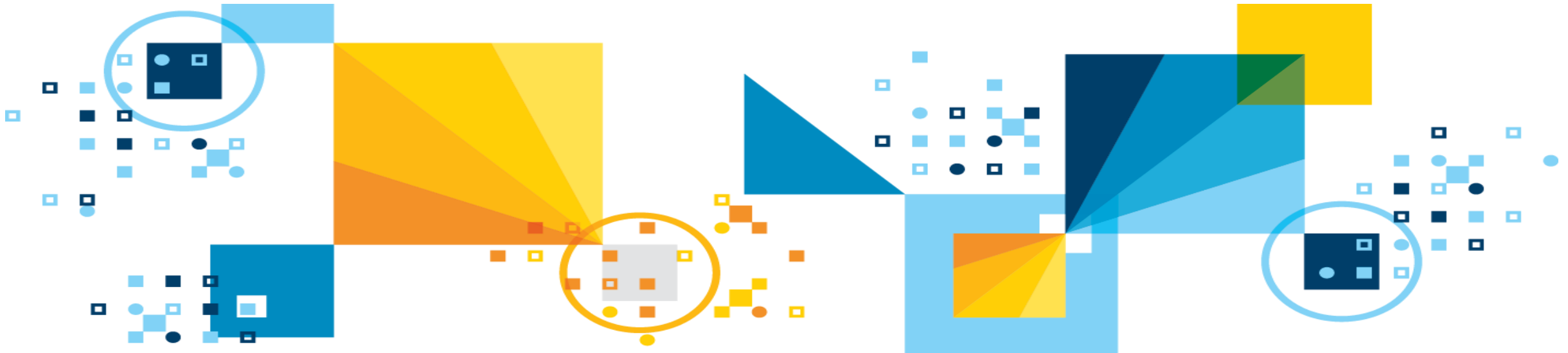March, 2017

DB2 12 for z/OS and Beyond

Jeff Josten
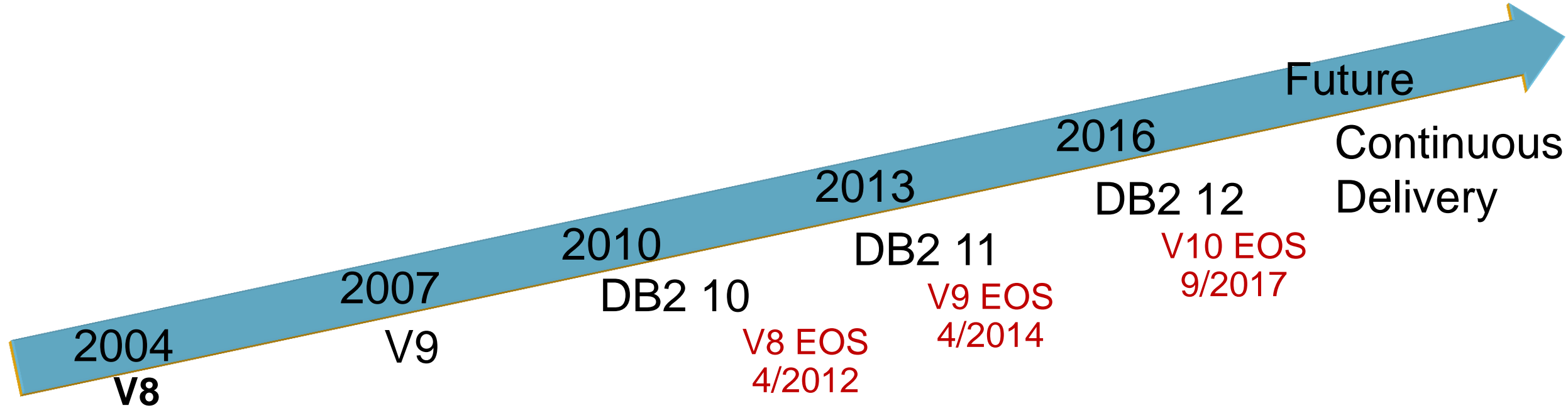**Distinguished Engineer, DB2 for z/OS Development**

Please Note

- IBM's statements regarding its plans, directions, and intent are subject to change or withdrawal without notice at IBM's sole discretion.

