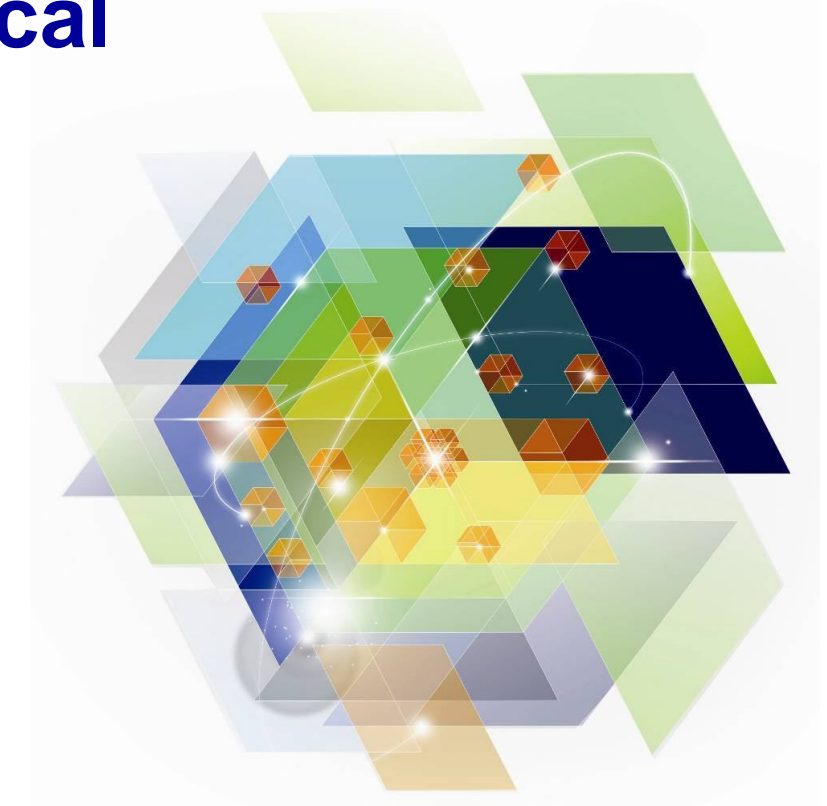# IBM DB2 for z/OS Technical Trends and Directions

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Distinguished Engineer

DB2 for z/OS Development,

IBM Silicon Valley Lab

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BladeCenter*	FICON*	RACF*	System z10	z/OS*
				z/VM*

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Notes:

Performance is in Internal Throughput Rate (ITR) ratio based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will vary depending upon 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 throughput improvements equivalent to the performance ratios stated here.

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Challenges Faced by Data Centers Today

78% of CIOs
want to improve the way they use and manage their data

70 cents per dollar
is spent operating / maintaining current IT infrastructures rather than adding new capabilities

7 out of 10 companies
in the Global 1000 will need to modify their data centers to meet increased power and cooling requirements

CIO Mandates

Expand
Refine business processes and enhance collaboration

Leverage
Streamline operations and increase organizational effectiveness

Transform
Change the industry value chain through improved relationships

Pioneer
Radically innovate products, markets, business models

## Need Smarter Systems & Software for Enterprise Computing

To address today's business challenges –and–

tomorrow's business opportunities and demands…

- Link and optimize multiple systems to work as a single, integrated service delivery platform

- Scale, without adding complexity, to meet the growing demands on the IT infrastructure

- Simplify data center management

- Transform IT into an engine for business innovation and growth
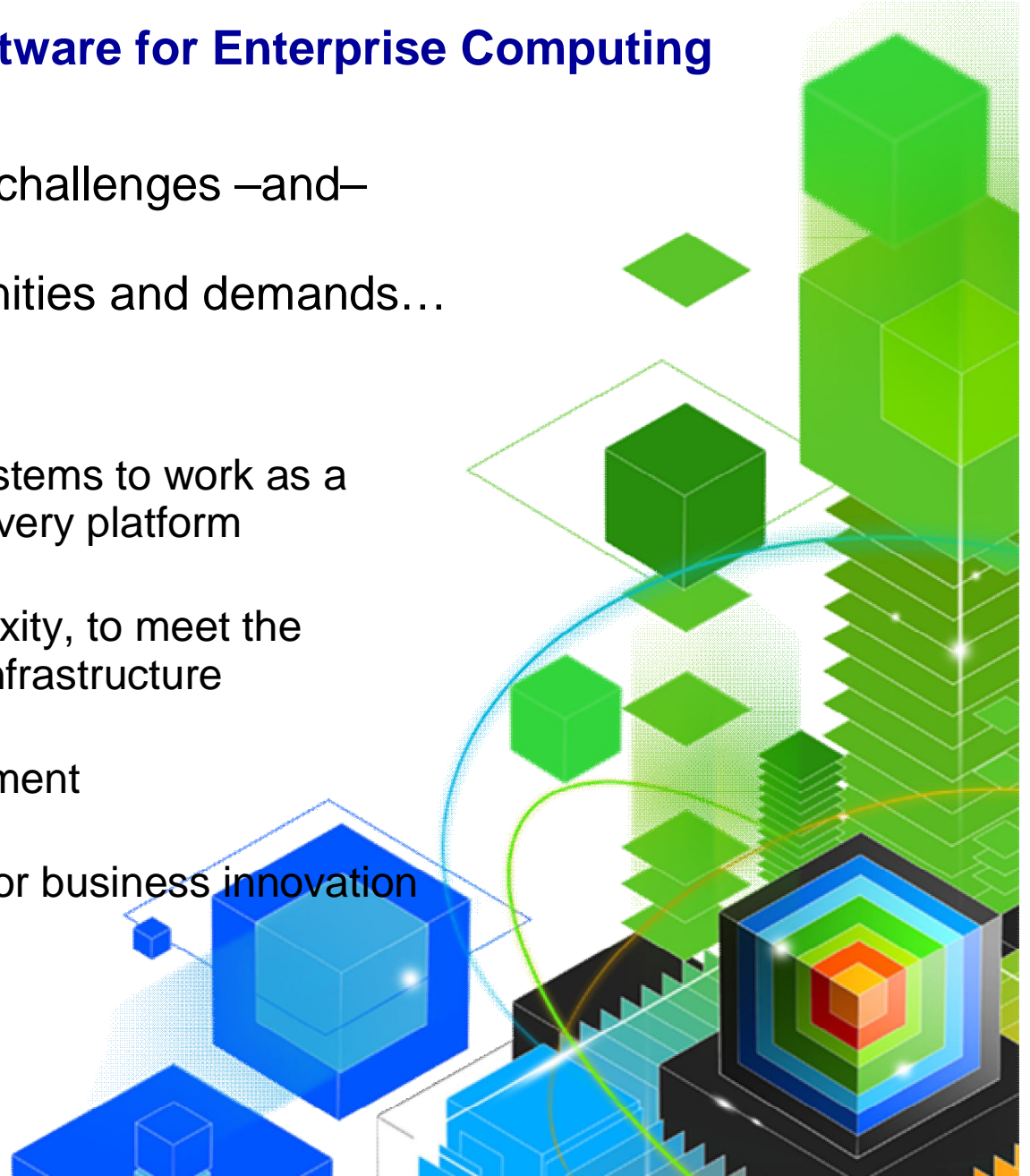
Customers Select DB2 for z/OS to Address their Critical Business Needs – Today and Tomorrow

High business growth
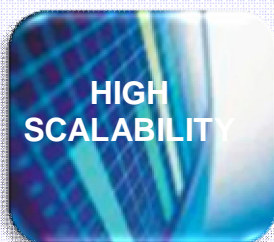
HIGH SCALABILITY

Continuous business operations

HIGH AVAILABILITY RELIABILITY

Flexibility and speed to respond

EXTREME VIRTUALIZATION

REAL TIME ANALYTICS

Reduce business risk

SECURITY

Reduce costs

EFFICIENCY

COST SAVINGS

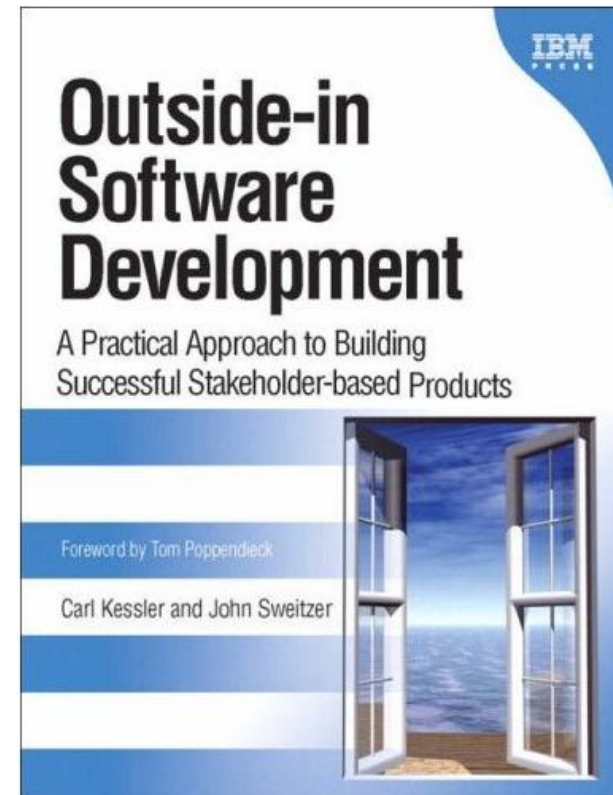**Secure Cloud Services**

CLOUD

DB2 for z/OS: Outside-In Development Approach

- **Principals**
  - Buyers and Decision Makers
  - CIOs, CTOs, & Sr. Business Mgmt

- **Insiders**
  - Inside interest in product aspects
  - IBM Execs; Product Managers; et.al.

- **Partners**
  - ISVs and Business Partners
  - SAP, DB2 Tools, BMC, etc.

