IBM System z Technology Summit

DB2 10 – The Secrets of Scalability

Agenda

- **Introduction**
- **The Need for Scalability**
- **DB2 10 Scalability Enhancements**
  - Virtual storage constraint relief
  - Latch contention reduction
  - Catalog concurrency enhancements
  - SMF compression
  - Other scalability enhancements
    - Concurrency
    - Index Enhancement
    - Multirow Operations
    - LOBs
    - Hash Organization
    - Optimization
    - Additional zIIP Exploitation
- **Summary & Questions**

The Need for Scalability

- **IT volumes continue to increase**
  - More applications
  - More data
  - More transactions
- **Performance is ever more important**
  - Customers need to support workload growth without a drop-off in performance
- **Availability is ever more important**
  - Pressure to reduce both planned and unplanned outages
- **End result: each DB2 environment is being asked to work harder, with less downtime**
- **Every DB2 release attempts to push back these boundaries, but major progress has been made in DB2 10**

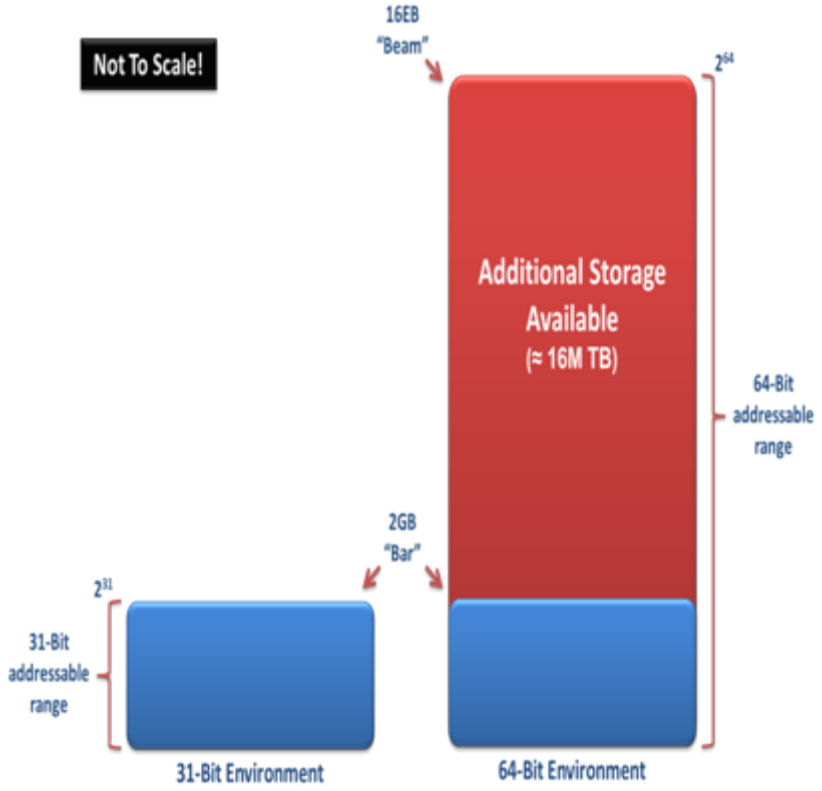
DB2 10 Scalability Enhancements

