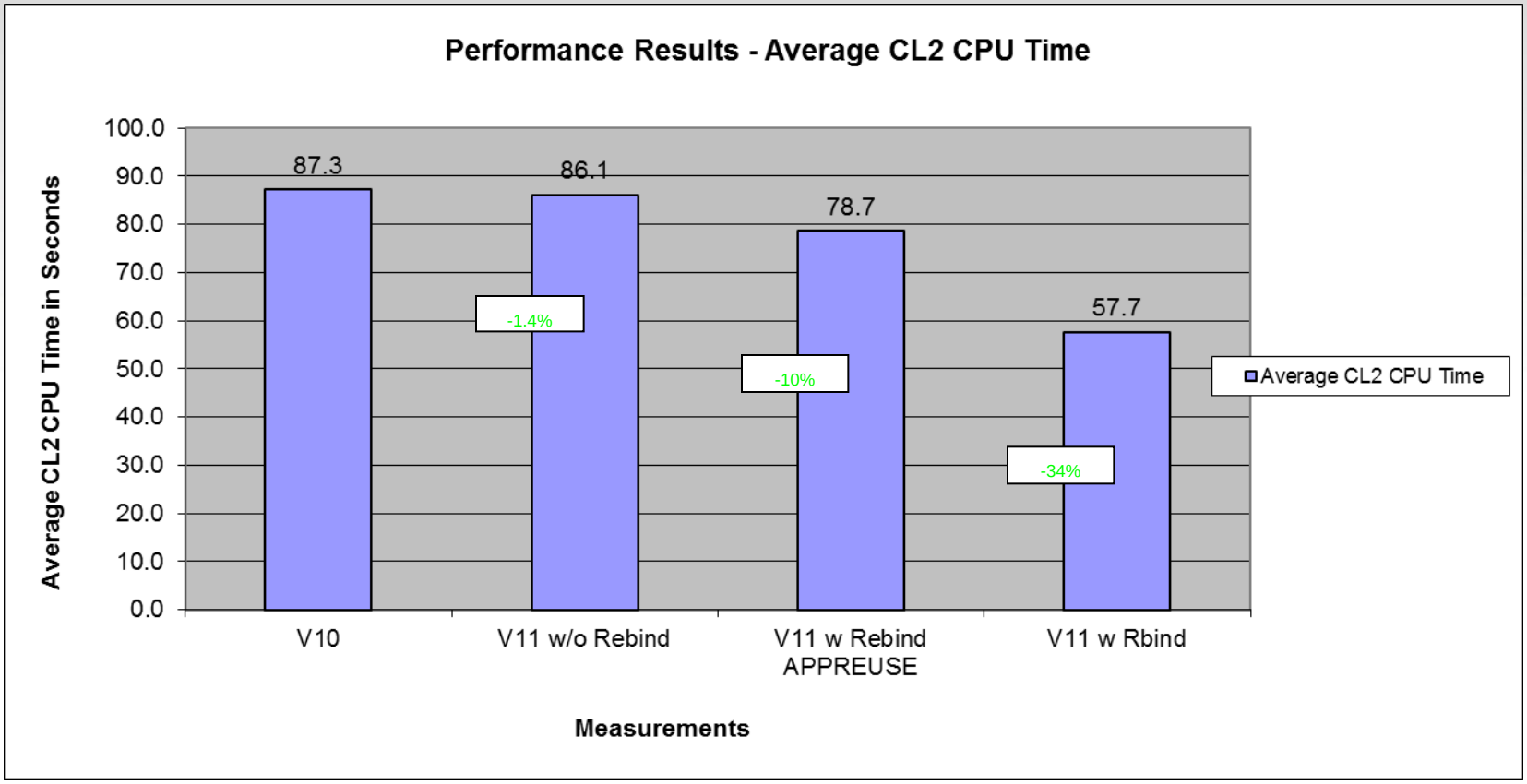
Announce Oct. 1

GA Oct. 25

Impressive DB2 11 Performance Results!