- Information regarding potential future products is intended to outline our general product direction and it should not be relied on in making a purchasing decision.

- The information mentioned regarding potential future products is not a commitment, promise, or legal obligation to deliver any material, code or functionality. Information about potential future products may not be incorporated into any contract.

- The development, release, and timing of any future features or functionality described for our products remains at our sole discretion.

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.

DB2 for z/OS Timeline

Future

Continuous
Delivery

2016

DB2 12

V10 EOS
9/2017

2013

DB2 11

V9 EOS
4/2014

2010

DB2 10

V8 EOS
4/2012

2007

V9

2004

V8

Version	GA
V7	3/2001
V8	3/2004
V9	3/2007
V10	10/2010
V11	10/2013
V12	10/2016

DB2 12 ESP ("beta") started in March, 2016

Over 50 customers and partners tested
DB2 12 in the ESP

GA October, 2016

DB2 12

DB2 12 for z/OS – GA October, 2016

Redefining enterprise IT for digital business and the mobile app economy

Scale and speed for the next era of mobile applications

Super fast ingest rate **--** over **11 Million Inserts per second** for IOT, Mobile and Cloud*

280 trillion rows in a single DB2 table, with **agile partition technology**

DRDA Fast Load for easier loading of data from distributed clients

In-Memory database

Advanced in-memory techniques in DB2 12 means faster transactions with less CPU

Deliver analytical insights faster, expand to more applications

2-10x improvement for modern analytics workloads

Individual modern analytic queries may see up to 100x improvement**

JSON data management improvements

SQL improvements such as SQL pagination, enhanced MERGE, piece-wise DELETE

Easier to manage, higher availability

Cloud-based self-service provisioning of resources

Automated admin operations such as RUNSTATS

More schema and partition flexibility

TRANSFER OWNERSHIP for easier security admin

Dynamic SQL plan stability

The launch pad for Continuous Delivery

*: Under dedicated environment using 12 way data sharing on z13, insert against one table (PBR/Member Cluster) from zLinux clients. All partitions were GBP dependent and logging enabled. Our record is, 11.7 million insert per second without index, 5.3 million insert per second with index defined.

** Modern analytics queries evaluated include SQL constructs such as UNION ALL, outer joins, complex expressions (CASE, CAST, scalar functions etc)

DB2 for z/OS and Cloud

DB2aaS
DB2-as-a-Service

SYSTEM PROVISIONING :
INSTALL, MIGRATION,
HOUSEKEEPING

RESOURCES PROVISIONING :
DB,TABLES, INDEXES, DATA

APP DEV LIFECYCLE :
SINGLE OR MULTI-PLATFORM
APPLICATION DEPLOYMENT

APP DEV ENVIRONMENT :
DEDICATED ENVIRONMENT
ON OR OFF PREMISES

DaaS
DB2 Data-as-a-Service

Digital & Modern Enterprise App
Native RESTful APIs
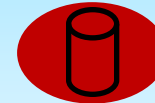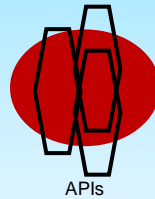
APIs