- **End Users**
  - People who use the product to get their job done
  - DBAs and Application Programmers

Outside-in Software Development

A Practical Approach to Building Successful Stakeholder-based Products

Foreword by Tom Poppendieck

Carl Kessler and John Sweitzer

DB2 for z/OS

The most robust and cost effective data server

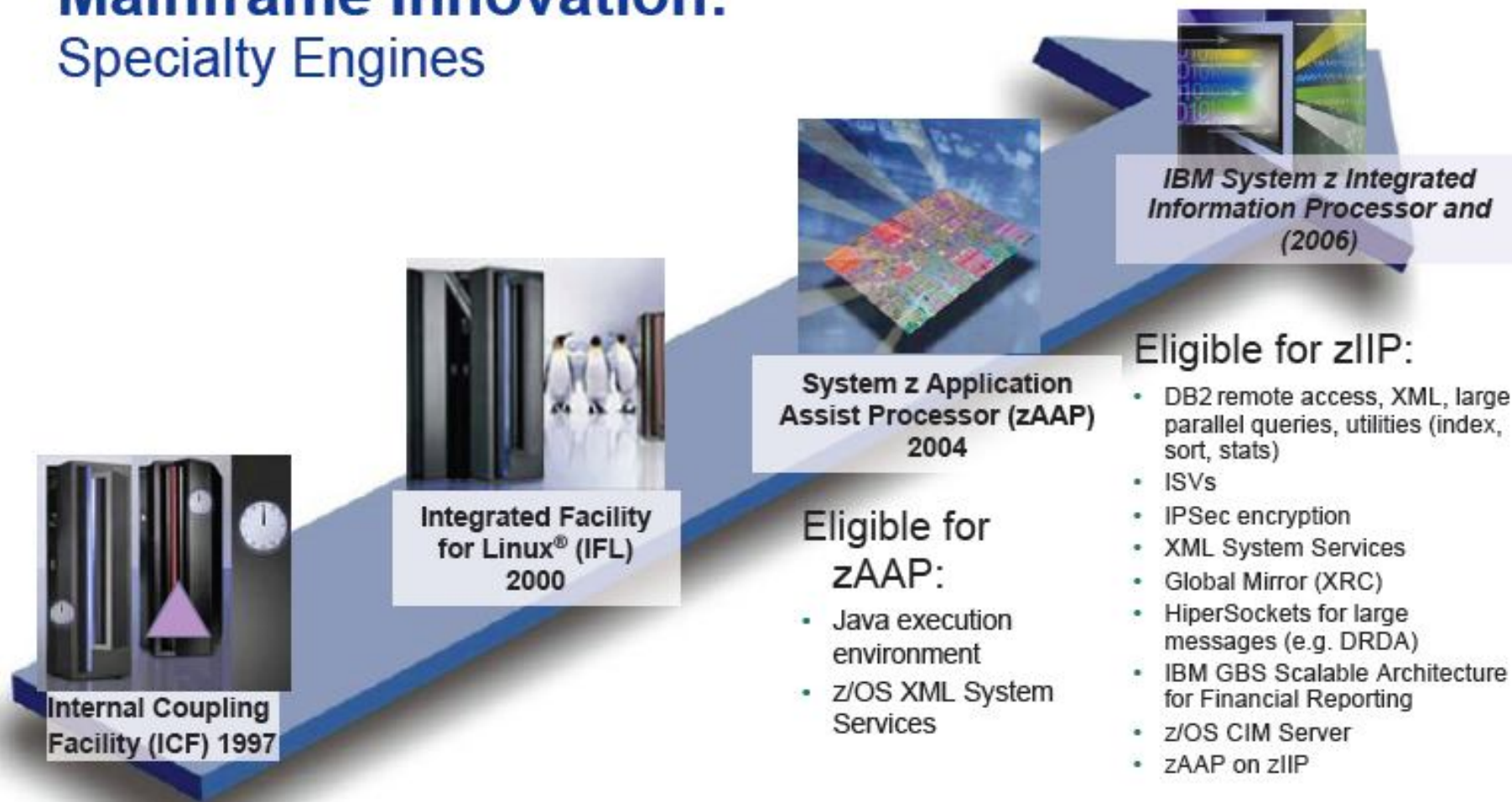|	DB2	DB2 9	DB2 10
Efficiency	■ Deep synergy with System z ■ HW Compression ■ Consolidation	• Up to 20% utility CPU savings • Compress indexes, save 50% disk • More CPU on specialty engines	• Save up to 5-10% CPU batch & transactions out-of-the-box (rebind) • On-the-fly data Compression • Temporal data support • Skip-level migration
Resilience	■ Unmatched availability ■ Unparalleled security ■ Industry leading reliability	• Flexible context and role security • Expanded online schema changes • Volume level backup & recovery	• Ten times more concurrent users • More online schema changes • More granular access control
Growth	■ Near-linear scalability ■ Optimized for SOA ■ Flexible development ■ Warehousing capabilities	• Seamless integration of XML and relational • Improved SQL • Native SQL PL • Partition by growth • OLAP expressions	• Enhanced query parallelism • Advanced query acceleration • Query optimizations • More SQL compatibility • Improved pureXML and SQL PL

DB2 Deep Synergy with System z

Key integration points include:

- Data sharing (availability and scale out)
- zIIP and other specialty engines
- Unicode conversion
- Encrypted communication and data
- Hardware data compression & encryption
- Cross-memory, memory protection keys
- Sorting
- Multi-core, large N-way
- 64-bit addressing and large memory
- z/OS Workload Manager
- z/OS Security Server (RACF)
- z/OS RRS integrated commit coordinator
- System z10 1 MB page size, decimal float
- Solid state disks
- zEnterprise 196, z114, zBX, z10, …

DB2 9 for z/OS
Performance Topics

Redbooks

Mainframe Innovation:
Specialty Engines

IBM System z Integrated Information Processor and (2006)

System z Application Assist Processor (zAAP) 2004

Integrated Facility for Linux® (IFL) 2000

Internal Coupling Facility (ICF) 1997

Eligible for zIIP:

- DB2 remote access, XML, large parallel queries, utilities (index, sort, stats)
- ISVs
- IPSec encryption
- XML System Services
- Global Mirror (XRC)
- HiperSockets for large messages (e.g. DRDA)
- IBM GBS Scalable Architecture for Financial Reporting
- z/OS CIM Server
- zAAP on zIIP

Eligible for zAAP:

- Java execution environment
- z/OS XML System Services

* Statements represent the current intention of IBM. IBM development plans are subject to change or withdrawal without further notice.

DB2 and IBM zIIP Add Value to Database Work

Portions of the following DB2 9 & DB2 10 workloads may benefit from zIIP or zAAP

DB2 9 in blue   DB2 10 in green

1. **DRDA over TCP/IP connections**
   - DB2 9 for zOS remote native SQL procedures
   - DB2 9 XML parsing, DB2 schema validation
   - Increased portion of DRDA redirected to zIIPS – up 60%
     - Improved performance via reduced processor switching

2. **Requests that use parallel queries**
   - Higher percentage of DB2 9 parallel queries are zIIP eligible
   - More DB2 10 queries are eligible enabling more parallelism

3. **DB2 utilities LOAD, REORG and REBUILD functions used to maintain index structures and sort**
   - DB2 10 RUNSTATS – optoins other than column group, inline

   - **DB2 10 buffer pool prefetch and deferred write**

Hardware Trends Leveraged by DB2 for z/OS

- **Drive toward multi core, slowing growth in processor frequency**
  - Higher n-ways, more parallelism bring potential latching bottlenecks, memory cache thrashing, …
  - S/W techniques for single threaded performance growth
  - Clustered systems for massive scale out and continuous availability

- **Specialty engines (price / performance)**

- **Hybrid systems, accelerators**
  - Use cores that are more specialized to their purpose
  - New performance opportunities
  - New programming paradigms (e.g. OpenCL)

- **Memory hierarchy design**
  - Higher CPU frequencies, n-ways make cache utilization a critical factor
  - Translation lookaside buffer design, large System z page sizes

- **Solid state disk (and other disk related improvements)**
  - Performance, energy consumption, reliability benefits of HDD

System zEnterprise Benefits for DB2
Taking System z to the next level

- Faster CPUs, more CPUs, more memory → better DB2 performance and scalability

- Compression hardware expected to increase DB2 data compression performance

- Cache optimization, 192M L4 Cache expected to benefit DB2 work

- Hybrid architecture query performance acceleration with IBM Smart Analytics Optimizer

- Excellent synergy with DB2 10 → significant cost reduction and scalability increase

  - CPU reductions

  - Remove key single system scaling inhibitors: virtual storage, latching, catalog, utilities, …

  - Translation Lookaside Buffer changes expected to improve performance for 1MB page sizes

  - Buffer pool management

DB2 and zEnterprise 196

- **CPU reduction in all types of DB2 workloads**

  – Larger processor cache (1.5MB L2 per core,   24MB L3 per chip,   129MB L4)

  – Various types of DB2 9 and 10 workloads show 20% to 40% DB2 CPU reduction compared to z10 processors.

z196 CPU Reduction from z10

45
40
35
% CPU reduction
30
25
20
15
10
5
0

OLTP-1   OLTP-2   Concurrent Insert   Utilities (avg)   Queries (avg)   Batch (avg)