TPC-H Using Static SQLPL



-10% out-of-box improvement with DB2 11 when rebinding with APREUSE

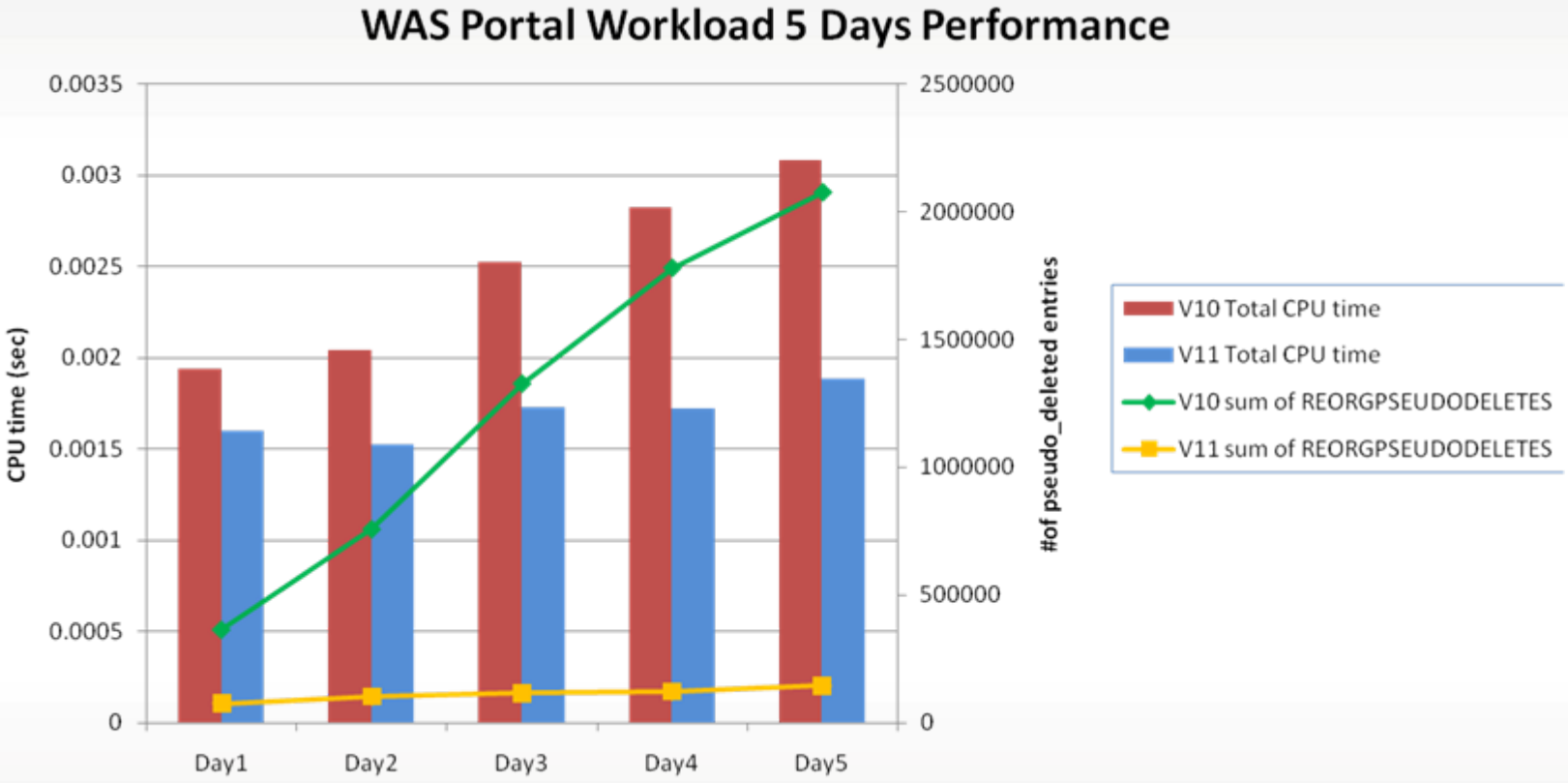
- 34% improvement in DB2 11 when rebinding to obtain DB2 11 AP

Performance Improvements
no REBIND needed – Partial List

- DDF performance improvements
  - Reduced SRB scheduling on tcp/ip receive using new CommServer capabilities
  - Improved autocommit OLTP performance
- INSERT performance
  - Latch contention reduction
  - CPU reduction for Insert column processing and log record creation
  - Data sharing LRSN spin avoidance
  - Page fix/free avoidance in GBP write
- Automatic index pseudo delete cleanup
- IFI 306 filtering capabilities to improve Replication capture performance
- DGTT performance improvements
  - Avoid incremental binds for reduced cpu overhead *
- Utilities performance improvements
- Java stored procedures: multi threaded JVMs, 64-bit JVM – more efficient

DB2 11 Auto Pseudo Delete Cleanup

- Up to 39% DB2 CPU reduction per transaction in DB2 11 compared to DB2 10
- Up to 93% reduction in Pseudo deleted entries in DB2 11
- Consistent performance and less need of REORG in DB2 11



Performance Improvements
REBIND required – Partial List

- Query transformation improvements – less expertise required for performant SQL
- Enhanced duplicate removal
  - Lots of queries require duplicate removal: e.g. DISTINCT, GROUP BY, etc.
  - Dup elimination via sorting can be expensive
  - New techniques: Index duplicate removal, early out
- In-memory techniques
  - In-memory, reusable workfile
  - Sparse index (limited hash join support)
  - Non-correlated subquery using MXDTCACH
  - Correlated subquery caching
- Select list do-once
  - Non column expressions in the select list can be executed once rather than per-row
- Column processing improvements
  - Xproc (generated machine code) for column processing
- DPSI performance improvements
- Data de-compression optimizations
- Optimizer CPU and I/O cost balancing improvements
- DRDA package based continuous block fetch

Performance Improvements
Sysprog, DBA, or appl effort required – Partial List

- Suppress-null indexes
  - Index entries not created when all values for indexed columns are NULL
  - Reduced index size, improved insert/update/delete performance, compatibility with other DBMSes
  - Improved utility and CREATE INDEX performance
- New PCTFREE FOR UPDATE attribute to reduce indirect references
- DGTT performance improvements
  - Non logged DGTTs
- Extended optimization - selectivity overrides (filter factor hints)
  - Improve optimizer's ability to find the cheapest access path
  - Collect filter factors for predicates in a Selectivity Profile
- Open dataset limit raised to 200K

DB2 11 and zEC12 Synergy

- Faster CPU – 1.25x compared to z196
  - 5.5GHz processors, bigger/faster cache
  - 25% reduction measured with DB2 workloads
- 50% More System Capacity to help consolidation
  - Up to 3TB real memory per server
  - Excellent synergy with DB2 10 and 11 scalability
- New Features that DB2 11 Exploits
  - FLASH Express and pageable 1MB frames, used for:
    - Buffer pool control blocks
    - DB2 executable code
  - 2GB frame support for buffer pools
    - Performance improvement expected for extremely large memory sizes
- New zEC12 GA2 features that benefit DB2
  - zEDC Express for enhanced DB2 SMF data compression
  - RoCE Express for faster, cheaper z/OS to z/OS DRDA communication
    - Preliminary measurements show up to 2x DRDA transaction throughput increase

RAS and Usability Improvement Highlights

- Logging capacity and performance: RBA/LRSN optionally expands to 10 bytes
- BIND / DDL / Online REORG concurrency with persistent threads
  - Avoid having to shut down apps to get a REBIND through, e.g. for application upgrades
- More online schema changes
  - Alter partitioning limit keys
  - DROP column
  - Point in time recovery support for deferred schema changes

99.999% availability because your business never stops.[1]