DB2 z/OS

**Hybrid Cloud
Services
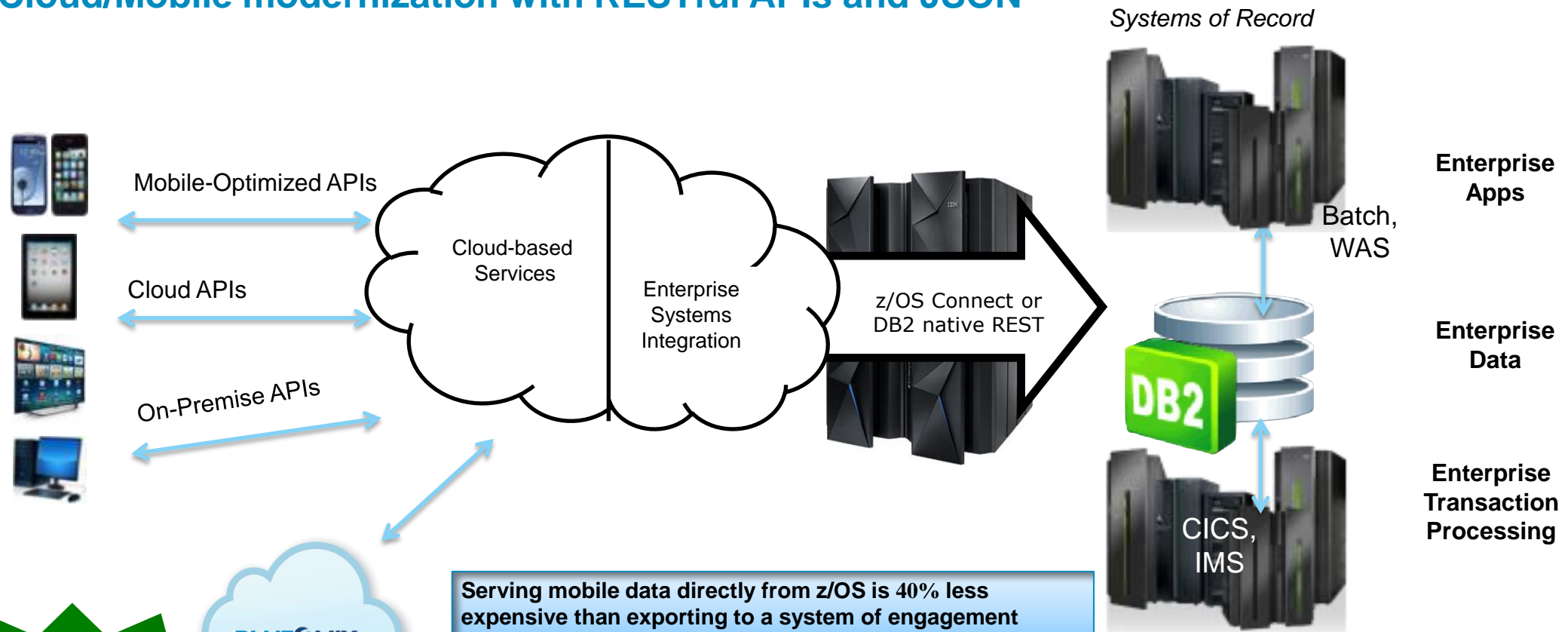For DB2**

DATA ANALYTICS

BUSINESS ANALYTICS

OPERATIONAL ANALYTICS

DB2 Customers increasingly want DB2aaS and they want DB2 Data as a Service (RESTful APIs to DB2)
for improved administration with lower skills required, and for their next generation application development

DB2 Data as a Service

DB2 Cloud/Mobile modernization with RESTful APIs and JSON

Systems of Record

Mobile-Optimized APIs

Cloud-based Services

Cloud APIs

Enterprise Systems Integration

On-Premise APIs

z/OS Connect or DB2 native REST

Enterprise Apps

Batch, WAS

Enterprise Data

DB2

CICS, IMS

Enterprise Transaction Processing

BLUEMIX

Serving mobile data directly from z/OS is 40% less expensive than exporting to a system of engagement

Native DB2 REST service provider now available

- Many modern application developers work with REST services and JSON data formats
- DB2 12 (and DB2 11 APAR PI66828) ship a Native DB2 REST service
  - Easier DBA management of DB2 RESTful services, means easier adoption
  - z/OS Connect Enterprise Edition (zCEE) integration

6

IBM **Analytics**

An optimized and automated process for rapid deplo[...]
to simplify and speed the delivery of critical operation[...]