DB2 Workload Type
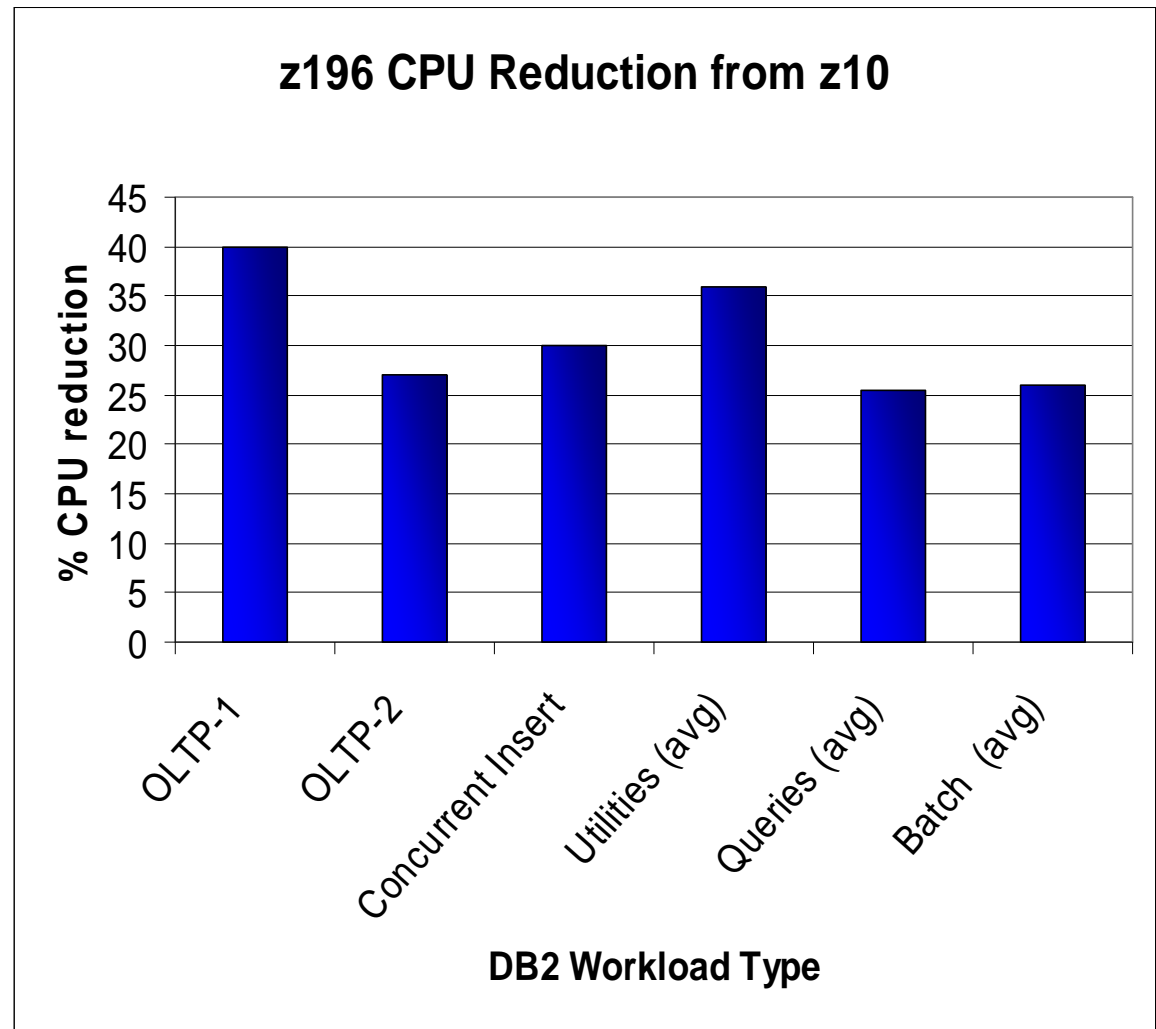
DB2 10 and zEnterprise 196

- **Scalability with DB2 10 and z196**
  - Higher DB2 CPU reduction can be achieved as #of processors per LPAR increases
    - Best fit with DB2 10 scalability
  - More than 20% improvement with DB2 10 compared to DB2 9 on z196 64 way

z10->z196 DB2 CPU Reduction
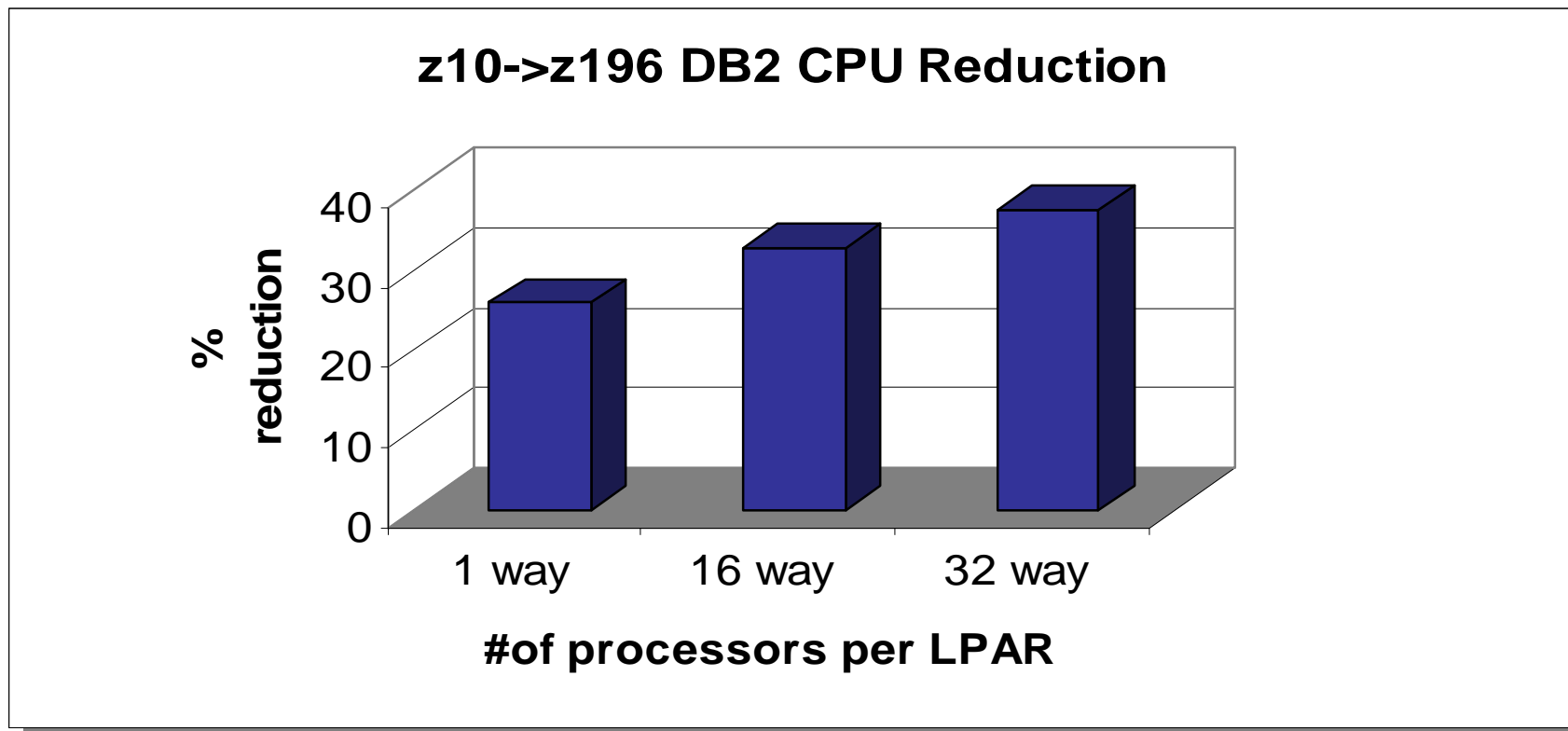
SAP Sales and Distribution Benchmark

- **SAP SD Benchmark**

  – z10 and z196 4 processors per LPAR

  – Enabled 1 MB large frames

  – Comparing the results of running the SAP SD workload with DB2 9 on z10 to running it with DB2 10 on z196, there is a 76% improvement in ITR (or close to a factor of 1.8x)

z10 4w and z196 4w SAP-SD ITR
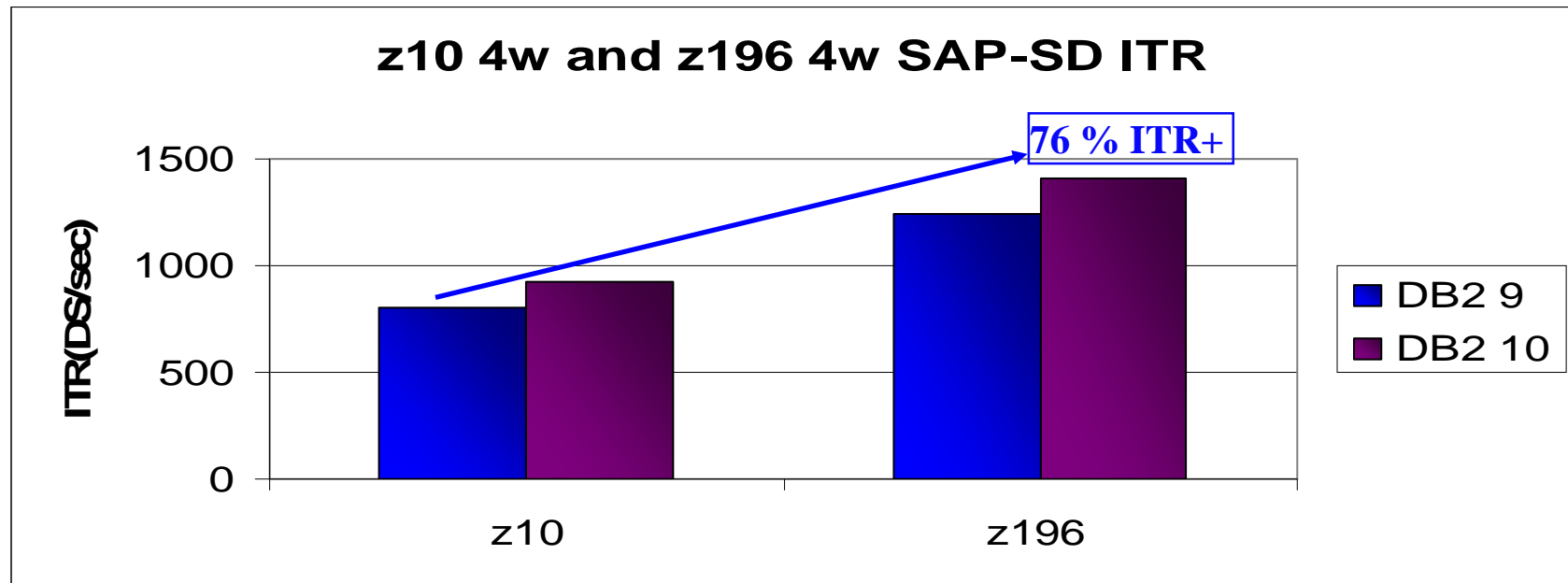
IBM zEnterprise Provides a New Dimension in Cloud Computing

The world's fastest and most scalable system:
IBM zEnterprise™ 196 (z196)

Unified management for a smarter system:
IBM zEnterprise Unified Resource Manager (zManager)

Scale out to a trillion instructions per second:
IBM zEnterprise BladeCenter® Extension (zBX)

z/OS
z/VM
z/VSE
z/TPF
Linux
AIX
Linux

Broad Network Access
Very large number of end user access from multiple sources including mobile devices

Rapid Elasticity
A new dimension of Scale. Most efficient platform for Large-scale Linux consolidation

Resource Pooling
1000s of virtualized systems across a heterogeneous resource pool

Measured Service
Meter, monitor, and track workloads for chargebacks and capacity expectations