- Autonomics improvements
  - Automatic index pseudo delete cleanup
  - Overflow row reduction
  - Optimizer externalizes missing stats to enable automated RUNSTATS
- Data sharing improvements
  - Group buffer pool write-around
  - Restart light enhancements
  - Index split performance and other indexing improvements
  - Full LRSN spin avoidance
- Plan management improvements - APREUSE(WARN) support
- -ACCESS DATABASE … MODE(STATS) option to externalize RTS statistics

Security Enhancements

- Remove inconsistencies between DB2 and RACF access controls
  - Automatic DB2 cache refresh when RACF changes are made
    - Package auth cache, dynamic statement cache, user authentication cache
  - Support BIND OWNER when using RACF exit
  - Support auto REBIND using owner's authid when usi RACF exit
  - Dynamic SQL authorisation checking improvements
- Bind plan option to ensure the program is authorized to use the plan
  - New PROGAUTH bind option
- Remove column masking restrictions for GROUP BY and DISTINCT

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Summary of Utilities Improvements

- Availability
  - Online data repartitioning
    - REORG REBALANCE SHRLEVEL(CHANGE)
    - Online ALTER of limit keys
  - Online REORG availability improvements
    - SWITCH phase reduction
    - Improved drain processing
  - Part level inline image copies for REORG
- Usability
  - Online REORG automated mapping tables
  - REORG delete unused PBG datasets
  - System cloning improvements
- CPU reduction
  - More zIIP offload for LOAD and RUNSTATS
- Performance
  - Faster LOAD processing
  - Inline statistics improvements, reduced need for RUNSTATS
  - Optimizer input to statistics collection
  - REORG option to avoid sorting data for clustering
  - DSNACCOX performance

Over 40 new enhancements!

Key utilities performance numbers

- Up to 81% zIIP-eligible CPU with RUNSTATS COLGROUP
- Up to 40% zIIP-eligible CPU in REORG & LOAD with inline distribution stats
- REORG SWITCH phase outage reduced by up to 91%
- Up to 71% elapsed time reduction for REORG of subset of partitions
  - SORTNPSI option retrofitted to V9 & V10
- RECOVER from part-level image copies reduced CPU by up to 50%, elapsed by up to 40%
- LOAD from single input dataset elapsed time reduced by up to 70%
- Crossloader support for FETCH CONTINUE for LOB & XML data
  - 28% CPU reduction

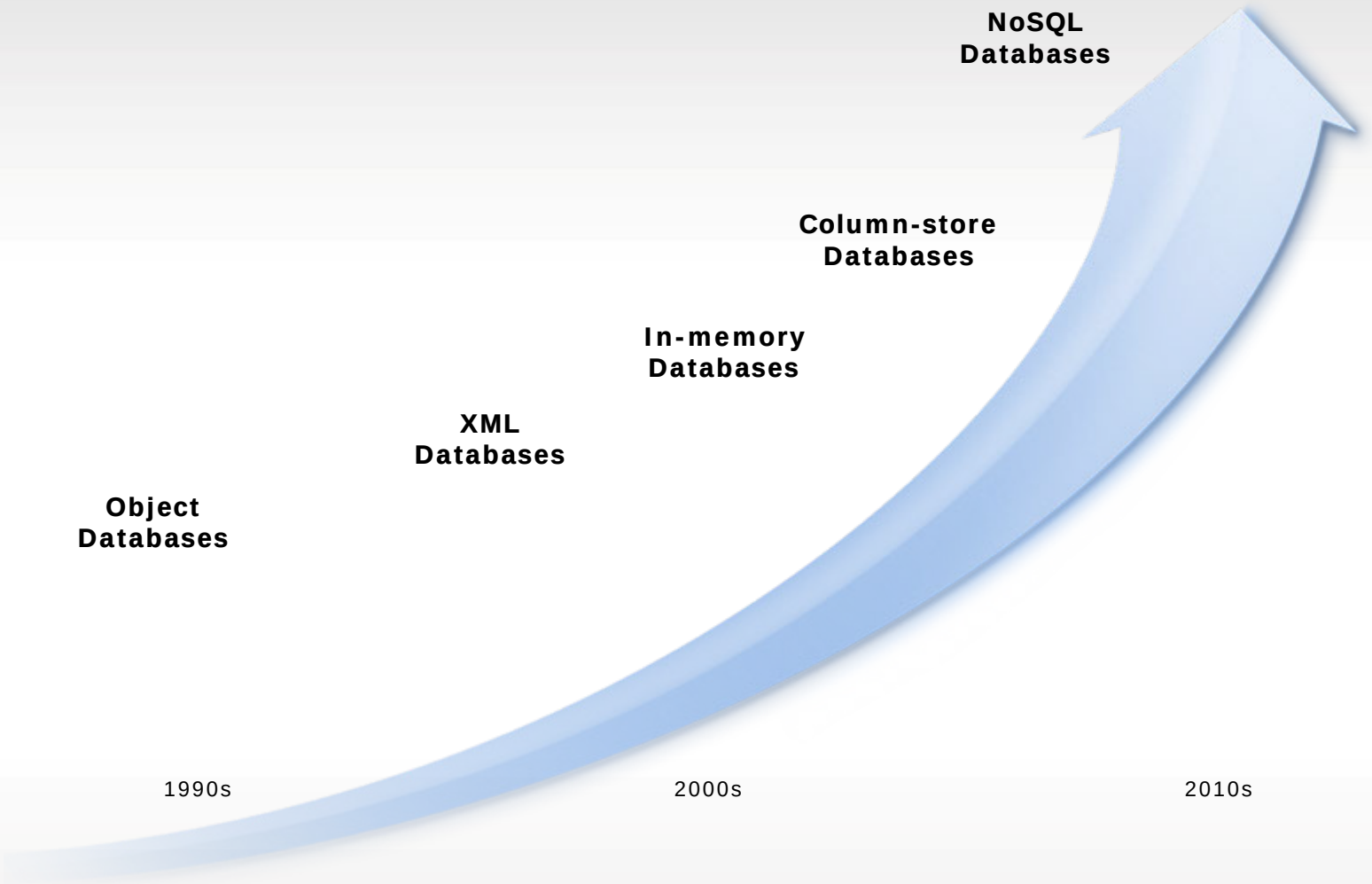
SWITCH phase impact relief – reduced application impact