SPEED
- Reduce time and cost to deploy application changes
- Deploy more frequently with more autonomy and control
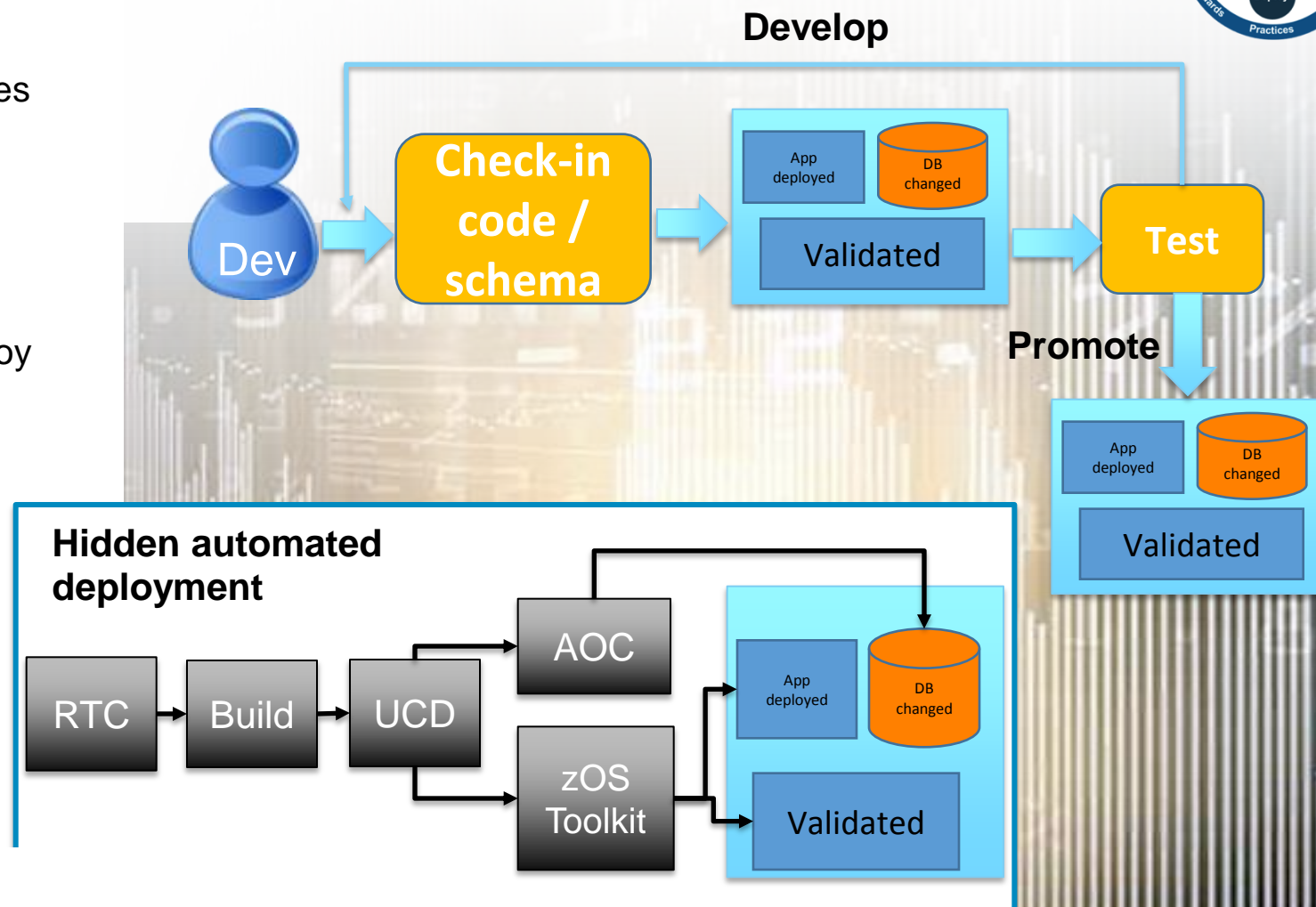- Automated. Accelerated.

SIMPLICITY
- Reduce errors of manual process
- Frees up resources by allowing other users to deploy
- Collaborative. Accurate.

SECURITY
- Safeguard valuable assets under the control and security of DB2 for z/OS
- Transparent and auditable review built into process
- Protected. Secured.

IBM DB2 Change Management Solution Pack

See the new video on World of DB2!
"DB2 for z/OS – IBM Urban Code Deploy – Automate Application Deployments"

Develop

Dev → **Check-in code / schema** →

App deployed | DB changed | Validated

→ **Test**

Promote

App deployed | DB changed | Validated

Hidden automated deployment

RTC → Build → UCD → AOC

zOS Toolkit

App deployed | DB changed | Validated

In-Memory Index Optimization

- **A new Index Fast Traverse Block (FTB) is introduced**
  - Memory optimized structure for fast index lookups
  - Resides in memory areas outside of the buffer pool
    - New zparm INDEX_MEMORY_CONTROL
    - Default=AUTO (min. of 500 MB or 20% of allocated BP storage)
  - UNIQUE indexes only, key size 64 bytes or less