On Demand Self-Service
Automate provisioning and service requests reducing provisioning cycles from weeks to minutes

A Look Inside the zEnterprise System
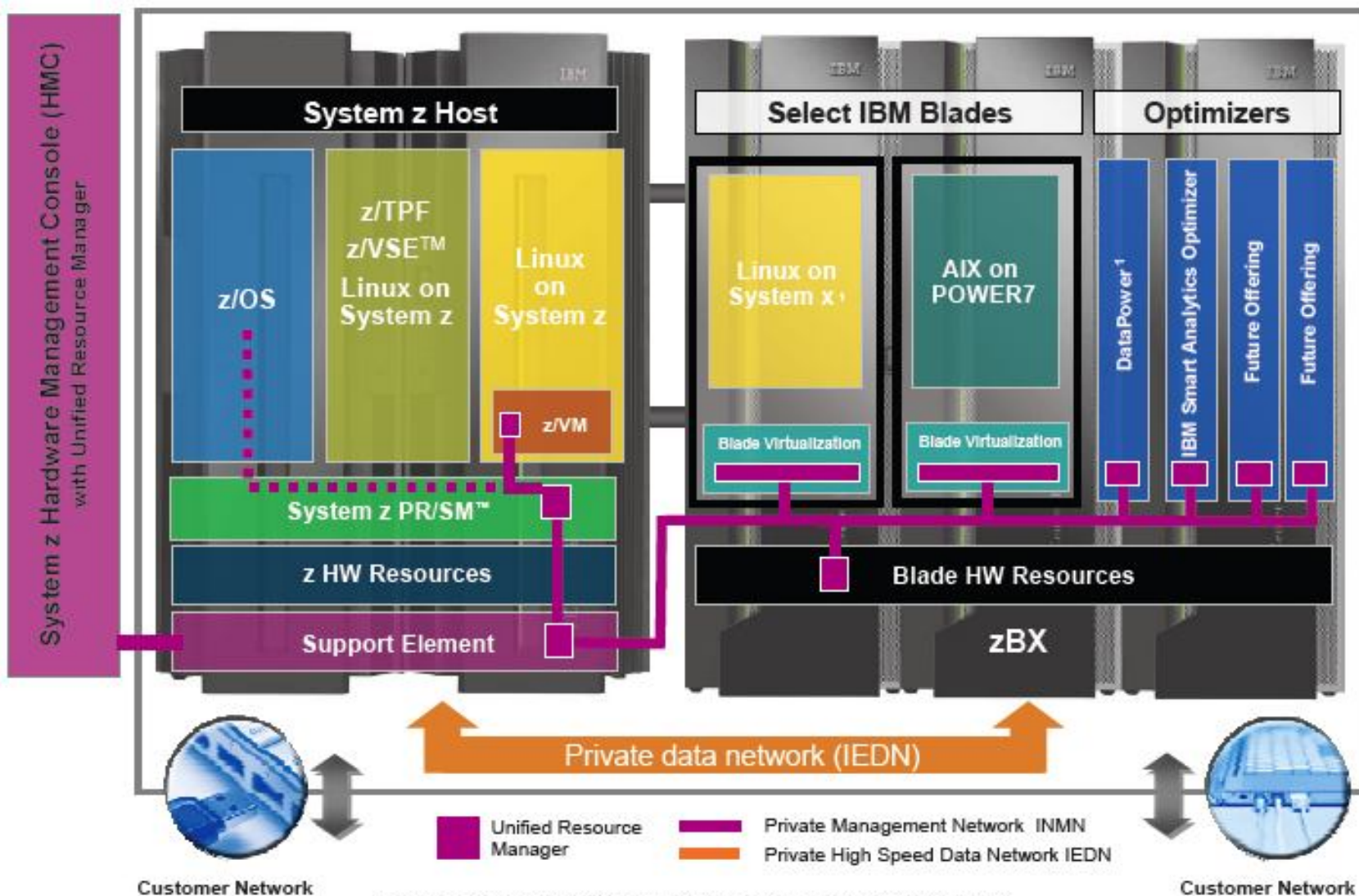
DB2 for z/OS Technical Strategy

➢Continuous availability, RAS leadership

➢Performance and scalability

➢Ease of management / autonomics

➢Advanced application features

➢Low cost of computing

➢OLTP, batch, query, mixed workloads

DB2 10 for z/OS

GA'ed October 2010

Completed Largest Beta Ever

- 23 WW customers

- +10 Extended Beta

- Over 80 vendors

Fastest uptake out of the gate

- As of July, 2011 3x more unique customers compared to prior release

- More than 4x the number of licenses

- About 25% are migrating from V8

- Every core beta customer is continuing with migration plans

First large customers already in production

What Customers want from DB2

- ✓ **Reduce CPU time 5% - 10%**

- ✓ **Increased ability to scale up**

- ✓ **Easier security compliance and audit**

- ✓ **Improved productivity**
    - ✓ Temporal and more enhanced SQL & XML
    - ✓ Administration, scaling and performance
    - ✓ Move from DB2 9 or V8

- ✓ **Ready for production, stable and available**

- ✓ **Customer references**

Information Management

Draft Document for Review February 25, 2011 11:01 am

IBM

SG24-7942-00

DB2 10 for z/OS
Performance Topics

Triton
CONSULTING

DB2 10 for z/OS
A Smarter Database for a Smarter Planet

Online
reorganization

These and more addressed by DB2 10!

DB2 10
Customers seeing reduced costs, simplified workloads through proven technology

Reduced Costs	Simplified Workloads	Proven Technology
"Based on the performance metrics from our controlled test environment, we see a significant amount of CPU and Elapsed time savings. This release has many features that will help bring down our operating costs." Morgan Stanley DB2 Team	**"With DB2 10 able to handle 5-10 times as many threads as the previous version, the upgrade will immediately give the bank some much-needed room for future workload growth while simultaneously reducing their data sharing overhead."** Paulo Sahadi - Senior Production Information Management Division at	"Every single SQL statement we have tested has been better or the same as our current optimal paths – we have yet to see any significant access path regression. We had to spend a lot of time tuning SQL with DB2 9, but we expect that to disappear when we upgrade to DB2 10." Philipp Nowak, BMW DB2 Product Manager
"We are particularly interested in the performance improvements due to the potential CPU reductions that we realized during our DB2 10 Beta testing. Our early testing has shown out-of-the-box processing cost reductions of between 5% - 10% and for some workloads as high as 30%. Potential cost savings of this magnitude cannot be ignored given today's business climate." Large Global Bank	*"We are really thrilled about "Temporal Data" feature – this feature has the potential to **significantly reduce overheads. We have estimated that 80% of our existing temporal applications could have used "the DB2 10 temporal features" instead of application code - this feature will drastically save developer time, testing time – and even more importantly make applications easier to understand so improve business efficiency and effectiveness."*** Frank Petersen – System Bankdata	**The new audit capabilities in DB2 10 will allow tables to be audited as soon as they are created, which is an obvious benefit for the business and will reduce costs and simplify our processes"** Guenter Schinkel -Postbank Systems AG

For more customer references visit
*http://www.ibm.com/software/data/db2/zos/testimonials.html*

DB2 10 Performance

- Most customers can see a 5% - 10% out-of-the-box CPU reduction (transactions and batch) after rebind

- Some workloads and customer situations can see a CPU reduction of up to 20%

- Synergistic operation with latest System z hardware

Sample: Preliminary Measurements of IBM Relational Warehouse Workload (IRWW) with Data Sharing

- Base: DB2 9 NFM REBIND with PLANMGMT EXTENDED

- DB2 9 NFM → DB2 10 CM without REBIND showed 1.3% CPU reduction

- DB2 10 CM REBIND with same access path showed 4.8% CPU reduction

- DB2 10 NFM brought 5.1% CPU reduction

- DB2 10 CM or NFM with RELEASE DEALLOCATE 12.6% CPU reduction from DB2 9

Average %CPU improvements version to version
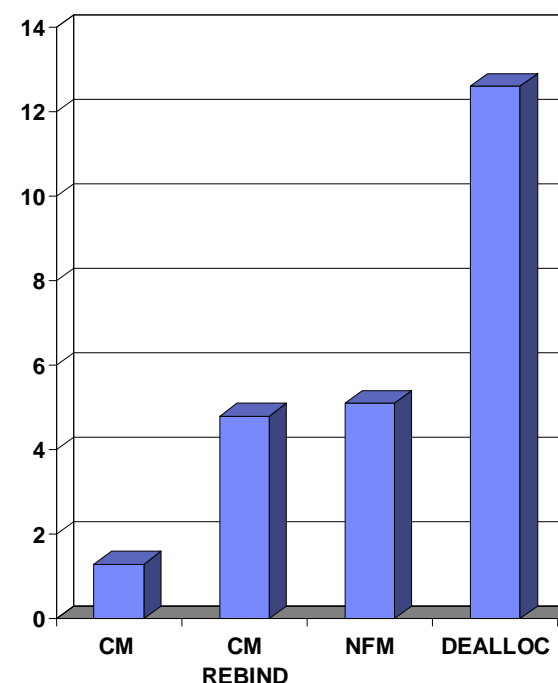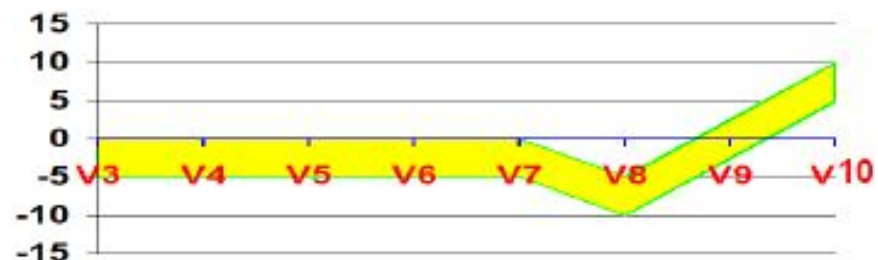
CPU Percent reduced from DB2 9

Performance Enhancements

- **Requiring few changes (CM)**
  - SQL runtime improved efficiency
  - Address space, memory changes to 64 bit, some REBINDs
  - Faster single row retrievals via open / fetch / close chaining
  - Distributed thread reuse High Performance DBATs
  - JCC Type2 and ODBC for z/OS performance improvements
  - Parallel index I/O at insert
  - Workfile in-memory enhancements
  - Index list prefetch
  - Solid state disk tracking in real time statistics
  - Buffer pool enhancements
    - Utilize 1MB page frames on z10 or z196
    - "Fully in memory" option (ALTER BUFFERPOOL)