- Easier drain acquisition
- Prevent new claims on all target partitions whilst waiting for drains
  - Faster drain acquisition for part-level REORG
- New DRAIN_ALLPARTS option to momentarily drain all data parts
  - Eliminates claim-drain “deadlocks” for part-level REORG with NPSIs
- Restructure SWITCH phase processing for outage reduction
  - SWITCH phase ET reduction of 91% measured when reorging 20 parts
- New SWITCHTIME parameter to determine earliest point at which drain processing will be attempted
  - Govern timing of drain without the need to schedule separate –ALTER UTILITY command

Expanded SQL and Analytics Capabilities

- Global variables
- SQLPL improvements: array data type, autonomous transactions
- Alias support for sequence objects
- Temporal data enhancements
  - Support for views
  - Special register support
  - Integrated auditing support (planned)
- Transparent archive query
- SQL Grouping Sets, including Rollup, Cube
- Unicode column support for EBCDIC tables
- Hadoop access via table UDF
- JSON support

New Technology Emerges



JSON Database Technology Preview

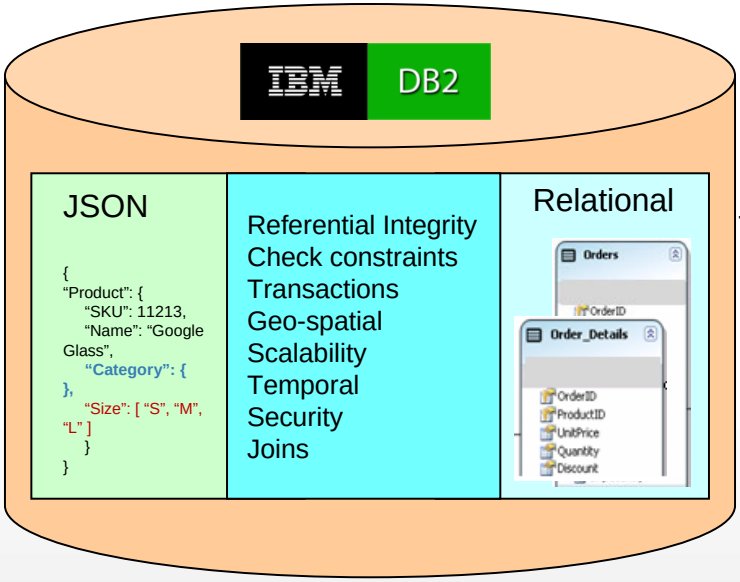
Providing the best of both worlds

MongoDB API

JSON API	SQL + JSON API	SQL API

Tunable Consistency

Performance & Scalability



Tools for higher Productivity

Established Security

Announced in DB2 Accessories Suite for z/OS, V10 and V11

Why is System z Important for Big Data and Analytics?

Because the world's largest and most successful companies store their operational data on z

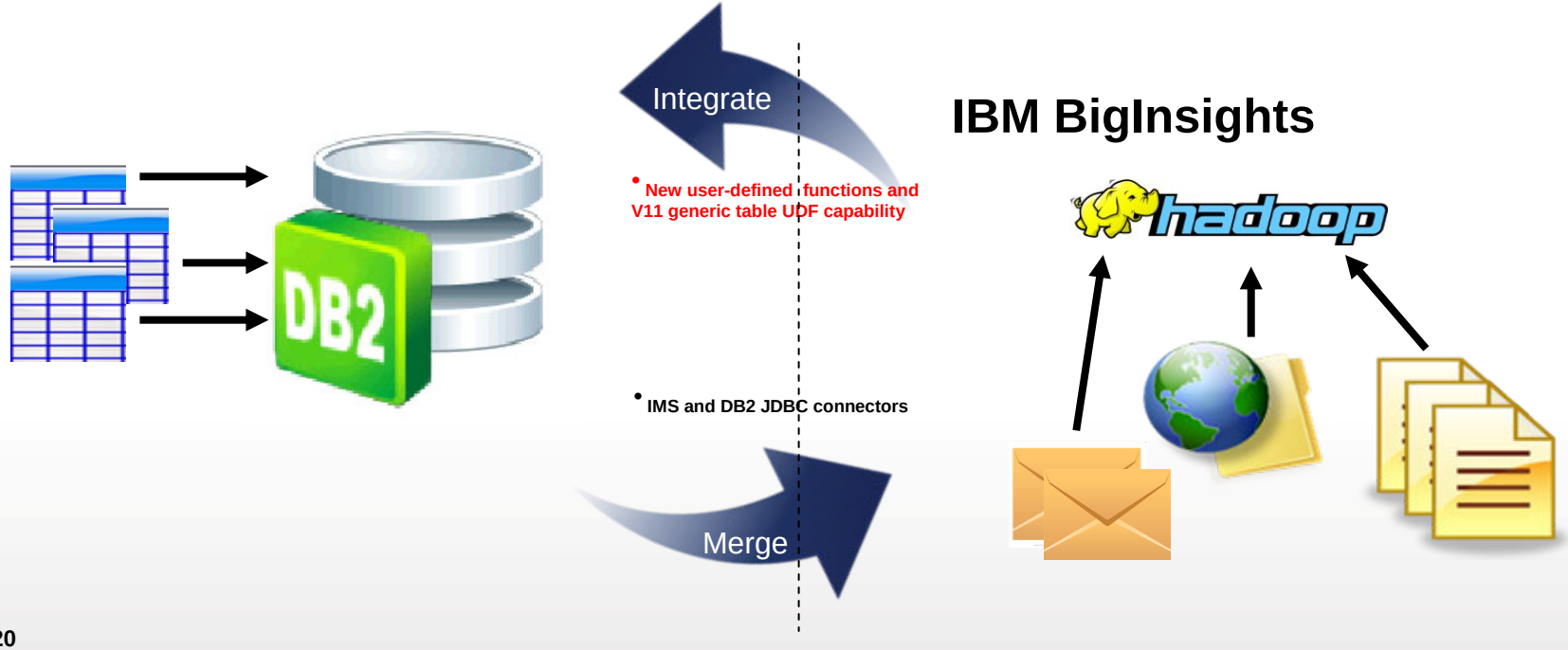
- Data that originates and/or resides on zEnterprise
  - 2/3 of business transactions for U.S. retail banks
  - 80% of world's corporate data
- Businesses that run on zEnterprise
  - 66 of the top 66 worldwide banks
  - 24 of the top 25 U.S. retailers
  - 10 of the top 10 global life/ health insurance providers
- The downtime of an application running on zEnterprise = apprx 5 minutes per yr
- 1,300+ ISVs run zEnterprise today
  - More than 275 of these selling over 800 applications on Linux