- DB2 automatically determines which indexes would benefit from FTB

- DISPLAY STATS command shows which indexes are using FTBs

- New SYSINDEXCONTROL catalog table

  - Specify time windows to control use of FTBs for an index

- New IFCIDs 389 and 477 to track FTB usage

DB2 12: CPU Reductions for Transactions

DB2 12 CPU Reduction (%) from DB2 11 NFM
(Pre-GA measurements)

Legend: ■ FTB=AUTO ╱ FTB=Disable
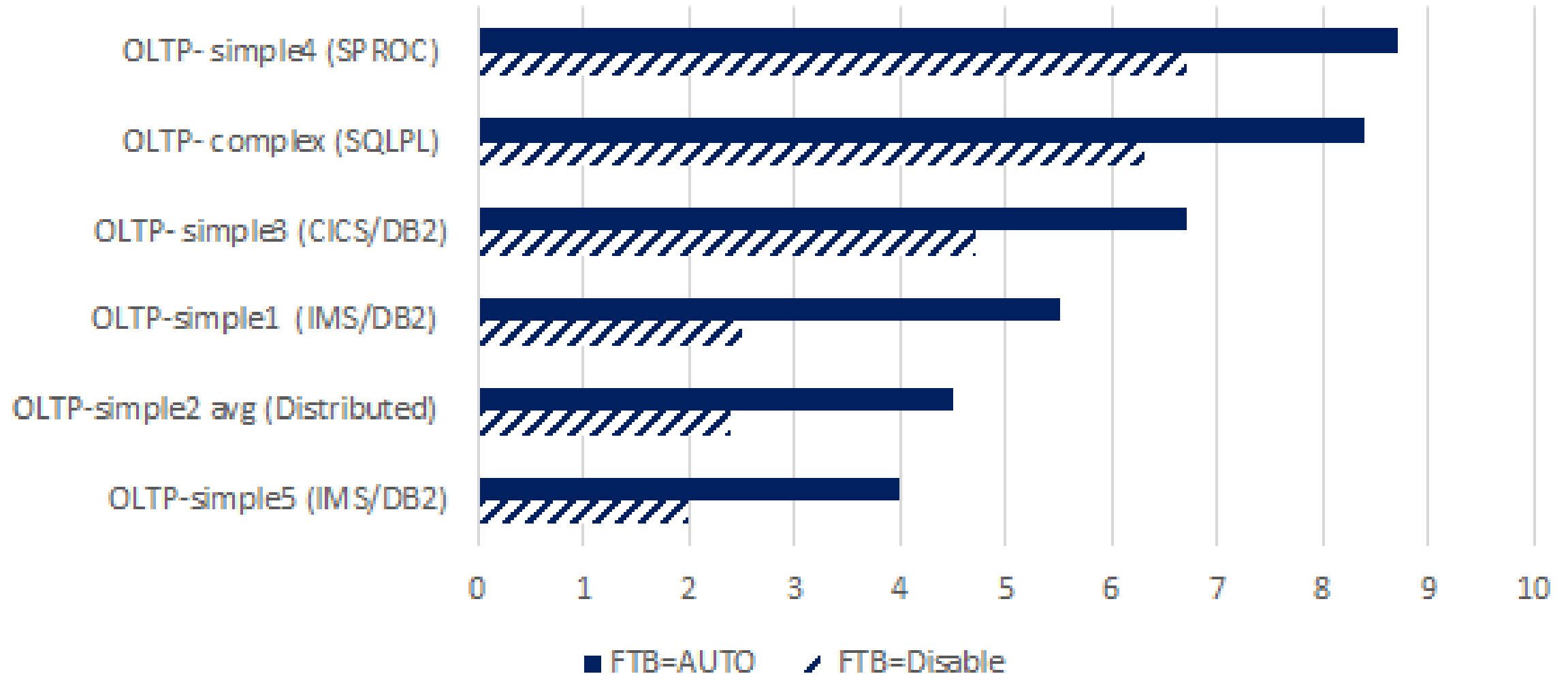
- Insert workloads are amongst the most prevalent and performance critical

- DB2 12 delivers significant improvements for Non-clustered insert: journal table pattern