- **Requiring REBIND (CM)**
  - Most access path enhancements
  - Further SQL runtime improvements
  - Use of RELEASE(DEALLOCATE)
  - SQL paging performance enhancements
    - Single index access for complex OR predicates
  - IN list performance
    - Optijized Stage 1 processing (single or multiple IN lists)
    - Matching index scan on multiple IN lists
  - Safe query optimization
  - Query parallelism improvements
  - More Stage 2 predicates can be pushed down to Stage 1
  - More aggressive merge of views and table expressions
    - Avoid materialization of views
  - If migrating from V8, get new RUNSTATS before mass rebind

(cont) Performance Enhancements

- **Requiring NFM**
  - DB2 catalog concurrency and productivity
  - Compress on insert
  - Most utility enhancements
  - LOB streaming between DDF and rest of DB2
  - SQL procedure language performance improvements
  - Workfile spanned records, partition by growth
  - Access to currently committed data
  - Insert improvement for univeral table spaces
  - LRSN spin avoidance for inserts to the same page
  - Efficient caching of dynamic SQL statements with literals
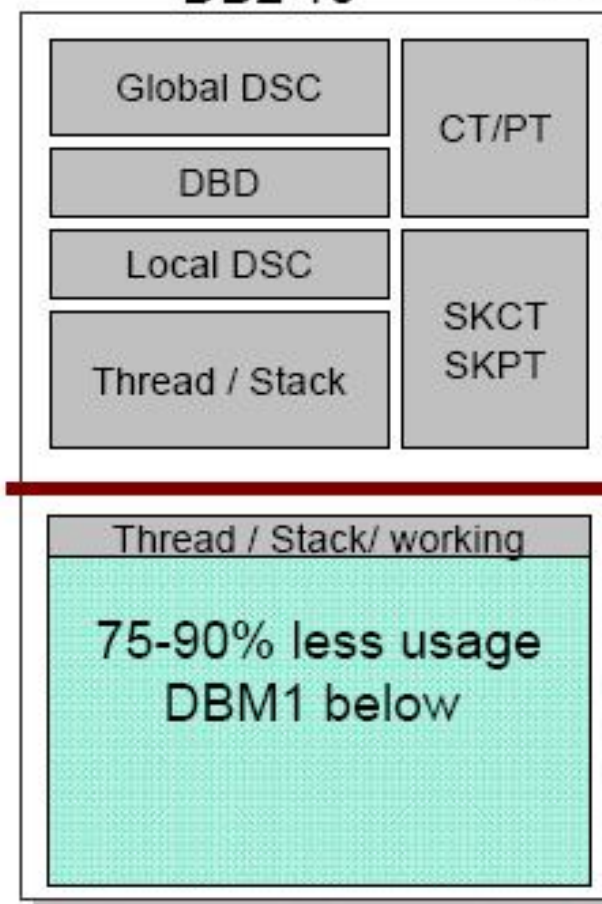
- **Requiring NFM + DBA work**
  - Hash access path
  - Index include columns
  - Inline LOBs
    - Index on expression now possible for LOB columns
    - Important for spatial performance
    - LOAD/UNLOAD performance improvements
    - LOB compression for inline portion
  - DEFINE NO for LOB and XML columns
  - MEMBER CLUSTER for universal table space
  - Alter to universal table space, page size, data set size, segment size
  - Online reorg for all catalog and directory table spaces

Virtual Storage Improvements

- **DBM1 below 2GB**

  - 75-90% less usage in DB2 10 compared to DB2 9

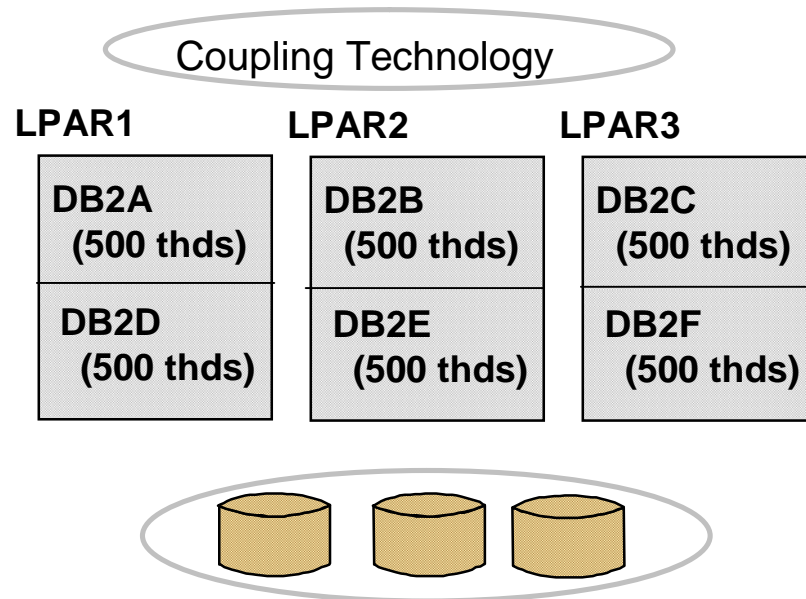 - Some working storage (stack, xproc storage) stays below 2GB

- **Larger number of threads**
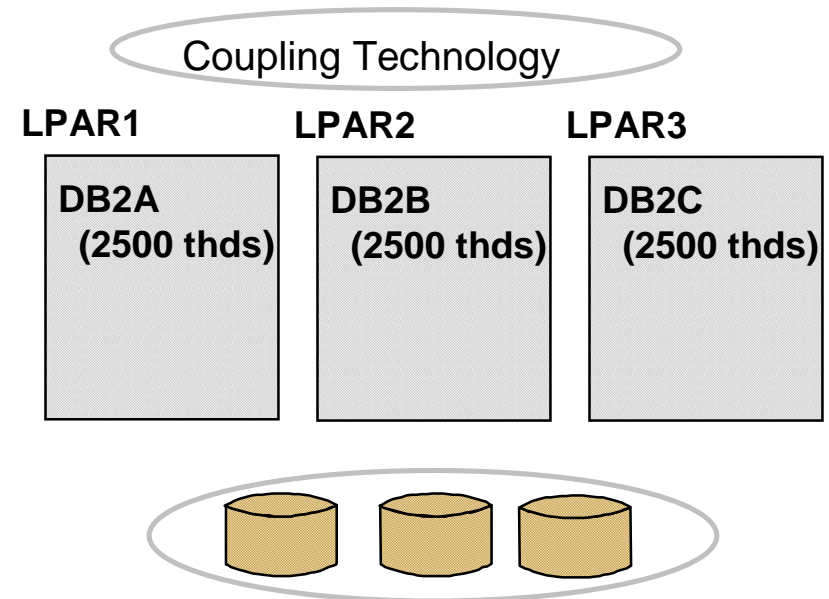
  - Possible data sharing member consolidation

DB2 10

Global DSC	CT/PT
DBD	
Local DSC	SKCT
Thread / Stack	SKPT

Thread / Stack/ working

75-90% less usage
DBM1 below

IBM. Reliable Global
Announcing DB2 10 for z/OS
Savings...right out of the box
Market Leader Secure
Trustworthy Innovative

Running a Large Number of Active Threads

Today

Coupling Technology

LPAR1   **LPAR2**   **LPAR3**

| DB2A |
| (500 thds) |

| DB2D |
| (500 thds) |

| DB2B |
| (500 thds) |

| DB2E |
| (500 thds) |

| DB2C |
| (500 thds) |

| DB2F |
| (500 thds) |

- Data sharing and sysplex allows for efficient scale-out of DB2 images
- Sometimes multiple DB2s per LPAR

DB2 10

Coupling Technology

LPAR1   **LPAR2**   **LPAR3**

| DB2A |
| (2500 thds) |

| DB2B |
| (2500 thds) |

| DB2C |
| (2500 thds) |

- More threads per DB2 image
- More efficient use of large n-ways
- Easier growth, lower costs, easier management
- Data sharing and Parallel Sysplex still required for very high availability and scale
- Rule of thumb: save ½% CPU for each member reduced, more on memory

Business Security & Compliance

- **Protect sensitive data from privileged users and improve productivity**
  - SECADM & DBADM without data access
  - Usability: DBADM for all DB
  - Revoke without cascade

- **Separate authorities to perform security related tasks, e.g. security administrator, EXPLAIN, performance monitoring and management**

- **Audit privileged users**

- **Row and column access control**
  - Allow masking of value
  - Restrict user access to individual cells

System Administrator Tasks

Security Administrator Tasks

Database Administrator Tasks

Access

Audit

Monitor

Productivity – Doing More with Less!

- **Easier scaling, simpler memory management**

- **Reduce contention, more online processing**

- **Reduced need for REORG**
  - Build compression dictionary on the fly
  - Index list prefetch enhancements
  - Row-level sequential detection

- **Configure IBM UDFs and stored procedures**

- **Statement level monitoring**

- **New DSNTIJXZ job to update migration input datasets with current zparm values**