*Source IBM CEO Study 2011

Integrating Big Data Analytics with DB2 for z/OS

- Much of the world's operational data resides on z/OS
- Unstructured data sources are growing fast
- Two significant needs:
  1. Merge this data with trusted OLTP data from zEnterprise data sources
  2. Integrate this data so that insights from Big Data sources can drive business actions
- Connectors to allow BigInsights to easily & efficiently access DB2 data
- DB2 is providing the connectors & the DB capability to allow DB2 apps to easily and efficiently access hadoop data sources

New V11 features enable this



XML Enhancements

- New Features
  - Basic xQuery (retrofit to v10)
  - COBOL samples for XML (published on Developerworks website)
- Feature Enhancements
  - Implicitly add doc node during insert/update
  - Crossloader support
  - Fix error reporting position predicate
  - Support xquery constructor as the source expression of insert and replace
- Performance Enhancements
  - Binary XML validation *(retrofit to DB2 V10)*
  - Partial validation after update
  - Date/Time Predicate Pushdown
  - XQuery(FLWOR) and XMLQUERY enhancement
  - Optimize Index Search Keys
  - XML Operator Improvements, use less storage and CPU
  - XQuery deferred construction
  - XMLTABLE pushdown cast
  - Avoid validation of validated binary XML data during LOAD

Easier DB2 Version Upgrade

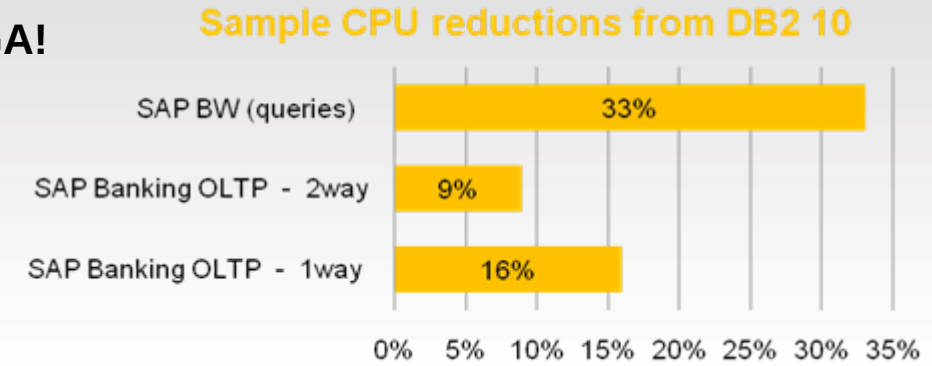
- Application Compatibility (APPLCOMPAT)
  - New feature to ease DB2 version upgrades – avoid impact to applications
  - New mechanism to identify applications affected by SQL changes in the new release
  - Seamless mechanism to make changes at an application (package) level or system level
- Faster ENFM processing
  - Lab measurement showed 18x faster in V11 vs. V10 using a large customer catalog
- Access path stability improvements
- Higher code quality stability levels
- SQL Capture/Replay tooling can help testing of DB2 version upgrades
- Migration Planning Workshops (MPW)
  - See the DB2 11 MPW community in DeveloperWorks for latest info

"We have seen some really good results regarding CPU savings - we have been so impressed with the product stability and have already moved an internal production system to DB2 11"

Stefan Korte GAD

DB2 11 Optimized for SAP

- **Immediate SAP certification for DB2 11 at GA!**
  - See SAP Note 1850403
  - Easy migration from DB2 10:
    No new SAP service packs required
    Facilitated online DB2 migration



- **Save with CPU reductions**
- **Low latency connectivity from SAP app server**
- **Federated and consistent cloning of SAP business processes spanning multiple SAP/DB2 systems**

- **Online data maintenance**
  - Better online REORG, online repartitioning
- **Better scaling**
  - Larger log RBAs, larger statement cache

DB2 11 SAP Certified at GA - the fastest ever certification for any DB2 for z/OS release in history

DB2 11 ESP Highlights

ESP Start	**February 2013**
First Code Drop	**March 2013**
“Regular” service process	**July 2013**
GA	**October 25, 2013**

Core - 21 WW Customers

Geography

- 11 EMEA
- 9 NA
- 1 SA

Industry

- 7 Banking
- 5 Insurance
- 3 Healthcare
- 2 Financial Markets
- 1 Automotive

Extended – 6 WW Customers

Geography

- 3 EMEA
- 2 NA
- 1 SA

Industry

- 3 Banking
- 2 Computer Services
- 1 Professional Services

DB2 11 ESP Client Feedback

- Excellent quality and stability
- Good performance and CPU savings
  - ✓ DRDA workload up to 20% CPU reduction
  - ✓ CICS workload up to 18% CPU reduction
  - ✓ Batch workload up to 20% CPU reduction
- Full menu of functions, including
  - Utility improvements
  - Transparent archiving
  - Large RBA/LSRN
  - Optimizer and migration improvements
  - Big Data Integration
  - JSON Support for modern workloads

DB2 11 for z/OS - over 30 quotes

DB2 11 - SPEED & COST
"The Archive Transparency feature addresses an issue we have needed to resolve for a long time at the Bank and will reduce."