  - UTS, MEMBER CLUSTER

- Advanced new insert algorithm to streamline space search

  - Default is to use the new fast algorithm for qualifying table spaces
    - DEFAULT_INSERT_ALGORITHM zparm can change the default
    - INSERT ALGORITHM table space attribute can override zparm

DB2 12: CPU Reductions for Query Workloads

IBM

Query workloads Performance difference (%)
DB2 11 vs 12   (Pre-GA measurements)

- SAP SFIORI
- WAS portal (selective)
- Customer 3cl
- SAP SFIN
- Biday short
- Customer 2
- TPCH NPID=1
- TPCH NPID=Any
- Customer 4
- Customer 1
- TPCH-SQLPL
- TPCD
- SAP BW
- Biday long

UNION ALL w/View Complex Outer Join, UDF

Complex reporting, large sort

Simple query or large data scan

■ CPU Reduction %

- LOB compression
  - Using zEDC hardware

- Much larger active log data sets – up to 768 GB

- Larger buffer pools – up to 16TB

- Query parallelism child tasks – now 100% zIIP eligible

- Avoid log force for identity columns in data sharing

DB2 12: Simplicity and RAS

- Dynamic SQL Plan Stability
  - Stabilize performance of repeating dynamic SQL statements

- DRDA Fast Load
  - Callable command for fast load of data into DB2 directly from files on distributed client

- RUNSTATS automation
  - Optimizer automatically update profile with RUNSTATS recommendations

- RLF control for static packages

DB2 12: application enablement

- **Several SQLPL Improvements**

  - SQLPL in triggers, including versioning and debug support

  - SQLPL obfuscation

  - Support for constants

  - Dynamic SQL in SQLPL UDFs and stored procedures

- **ARRAY and LOB global variables**

- **JSON function improvements for easier retrieval of JSON dataq**

- Enhanced MERGE support

- New SQL Pagination syntax

- Piece-wise modification of data (DELETE)

- XMLModify multiple update support

- Bi-temporal improvements
  - Inclusive/inclusive support
  - Temporal RI
  - Logical transaction for system time

- New PBR tablespace structure called 'PBR RPN'
- Relative page numbers (RPN) instead of absolute
- Remove dependency between #partitions & partition size
- New RID is Relative RID
  – Part Number stored in Partition Header Page
  – Page number stored in Data Page, relative to start of the partition
- Up to 1TB Partition Size, or 4 Petabytes (PB) per table space
- Maximum number of rows with 4K pages increased from 1.1 to 280 Trillion
  – @1,000 rows inserted per second, more than 8800 years to fill!
- Increasing DSSIZE is supported at partition-level
- New DSSIZE support for indexes
- These infrastructure changes position DB2 for future enhancements
  – Increase in partition limits, increase number of rows per page
  – Attribute variance by partition, schema changes via REORG PART

- Insert partition

- Online deferred ALTER INDEX COMPRESS YES
  - Previously placed indexes in RBDP

- Option to defer column-level ALTERs
  - Materialize through online REORG
  - Avoid availability constraints & conflict with other deferred alters

- TRANSFER OWNERSHIP

IBM DB2 12 Utilities – key to enabling DB2 function

- Continuing evolution of REORG utility
- Diminishing importance of data re-clustering for application performance
  - Optimizer improvements, I/O performance improvements, caching improvements, contiguous buffer pools
- Increasing use of IBM REORG for schema evolution
  - Insert partition
  - PBR RPN conversion
  - Deferred column-level alter
  - LOB compression
- Improved PBG partition management
  - Overflow to new PBG partition to ensure successful partition-level REORG of PBGs

DB2 12 Utilities Maximizing Efficiency & Eliminating Application Impact

- Improved efficiency
  - Further reduction in CPU cost & more offload to zIIP
    - REORG up to 57% zIIP offload
    - LOAD up to 90%
  - REGISTER NO option to eliminate data sharing overhead for RUNSTATS, UNLOAD
  - COLGROUP statistics CPU cost reduced by up to 25%, elapsed time up to 15%
  - More efficient handling of compressed data to reduce CPU and elapsed time across range of utilities
  - REORG avoidance: Immediate increase of partition DSSIZE with PBR RPN
  - Improved FlashCopy support
    - Multiple DFSMS COPYPOOL support for SLBs & better messaging
    - Improved FlashCopy handing in REORG & template support for MGMTCLAS, STORCLAS
- Eliminating application impact
  - Improved LOAD utility support for sequences with automatic handling of MAXASSIGNEDVAL
  - Online LOAD REPLACE – non-disruptive refresh of reference tables
  - Skip invalidation of cached statements by RUNSTATS
  - Removed recoverability restrictions for PBG table spaces