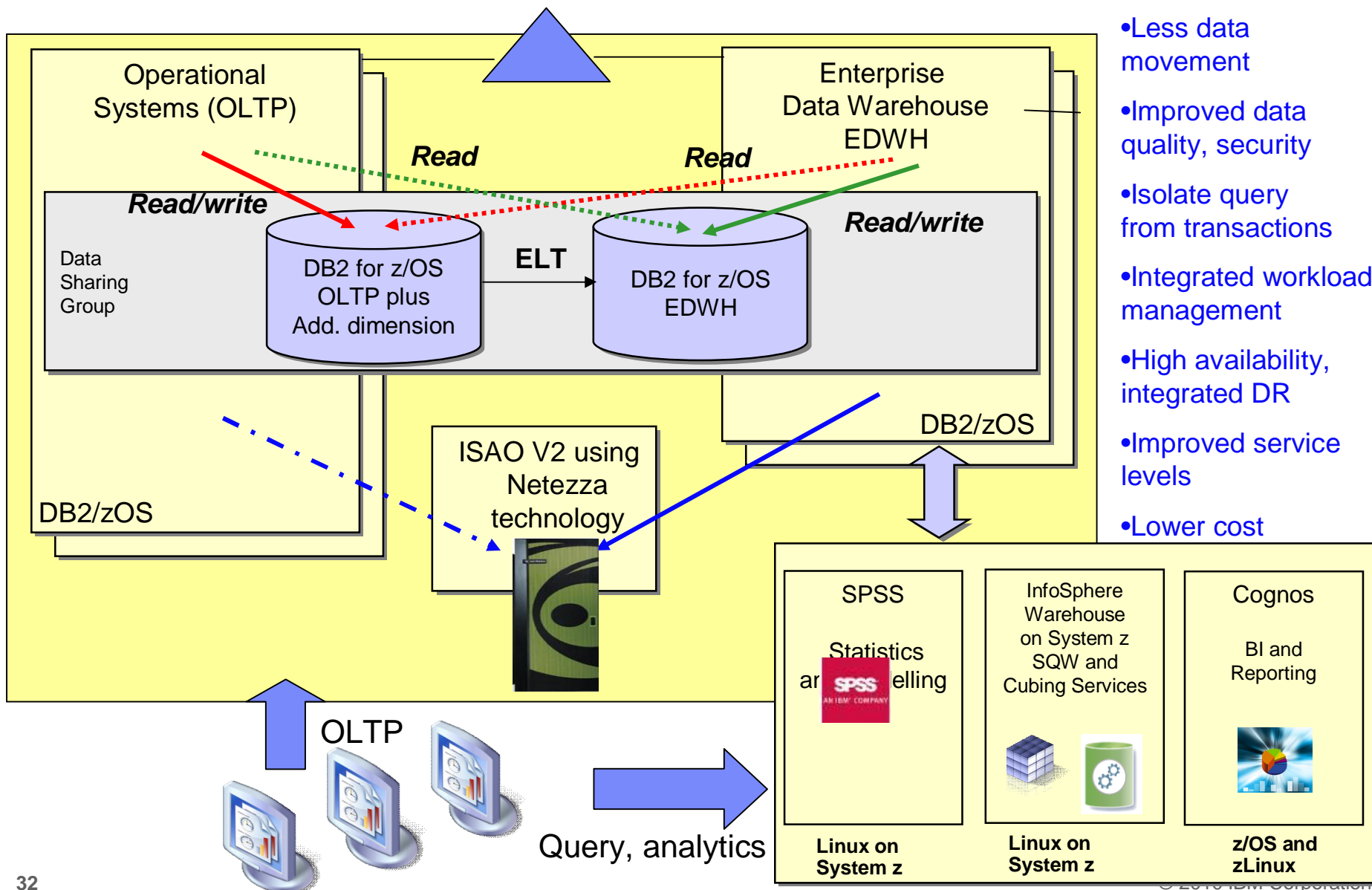- **DDF thread management enhancements**

Manual invocation of
- RUNSTATS
- COPY/BACKUP SYSTEM
- QUIESCE
- MODIFY RECOVERY
- REORG

Query Enhancements

- **Query processing enhancements**
  - Improved caching of dynamic SQL with literals
  - Safe query optimization
  - Aggressive view merge
  - IN list processing
  - SQL pagination
  - Parallelism enhancements
  - Index include columns

- **Access path stability**
  - Relief from package REBIND regression

- **Optimization techniques**
  - Remove parallelism restrictions; more even parallel distribution
  - Scalability: memory and latching relief allows more parallelism
  - Optimization validation with Real Time Statistics
  - In-memory techniques for faster query performance
  - Multiple IN-List matching
  - IN-List predicate transitive closure

- **RID overflow to workfile**
  - Mitigate increased workfile usage by increasing RID pool size
  - MAXTEMPS_RID zparm for maximum WF usage for each RID list

- **Sort performance enhancements**
  - Avoid workfile usage for small sorts
  - Hash support for large sorts

- **Query parallelism enhancements**
  - Removing parallelism restrictions
    - Allow parallelism if a parallel group contains a work file
    - Support parallelism with multi-row fetch
  - Parallelism effectiveness
    - dynamic record range partitioning
    - Straw model parallelism

DW and OLTP Co-residency In a Parallel Sysplex

Operational
Systems (OLTP)

Enterprise
Data Warehouse
EDWH

Read

Read

Read/write

Data
Sharing
Group

DB2 for z/OS
OLTP plus
Add. dimension

ELT

DB2 for z/OS
EDWH

Read/write

DB2/zOS

DB2/zOS

ISAO V2 using
Netezza
technology

SPSS

Statistics
and Modelling

SPSS
AN IBM COMPANY

InfoSphere
Warehouse
on System z
SQW and
Cubing Services

Cognos

BI and
Reporting

**Linux on
System z**

**Linux on
System z**

**z/OS and
zLinux**

OLTP

Query, analytics

- Less data movement
- Improved data quality, security
- Isolate query from transactions
- Integrated workload management
- High availability, integrated DR
- Improved service levels
- Lower cost

IBM Smart Analytics Optimizer

Capitalizing on the best of both worlds – System z and Netezza

- **What is It?**

  - The IBM Smart Analytics Optimizer is a workload optimized, appliance add-on, that enables the integration of business insights into operational processes to drive winning strategies

  - Accelerates select queries, with unprecedented response times

- **How is it different?**

  - **Performance:** unprecedented response times to enable 'train of thought' analyses frequently blocked by poor query performance

  - **Integration:** connects to DB2 through deep integration providing transparency to all applications

  - **Self-managed workloads:** queries are executed in the most efficient way

  - **Transparency:** applications connected to DB2 are entirely unaware of the Optimizer

  - **Simplified administration:** appliance hands-free operations, eliminating many database turning tasks

Breakthrough technology enabling new opportunities

IBM Smart Analytics Optimizer V2

- **Next generation Smart Analytics Optimizer**

  - Capitalizing on Netezza technology

  - Access through and is highly integrated with DB2 for z/

  - Enhances expandability

  - More robust query execution

  - Lowers cost

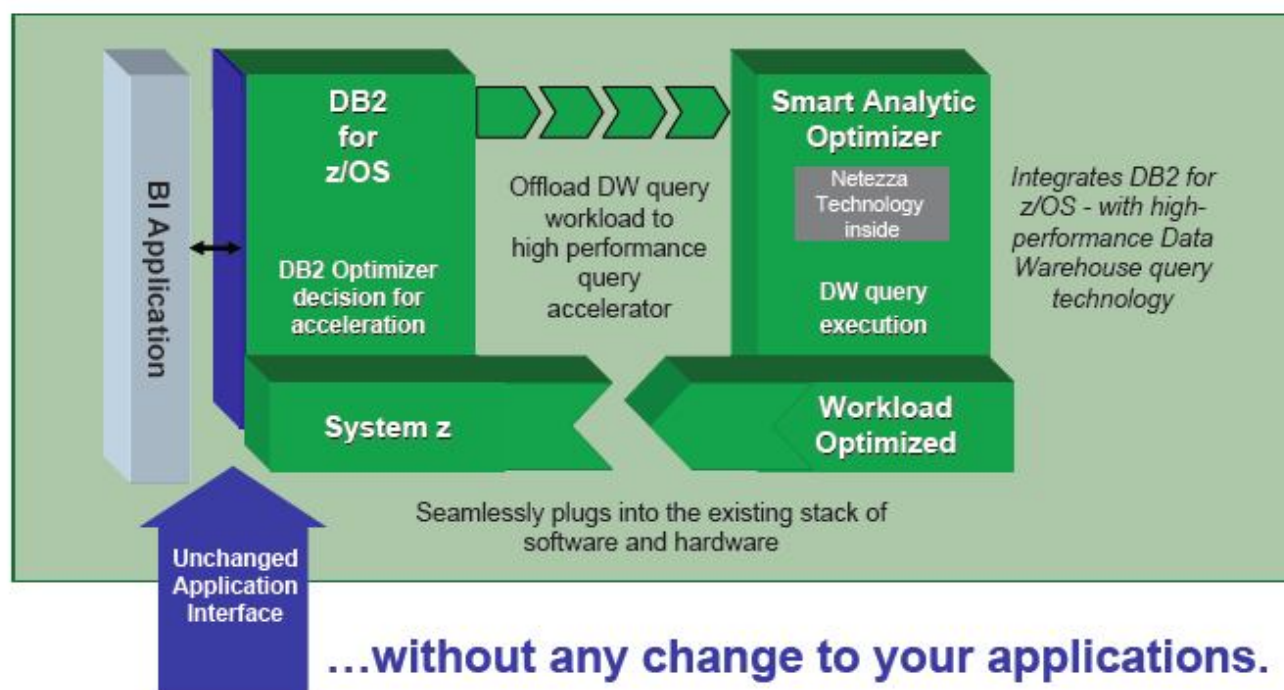 - Removes past restrictions

- Beta target to begin 3Q 2011

- Investment protection – the full value of IBM Smart Analytics Optimizer V1 will be applied to IBM Smart Analytics Optimizer V2

Optimizing the Workload
Integrating the best of each environment

Total solution remains centrally managed by System z...

BI Application

DB2 for z/OS

DB2 Optimizer decision for acceleration

Offload DW query workload to high performance query accelerator

Smart Analytic Optimizer

Netezza Technology inside

DW query execution

Integrates DB2 for z/OS - with high-performance Data Warehouse query technology

System z

Workload Optimized

Seamlessly plugs into the existing stack of software and hardware

Unchanged Application Interface

...without any change to your applications.

Key V2 Enhancements
- Extending acceleration to significantly larger number of queries

- Expanded size of the data to be accelerated

- Improved concurrent query execution

- Incremental update by partition

- DB2 9 and DB2 10 for z/OS support

- Supported only connected to z196 / z114 (zEnterprise) going forward

Application Enablement and Portability

- **Bi-temporal data (data versioning)**

- **pureXML enhancements**

- **Large object improvements**
  - Allow non-NULL default values for inline LOBs
  - Load and unload tables with LOBs

- **SQL enhancements**
  - Currently committed locking semantics
  - Implicit casting or loose typing
  - Timestamp with time zone
  - Variable timestamp precision – seconds to picoseconds
  - Moving Sum, Moving Average
  - SQLPL performance improvements

DB2 10's Temporal Data
IBM Innovation – 1st in the industry with standard bi-temporal support!