Paulo Sahadi, IT Executive Banco do Brasil

bankdata

BMW

BANCO DO BRASIL

"We have seen some really good results regarding CPU savings while running IMS-driven batch workload in our ESP test environment with DB2 11 CM/NFM - we have been so impressed with the **product stability** and have already moved an internal **production system to DB2 11**"

Stefan Korte GAD

DB2 11 Early Support Program (ESP)

CPU savings, very high quality, production level stability

*"We have been involved in several DB2 for z/OS ESP's. This one will **rank as one of, if not the smoothest one yet**." – Large NA retailer*

*"Overall they are **very satisfied and astonished about the system stability** of DB2 V11. In V10 they experienced this in another way." – European Insurance*

*"We have seen very few problems in [Installation, Migration, and Performance]. Overall, it has been a very pleasant experience!!…The **quality of the code is clearly much higher** than for the ESP for DB2 10…" - European Banking/FSS*

"Good code stability, no outages, no main failures, only a few PMRs…." – European Banking

DB2 11 Early Support Program (ESP)

CPU savings, very high quality, production level stability

“ Higher availability, performance, lower CPU consumption amongst other new features were the benefits perceived by Banco do Brazil with DB2 11 for z/OS. During our testing with DB2 11 we noticed improved performance, along with stability. ”

- Paulo Sahadi, IT Executive, Banco do Brasil

“We have seen some incredible performance results with DB2 11, a major reduction of CPU time, 3.5% before REBIND and nearly 5% after REBIND. This will significantly bring down our operating costs”

– Conrad Wolf, Golden Living

*“I saw a significant performance improvement in recovery of catalog and directory. (V10 5:53 minutes, V11 2:50 minutes) That rocks! … **DB2 11 is the best version I have ever seen**.”*

- European Gov’t

*“**Overall, we have been impressed** with the new version of DB2.”*

– NA Manufacturer

ESP Customer Experiences

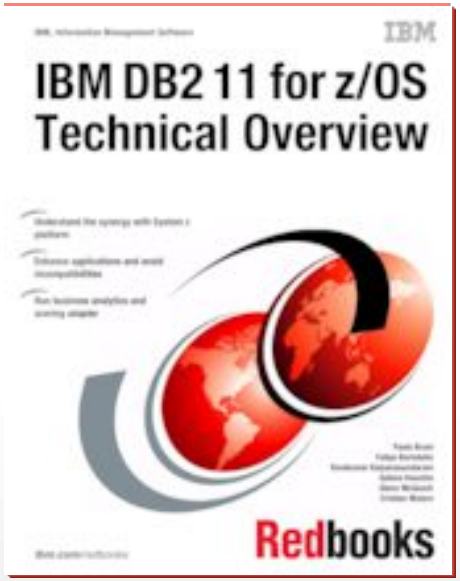
- Stadtwerke Bielefeld GmbH
  - Major business benefits: Performance and SAP feature exploitation. Expecting to move to DB2 11 as soon as SAP certification complete
  - “The SAP IS-U unbilled revenue batch workload showed an elapsed time reduction of about 20% in Conversion Mode” -- Bernd Klawa, Stadtwerke Bielefeld DB2 DBA
- JN Data
  - Major business benefits: Operational enhancements, extended log addressing, DBA productivity improvements
  - “We love autonomics. DB2 11 has some really nice features for reducing the burden on the DBA” -- Frank Petersen, JN Data DB2 Systems Programmer
- BMW Group
  - Major business benefits: Forthcoming zEC12 upgrade will allow use of 2GB page frames, ability to break into persistent threads and undertake more dynamic schema change will help business agility
  - “Virtual storage isn’t a big limitation for us any more, but we expect the CPU savings in DB2 11 to provide the major business benefit for us” -- BMW Group DB2 for z/OS Product Manager

DB2 11 Planning

- Dual mode migration (CM, ENFM, NFM)
- DB2 10 is the platform for migration
- z/OS 1.13 or above. z10 or above.
- No pre-V9 bound packages
- DB2 Connect V10.5 FP2 is the recommended level for V11
  - This level is required to exploit most new V11 features
  - Any in-service level DB2 Connect supports V11
- Sysplex query parallelism support is removed
- DB2 11 Migration Planning Workshop (MPW)
  - Free, 1-day education
  - DB2 11 MPW Community on DeveloperWorks

DB2 11 Resources

- Information Center
- DB2 11 Technical Overview Redbook (SG24-8180)
  - Draft version available, final version coming soon.
- DB2 11 links: https://www.ibm.com/software/data/db2/zos/family/db211/
  - Link to DB2 11 Announcement Letter
  - Links to webcasts
  - Customer case studies
  - Whitepaper: “DB2 11 for z/OS: Unmatched Efficiency for Big Data and Analytics”
  - Whitepaper: “How DB2 11 for z/OS Can Help Reduce Total Cost of Ownership”
- DB2 11 Migration Planning Workshop
  - http://ibm.co/IIJxw8
- Free eBook available for download
  - http://ibm.co/160vQgM