Data Sharing Improvements

- Support for global transactions

- DDF shared session data across group
  - DDF transaction re-routing, session token for client fail-over

- Data sharing performance improvements:
  - Improved lock avoidance checking to reduce CF lock requests
  - In-memory indexes can reduce GetPages and CF GBP requests
  - Improved insert space search can avoid P-lock contention and streamline inserts
  - RUNSTATS and UNLOAD ISOLATION(UR) to avoid CF page registration

Data Sharing Improvements …

- New data sharing peer recovery option

- Retry of automatic LPL and GRECP recovery

- Asynchronous CF Lock duplexing
  - Reduces overhead for system managed duplexing of CF LOCK1 and SCA structures
  - Secondary structure updates are performed *asynchronously* with respect to primary updates
  - DB2 will sync up with z/OS to ensure data integrity i.e., all modify locks have been "hardened" in the secondary lock structure before the corresponding undo/redo record for the update is written to DB2 the active log on DASD
  - Increases the practical distance for multi-site sysplex operations while duplexing of CF LOCK1 structure
  - Requirements:
    - z/OS 2.2 SPE with PTFs for APARs OA47796 and OA49148
    - CFCC Level 21 (z13)
    - DB2 12

Migration Prerequisites – Hardware & Operating System

- **Processor requirements:**
  - z196 class processors or higher

- **Software Requirements:**
  - z/OS V2.1 Base Services, (5650-ZOS), or later
  - DFSMS V2.1, or later
  - Language Environment Base Services
  - z/OS V2.1 Security Server (RACF), or later
  - IRLM Version 2 Release 3 (Delivered with DB2 12)

- **No more single version charging**

- **Additional details:**
  - http://www.ibm.com/common/ssi/rep_ca/1/897/ENUS215-371/ENUS215-371.PDF

Migration & Catalog

- **Single phase migration process**
  - No ENFM phase
  - New function activated through new command: -ACTIVATE FUNCTION LEVEL
  - BNFA vs. ANFA
  - APPLCOMPAT rules, fallback rules continue to apply
- **BSDS conversion to support 10 byte log RBA is pre-requisite**
- **No pre-V10 bound packages**
  - Get rid of 31-bit runtime, some performance improvements
- **BRF is deprecated**
  - BRF page sets still supported, but zparm and REORG options are removed
- **Temporal RTS tables**
 - Defined in catalog, enablement is optional

DB2 for z/OS Strategy

Extend the core
reliability:availability:scalability:security

Empower the future
analytics:autonomics:cloud:mobile

IBM Analytics

- **Analytics**
  - HTAP
  - In-transaction analytics, machine learning
- **Cloud**
  - Self-service for app developers
  - Hybrid cloud
  - Simplification, self-management
- **Modern Application Development**
  - Mobile, Internet of Things
  - SAP
  - Application portability, open source integration
  - Blockchain
- **Technology Leadership**
  - Security
  - Performance, scalability, in-memory, z integration
  - Continuous availability
- **Foundation: internal dev/test tooling modernization for Agile/DevOps**