DB2's temporal data capabilities enable customers to implement time-aware applications/queries that analyze/manage past, current and future events with minimal effort. Achieve audit and compliance initiatives, correct human errors and ensure the integrity of data over time

➤**System time** – relates to the time when the data was put into the system; Start and end timestamp values maintained by DB2
  - *e.g. When an insurance policy is modified or a loan created*
  - Enable regulatory compliance and auditing

➤**Application time (aka 'Business time')** – relates to the business transaction or business-relevant time period of the data; Start and end values maintained by the application
  - *e.g. Effective dates for the terms of an insurance policy*
  - Ease the tracking of business events over time
  - Application logic greatly simplified

➤**Bi-temporal** – both System time and Business time exists in a single table

➤**Inclusive-exclusive** for modeling time periods

Graphic from Triton Consulting
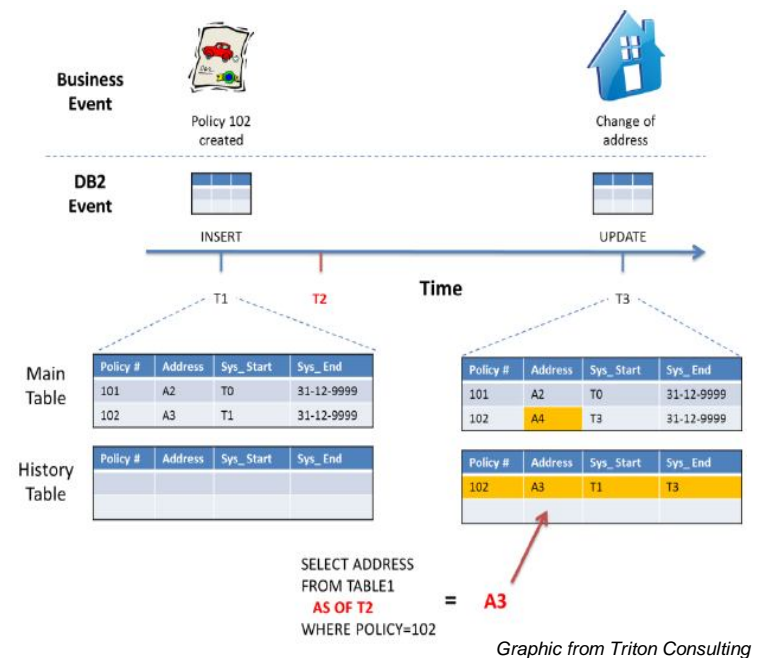
Global cross-industry applicability
Benefits includes application simplification, faster adherence to compliances and savings of time/effort

What DB2 brings to your Temporal Apps?

- **Cost savings via up to 10x[1] Application Simplification**
  - Complexity
  - Lines of code

- **Up to 10x[1] Reduction in Time to Deployment**

- **Better ROI from consultant engagement**

[1]: YMMV

What do you get for Compliance?

- **Ability to move it from application to database layer**

What is the magic sauce?

- **Powerful, novel, yet intuitive SQL (in ISO SQL 2011)**
- **End users deploy without IT Staff intervention**
- **Query past/future data with current queries**
- **Same schema name, simply add novel temporal clause**
- **Response time for current DML/queries preserved**
- **Response time for past/future queries comparable**

pureXML Improved Performance and Usability

- XML schema validation in the engine for improved usability and performance

- Binary XML exchange format improves performance

- XML multi-versioning for more robust XML queries

- Allow easy update of XML document nodes

- Stored procedure, UDF, Trigger enhanced support

- XML index matching with date/timestamp

- CHECK DATA utility checks XML

DB2 SQL   2010

z   DB2 10 for z/OS
common
LUW DB2 Linux, Unix & Windows 9.8

z — Multi-row INSERT, FETCH & multi-row cursor UPDATE, Dynamic Scrollable Cursors, GET DIAGNOSTICS, Enhanced UNICODE SQL, join across encoding schemes, IS NOT DISTINCT FROM, VARBINARY, FETCH CONTINUE, MERGE, SELECT from MERGE, **data versioning, access controls**

common — Inner and Outer Joins, Table Expressions, Subqueries, GROUP BY, Complex Correlation, Global Temporary Tables, CASE, 100+ Built-in Functions including SQL/XML, Limited Fetch, Insensitive Scroll Cursors, UNION Everywhere, MIN/MAX Single Index, Self Referencing Updates with Subqueries, Sort Avoidance for ORDER BY, and Row Expressions, 2M Statement Length, GROUP BY Expression, Sequences, Scalar Fullselect, Materialized Query Tables, Common Table Expressions, Recursive SQL, CURRENT PACKAGE PATH, VOLATILE Tables, Star Join Sparse Index, Qualified Column names, Multiple DISTINCT clauses, ON COMMIT DROP, Transparent ROWID Column, Call from trigger, statement isolation, FOR READ ONLY KEEP UPDATE LOCKS, SET CURRENT SCHEMA, Client special registers, long SQL object names, SELECT from INSERT, UPDATE or DELETE, INSTEAD OF TRIGGER, Native SQL Procedure Language, BIGINT, file reference variables, XML, FETCH FIRST & ORDER BY in subselect & fullselect, caseless comparisons, INTERSECT, EXCEPT, not logged tables, OmniFind, spatial, range partitions, data compression, session variables, DECIMAL FLOAT, optimistic locking, ROLE, TRUNCATE, index & XML compression, created temps, **inline LOB, administrative privileges, implicit cast, date/time changes, currently committed, moving sum & average, index include columns, PureScale**

luw — Updateable UNION in Views, GROUPING SETS, ROLLUP, CUBE, more Built-in Functions, SET CURRENT ISOLATION, multi-site join, MERGE, MDC, XQuery, XML enhancements, array data type, global variables, even more vendor syntax, temp table compression

DB2 10 for z/OS' Skip-Level Migration

V7 → V8 → DB2 9 → DB2 10

Introducing
DB2 10 for z/OS

Announce Oct 19, 2010
GA Oct 22, 2010

- Option to move from V8 to DB2 10
    - Help V8 customers catch up and reposition themselves to stay current as subsequent releases becomes available
    - Support for DB2 for z/OS V8 will formally end April 30, 2012

- Migration, fallback and data sharing coexistence fully supported
    - Mix of DB2 9 and 10 -OR- DB2 V8 and 10
    - Migration checklist provided

- DB2 10 Upgrade Timing based upon many factors including: GA, v8 end of service, other software, ability to test early software, and more…
    - Organizations needing to complete their V8 upgrade to DB2 10 should begin planning their V8 upgrade immediately if they plan to complete their V10 upgrade before V8 support is withdrawn in April 2012

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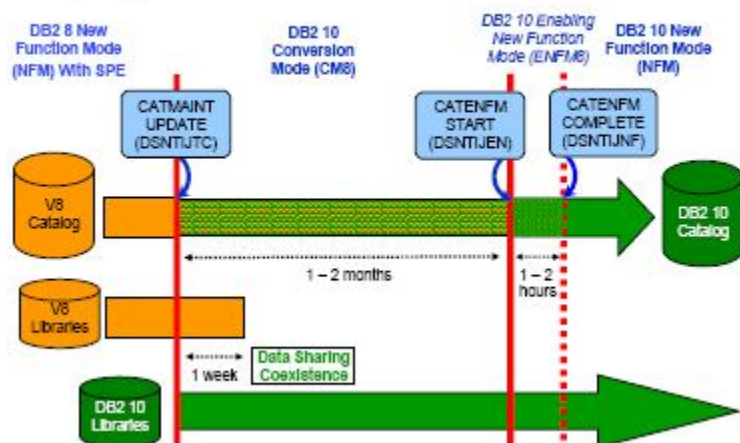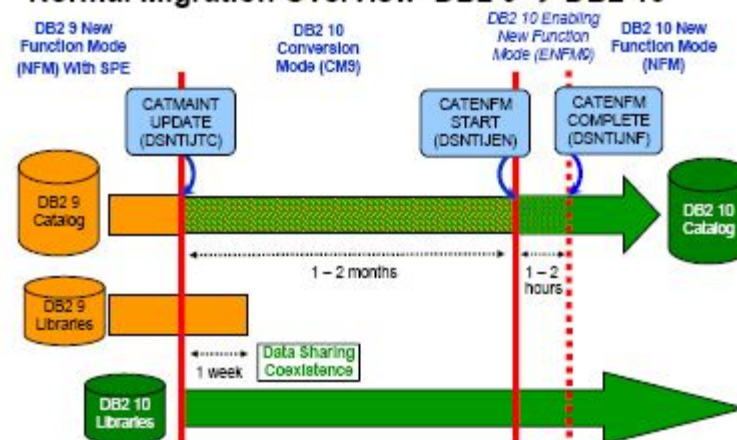
Key Information to Get Ready for DB2 10

Prerequisites: migrate from DB2 9 NFM or DB2 V8 NFM

- z/OS V1.10 SMS-controlled DB2-managed DB2 catalog
- System z z196, z10, z9, z890, z990, and above (no z800, z900)
- DB2 Connect 9 FP1, 9.7 FP3a for 10 function
- Premigration check DSNTIJPA PM04968
- Info APARs II14477 (DB2 9)   II14474 (V8)

Eliminated items that had been deprecated in earlier versions – more for migrating from V8

- Private protocol → DRDA
- Old plans and packages V5 or before → REBIND
- Plans containing DBRMs → packages
- ACQUIRE(ALLOCATE) → ACQUIRE(USE)

Free Migration Planning Workshops (MPW) for DB2 10 and DB2 9

- Understand breadth of features in DB2 for z/OS
- Bring together a toolbox of resources for your migration planning
- Explain the current migration process
- Bring a project focus to migration
- Remain relevant through GA life of the product