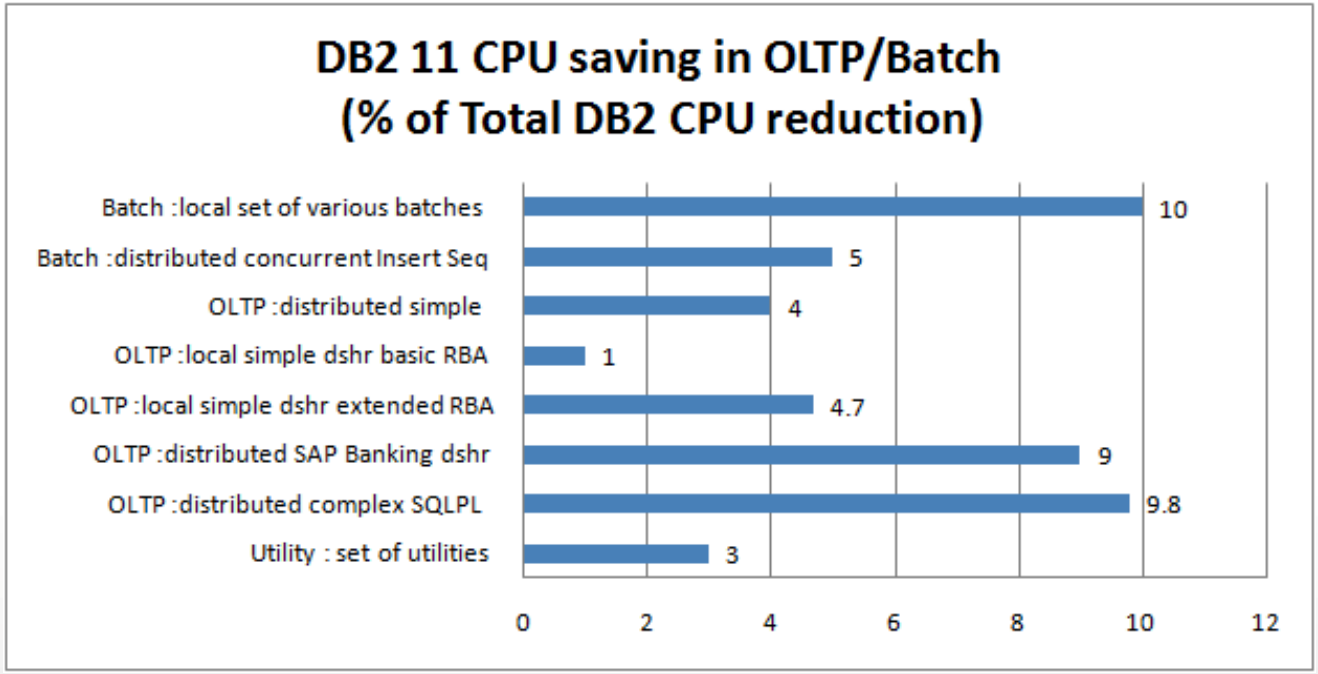
DB2 Cypress Themes

- In-memory processing
  - HW/SW integration into the future on z
  - Out-of-the-box performance improvement
- “Mobile-scale” data bases
  - More schema flexibility
  - Extreme scale tables, indexes
  - Higher data ingest rates
- Cloud enablement
  - Developer self-service, cloud-based provisioning, deployment
  - Self-optimizing system
    - More transparent SQL optimization
    - Temporal catalog for powerful problem diagnosis capabilities
    - Easier management of large tables
- Analytics and Big Data
- Extend System z leadership for continuous availability