Analytics	Cloud	Modern App Dev
Technology Leadership		
Foundation		
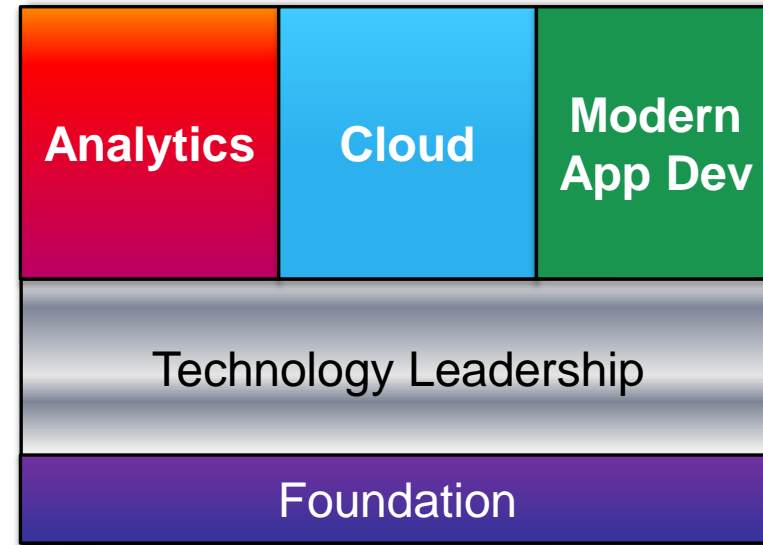
Next Gen workloads with our world class Qualities of Service

27

IBM Analytics

- **Start slow, speed up as we go**
  - Quality, stability is priority #1
  - Some features will be retrofit to V11 since this is where the majority of customers are – this will diminish over time
  - Function levels (FLs) are the mechanism to activate new features on V12
  - FL every 4-6 months looks likely
- **FL 501 – 1st post-GA delivery, "practice run" for the FL mechanism (1Q17)**
  - LISTAGG
- **FL 502 – 2nd delivery**
  - Timing or content not yet set

- More accurate real storage indicators in IFCID 225
- Store version 0 info, bug fix
- V12 Insert algorithm 2 robustness (ESP customer feedback)
- RunStats profile usability, performance (ESP customer feedback)
- New LOAD IGNORE options
- Inline image copy for LOAD RESUME

- Partition by hidden ROWID (V11, V12 – not CD function levels)
- HTAP enhancements (V11, V12 initially)
- Transparent data encryption (V11, V12 fuller function)
- zNext integration
- Query performance improvements for SAP CDS and others
- Catmaint robustness improvements
- DB2aaS improvements

Client Ready Workshops & Seminars

DB2 Performance Day
- One day technical seminar to identify opportunities across DB2, Analytics, Tools & Utilities

DB2 11 & DB2 12 Migration Planning Workshop
- Comprehensive review of capabilities, considerations, preparations & project planning for DB2 11

DB2 11 Best Practices & Optimization Workshop
- Help set the right level of expectations of DB2 11 and help clients maximize their return on investment

DB2 Utilities Workshop
- ½ day session to better understanding of the features & performance of DB2 Utilities

Fast Start DB2 for z/OS Application Development Topics
- Help DB2 for z/OS clients develop applications for DB2 for z/OS
- Target Audience: Application Developers

DB2 for z/OS and Cloud Workshop
- Help DB2 for z/OS clients develop applications for DB2 for z/OS
- Target Audience: Application Developers, Technical Architects

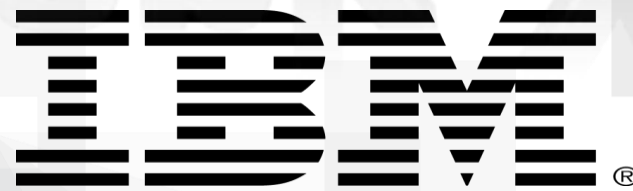**IBM DB2 Analytics Accelerator Workshop**
- How the latest version of this technology can help you improve the performance and cost of your DB2 for z/OS based Data Warehouse and related analytical business processes.
- Target Audience: Business / LOB Titles Marketing Analyst, Application Architect

- DB2 for z/OS product home page
  https://www.ibm.com/analytics/us/en/technology/db2/db2-for-zos.html

- Whitepaper: DB2 12 for z/OS The In-memory Enterprise Database for Transactions and Analytics
  http://ibm.biz/BdsyaT

- IDUG DB2 12 Technical whitepaper
  http://www.idug.org/db2v12whitepaper

- "Scaling Progressive SAP Solutions with DB2 12 – Immediate SAP Certification of DB2 12 at IBM General Availability"

- DB2 12 GA Announcement
  https://www-01.ibm.com/common/ssi/rep_ca/7/897/ENUS216-077/ENUS216-077.PDF

- World of DB2
  http://www.worldofdb2.com/

DB2 12 for z/OS

For mission critical data providing secure, seamless integration for analytics, mobile and cloud.