DB2 for z/OS time line

2001

V7　V8

2004

2007

DB2 9

V7 EOS

2010

DB2 10

V8 EOS

201x
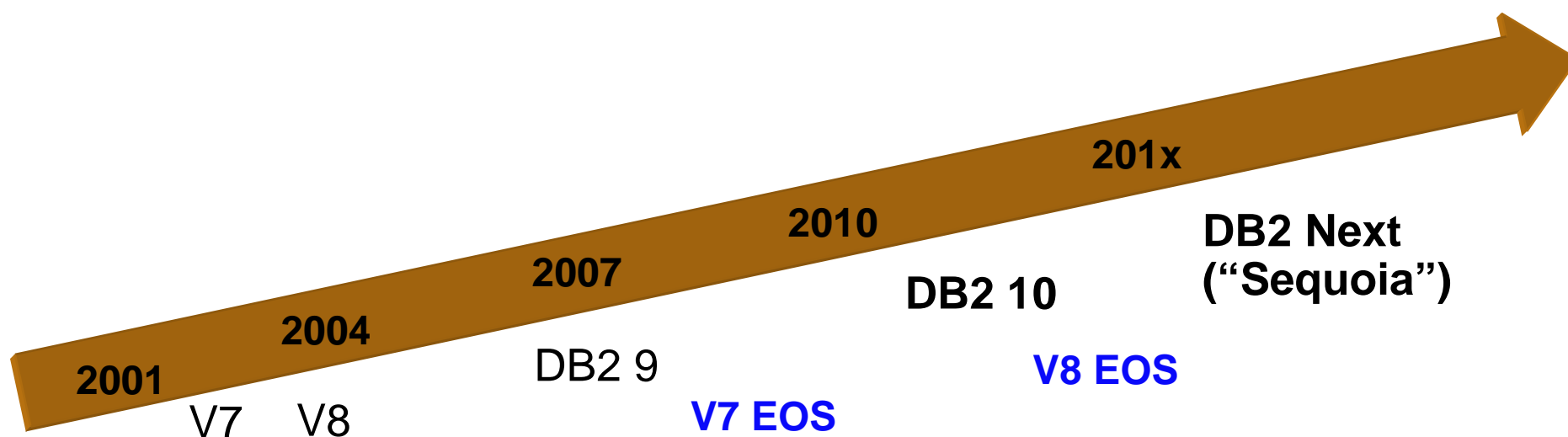
DB2 Next
("Sequoia")

DB2 Next – "Sequoia": Some Early Thoughts

- **Unmatched reliability, scalability, and availability**
  - Improved Data Sharing performance and efficiency
  - Even less downtime by removing growth limitations
  - Simplify management, reduce planned outages with more online schema changes and utilities improvements
  - Expanded logging capacity and scalability

- **Simpler, faster migration**
  - No application changes needed to account for SQL interface differences
  - Access path stability improvements
  - Better application performance with SQL and XML enhancements
  - Simplify application with expanded temporal and SQL PL

- **Enhanced business analytics**
  - Faster, more efficient performance for query workloads
  - Transparent archiving
  - More efficient inline database scoring enabling predictive analytics
  - ISAO optimizations

- **Save money, Save time**
  - Reduce CPU usage
    - OLTP and heavy INSERT workloads
    - Key query workloads
    - SAP day posting in data sharing
    - Additional utilities performance and CPU improvements
  - Save time and resources with new autonomic and application development capabilities

Academic Initiative Offerings

- Access to IBM hardware and software

- Course materials and textbooks

- Ongoing Faculty skills development (seminars and workshops)

- Roundtables

- Certification and Mastery offerings and discounts

- Curriculum assistance (Examples of majors, concentrations, and certificate programs)

- zSkills Help Desk

- Tutorials, articles and Redbooks

- Forums, technical webcasts, forums and newsletters

- Student portal

- Student Opportunity System

- Contests

- System z Job Board

Membership in the IBM Academic Initiative is free and open to individual faculty members.

Apply at *ibm.com/university/academicinitiative*

- Worldwide program
- Supports many IBM Brands and technologies
- Encourages open standards, open source

Mainframe computing is set for a rebirth – Sept 2009 CIO
"you cannot think seriously about your longer-term IT architecture without thinking equally seriously about what today's mainframe environment has to offer"

Member Schools Worldwide in System z Academic Initiative

- Participation continues to increase
  - **814** membership schools
  - Reaching students in over 61 countries

- WW demographics
  - 45% North America
  - 24% Europe, Middle East, and Africa
  - 16% Latin America
  - 15% Asia/Pacific

- Wide variety of schools in the program
  - Different level of participation

- All programs are unique
  - Designed to provide flexibility to the school to meet their requirements and capabilities

System z Job Board

http://www.systemzjobs.com

Connects IBM clients, partners and businesses with students and professionals seeking System z job opportunities

Typical Utilization for Servers

Windows: 5-10%   Unix: 10-20%   **System z: 85-100%**

System z can help **reduce** your floor space up to **75%-85%** in the data center

Thank You

System z can lower your total cost of ownership, requiring **as little as 30%** of the power of a distributed server farm running equivalent workloads

The cost of storage is typically **three times more** in distributed environments

DB2 10 Resources

- **Website** http://www.ibm.com/software/data/db2/zos/db2-10/
  - Case Studies, Customer statements
  - Demos: DB2 10 for z/OS, QMF 10
  - Brochures: DB2 10 for z/OS Highlights, QMF 10 What's New

- **Presentations**
  - DB2 10's new functions – ftp://public.dhe.ibm.com/software/data/db2/zos/presentations/v10-new-function/
  - Overviews - ftp://public.dhe.ibm.com/software/data/db2/zos/presentations/overview
  - Migration - ftp://public.dhe.ibm.com/software/data/db2/zos/presentations/migration

- **Books**
  - DB2 10 for z/OS Technical Overview http://www.redbooks.ibm.com/abstracts/sg247892.html
  - DB2 10 for z/OS Performance Topics – *coming soon* http://www.redbooks.ibm.com/abstracts/sg247942.html
  - Extremely pureXML in DB2 10 for z/OS http://www.redbooks.ibm.com/abstracts/sg247915.html
  - DB2 10 for z/OS Book ftp://public.dhe.ibm.com/common/ssi/ecm/en/imm14075usen/IMM14075USEN.PDF
  - DB2 10 Security – *coming*
  - DB2 9 Technical Overview http://www.redbooks.ibm.com/abstracts/sg247330.html
  - DB2 9 Performance Topics http://www.redbooks.ibm.com/abstracts/sg247473.html
  - DB2 9 Stored Procedures http://www.redbooks.ibm.com/abstracts/sg247604.html
  - DB2 9 Resource Serialization and Concurrency Control http://www.redbooks.ibm.com/abstracts/sg244725.html
  - DB2 9 Distributed Functions http://www.redbooks.ibm.com/abstracts/sg246952.html
  - DB2 9 Utilities http://www.redbooks.ibm.com/abstracts/sg246289.html
  - DB2 and Storage Management http://www.redbooks.ibm.com/abstracts/sg247823.html
  - Index Compression with DB2 9 for z/OS http://www.redbooks.ibm.com/abstracts/redp4345.html
  - Enterprise Data Warehousing with DB2 9 for z/OS http://www.redbooks.ibm.com/abstracts/sg247637.html
  - 50 TB Data Warehouse Benchmark on IBM System z http://www.redbooks.ibm.com/abstracts/sg247674.html
  - LOBs with DB2 for z/OS http://www.redbooks.ibm.com/abstracts/sg247270.html
  - Deploying SOA Solutions http://www.redbooks.ibm.com/abstracts/sg247663.html
  - Data Sharing in a Nutshell http://www.redbooks.ibm.com/abstracts/sg247322.html

(cont) DB2 10 Resources

- **(cont) Books**
  - Securing DB2 and Implementing MLS on z/OS http://www.redbooks.ibm.com/abstracts/sg246480.html
  - DB2 9 for z/OS Data Sharing: Distributed Load Balancing and Fault Tolerant http://www.redbooks.ibm.com/abstracts/redp4449.html
  - DB2 9 for z/OS Packages Revisited http://www.redbooks.ibm.com/abstracts/sg247688.html
  - Ready to Access DB2 for z/OS Data on Solid-State Drives http://www.redbooks.ibm.com/abstracts/redp4537.html
  - DB2 9 for z/OS: Buffer Pool Monitoring and Tuning http://www.redbooks.ibm.com/abstracts/redp4604.html
  - Securing and Auditing Data on DB2 for z/OS http://www.redbooks.ibm.com/abstracts/sg247720.html

- **Whitepapers**
  - Business Value Whitepaper – Julian Stuhler, Triton Consulting: "DB2 10 for z/OS: A Smarter Database for a Smarter Planet" *http://public.dhe.ibm.com/software/data/sw-library/db2/analystreports/tritonconsulting-db210forzos-smarterdatabase.pdf*
  - A Matter of Time: Temporal Data Management *http://public.dhe.ibm.com/software/data/sw-library/db2/papers/A_Matter_of_Time_-_DB2_zOS_Temporal_Tables_-_White_Paper_v1.4.1.pdf*
  - Why DB2 for z/OS is Better than Oracle RAC https://www14.software.ibm.com/webapp/iwm/web/signup.do?lang=en_US&source=sw-infomgt&S_PKG=db2z-better-thank-oracle-rac-wp
  - zJournal article by Willy Favero http://www.mainframezone.com/z-journal

(cont) DB2 10 Resources

- **<u>SAP Whitepapers</u>**
  - SAP article on DB2 10 *(published by SAP)* http://www.sdn.sap.com/irj/sdn/db2
  - SAP Best Practice Guide for Migrating to DB2 10 for z/OS *(published by SAP)* https://websmp207.sap-ag.de/~sapidb/011000358700001414122010E
  - (Updated) Business Continuity Guide for Running SAP on System z – based on DB2 10 for z/OS, DB2 Connect 9.7 FP3a, SAP NetWeaver 7.10 and Tivoli Automation for z/OS V3.3 http://publibfp.dhe.ibm.com/epubs/pdf/iapacs03.pdf
  - DB2 10 for z/OS with SAP on IBM System z Performance Report – new techdocs white paper http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101845
  - DB2 10 for z/OS – Optimized for SAP – http://cattail.boulder.ibm.com/cattail/?source=s#view=andreas.r.mueller@de.ibm.com/files/3198290001883DDBA202FBE4093F23B6
  - SAP on DB2 10 for z/OS - Being More Productive, Reducing Costs and Improving Performance – http://www.sdn.sap.com/irj/sdn/db2?rid=/library/uuid/005c6b33-aaf0-2d10-fcbb-b42e89ac5791
  - Enhancing SAP by Using Db2 9 for z/oS http://www.redbooks.ibm.com/abstracts/sg247239.html
  - Best Practices for SAP BI using DB2 9 for z/OS http://www.redbooks.ibm.com/abstracts/sg246489.html

<u>Some Certifications so far...</u>

- 1Q2011: SAP NetWeaver 7.30 and SAP R/3 4.6 is certified for DB2 10
- 2Q2011: All SAP products based on NetWeaver 7.00/7.01 is certified for DB2 10
- 2Q2011: PeopleSoft PeopleTools 8.50 and 8.51 is certified for DB2 10