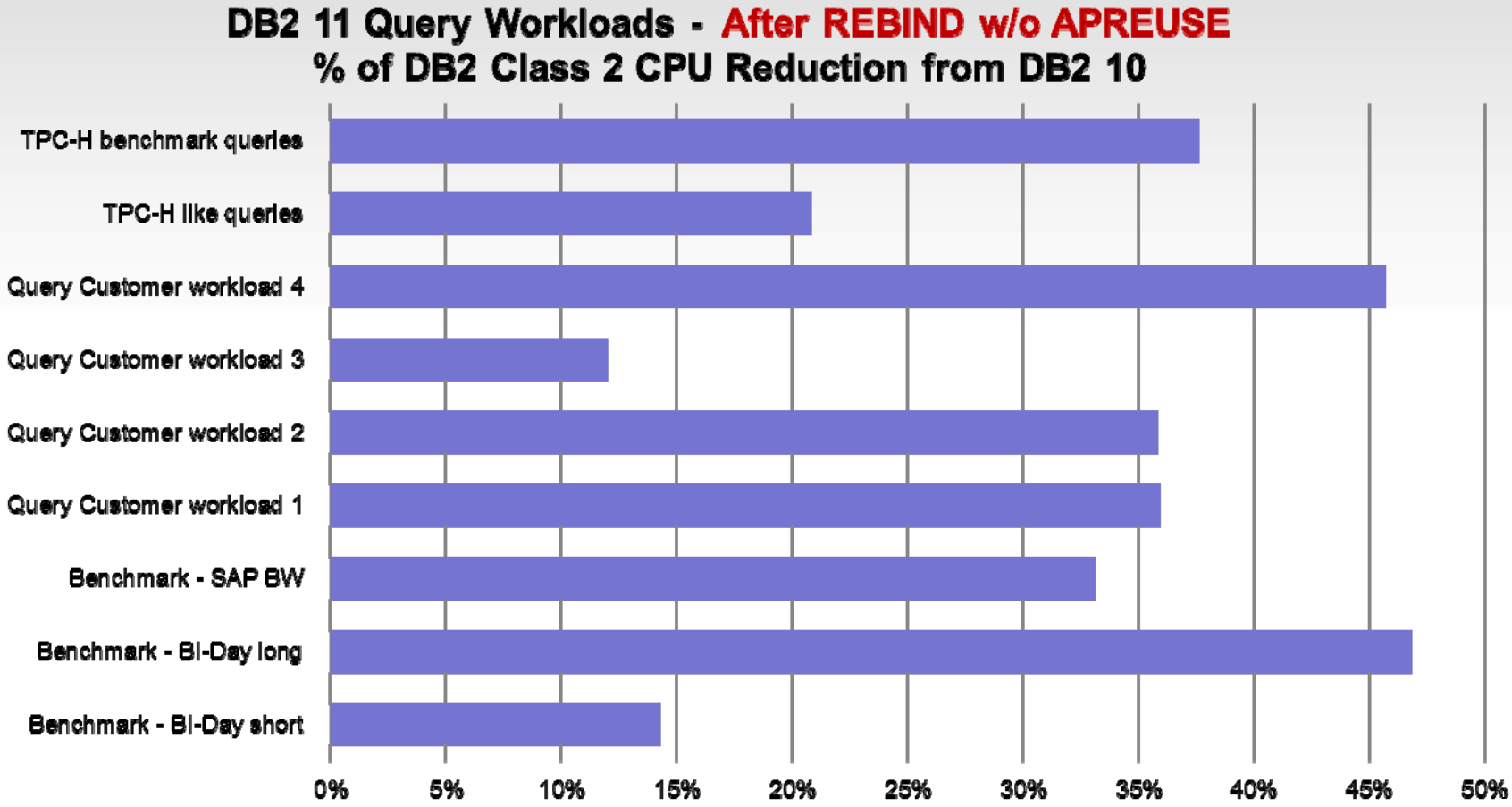

Thank You

DB2 11 OLTP/Batch Performance Expectations

- These are results from IBM testing
- Performance expectations vary depending on many factors, including
  - Access path selection, Read/Write ratio, Number of rows returned
  - Number and type of columns returned, Number of partitions touched
  - Schema - Number of partitions defined, DPSI, etc
  - RELEASE option, data compression



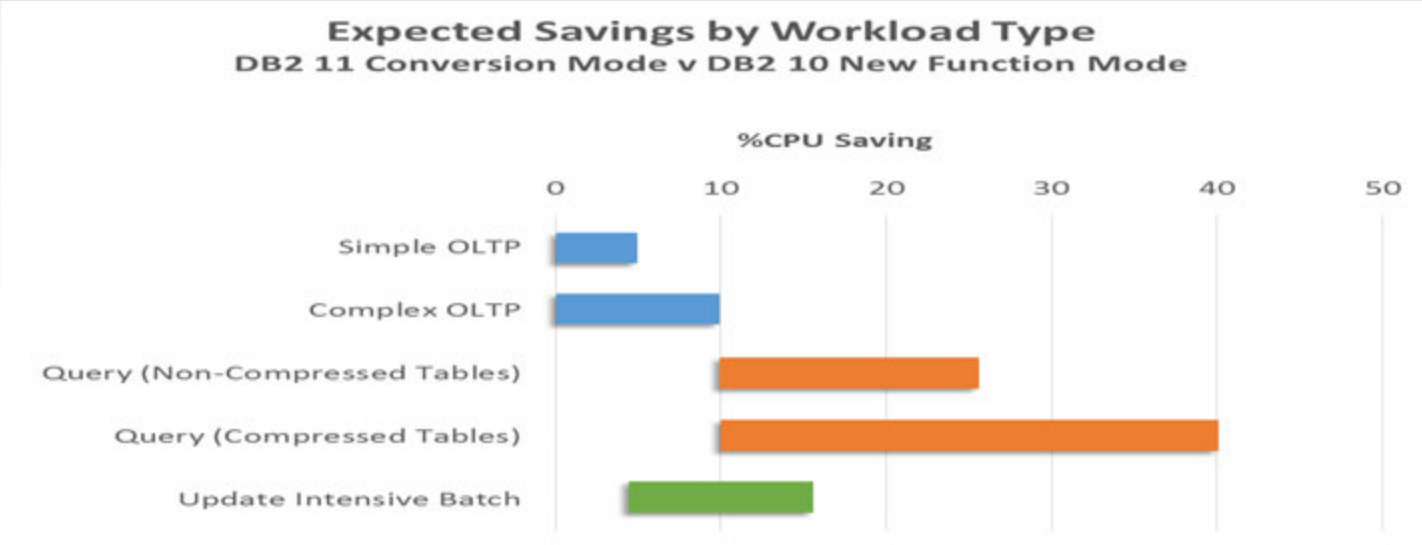
Significant CPU Reduction in Query Workloads



- Most performance improvements are also available with APREUSE
- New and improved access path choices may be available without APREUSE

DB2 11 Affordable for Every Type of Workload

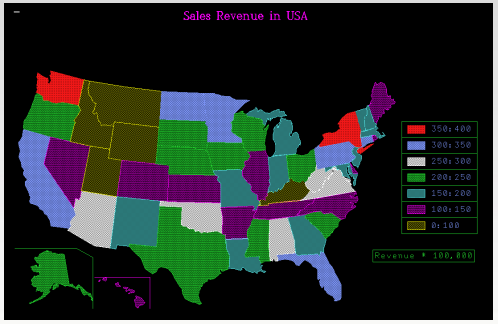
- **Out-of-the-box CPU Savings**



REBIND may be needed for best performance

- **DB2 base LOAD and REORG inline statistics collection** now executed under enclave SRBs, so are **now zIIP eligible**
- **More potential savings with application or system changes**
  - Log replication capture
  - Data sharing using extended log record format
  - Up to 20-90% CPU savings from pureXML performance enhancements

QMF 11: Business Analytics for the System z Enterprise



QMF Analytics for TSO

- Brand new component available in QMF Enterprise Edition 11
- Delivers unprecedented charting and statistical analysis capabilities directly to the mainframe
- Completely menu driven

Faster up and running with QMF reporting

- Adhoc Reports and Quick Reports
- Allows users to quickly and easily create their own sophisticated reporting objects using an open canvas

Analytics on unstructured data sources

- Text Analytics allows users to extract entities from unstructured data sources (either file-based or database-based) and display the results graphically

Increased support for the business user

- Dynamarts allow users to save their result sets with the objects for offline use
- Mobile device support for iPad and Android tablets