Top New Features

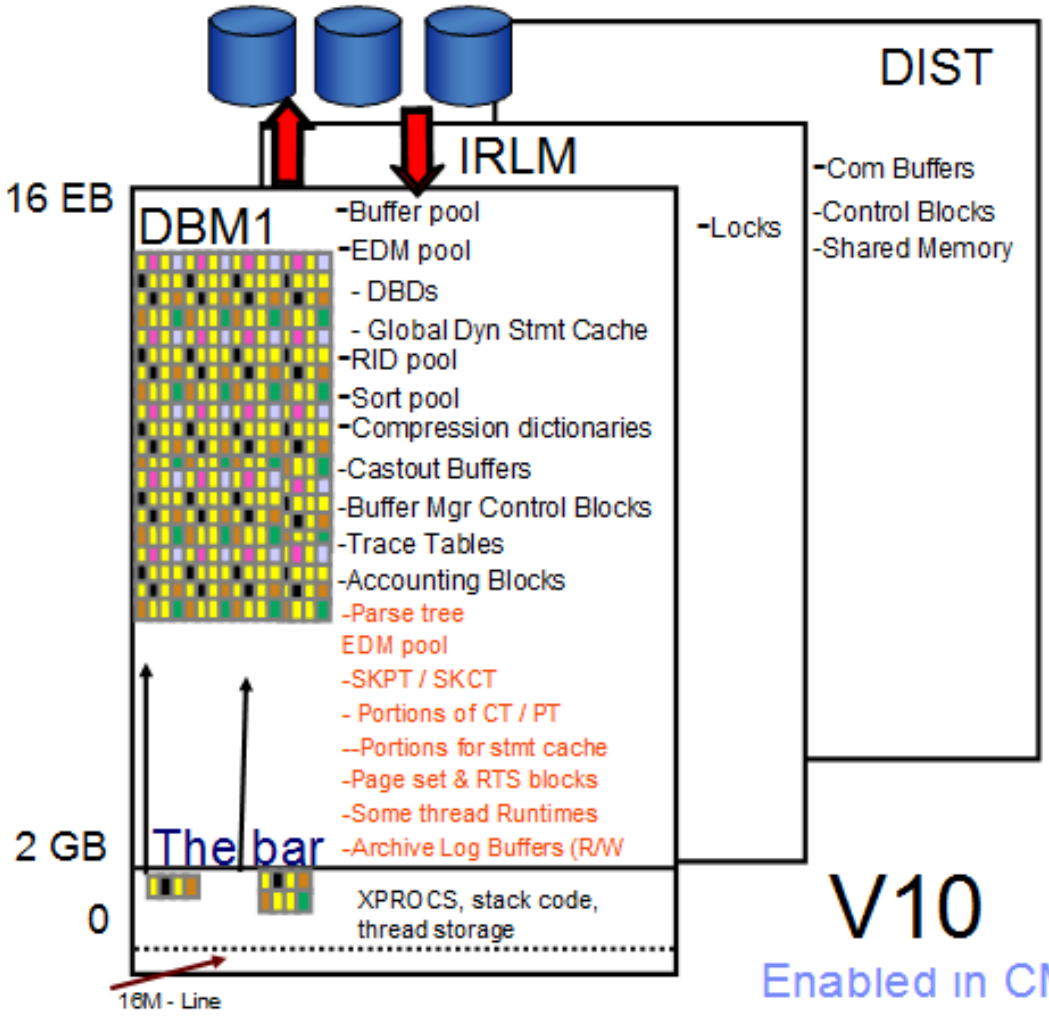
- CPU/Performance Improvements
- Virtual Storage Enhancements
- Security Extensions
- Improved Catalog Concurrency
- Temporal Data
- Access Path Management
- pureXML enhancements
- Currently Committed semantics
- Automated statistics
- Dynamic schema change enhancements
- In-memory object support
- Optimiser enhancements
- MEMBER CLUSTER for UTS
- Backup and recovery enhancements
- Enhanced audit
- Include additional index columns
- Enhanced SQL OLAP functions
- Skip Migration
- And many more….

Virtual Storage Enhancements

- **V8 began a major project to transform DB2 into a 64-bit RDBMS**
  - Laid the groundwork and provided some scalability improvements but a lot of DBM1 objects remained below the 2GB bar
- **DB2 9 improved things a little, but only by another 10-15% for most customers**
  - Practical limit of 300-500 threads per DB2 subsystem
- **DB2 10 moves 80-90% of the remaining objects above the bar, resulting in 5-10x improvement in threads per subsystem (CM)**

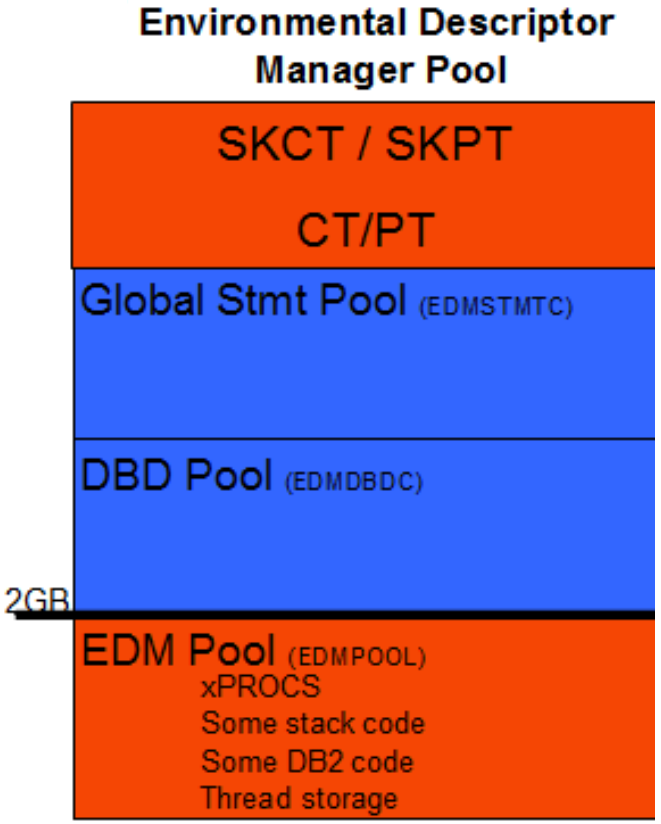


64 bit Evolution (Virtual Storage Relief)



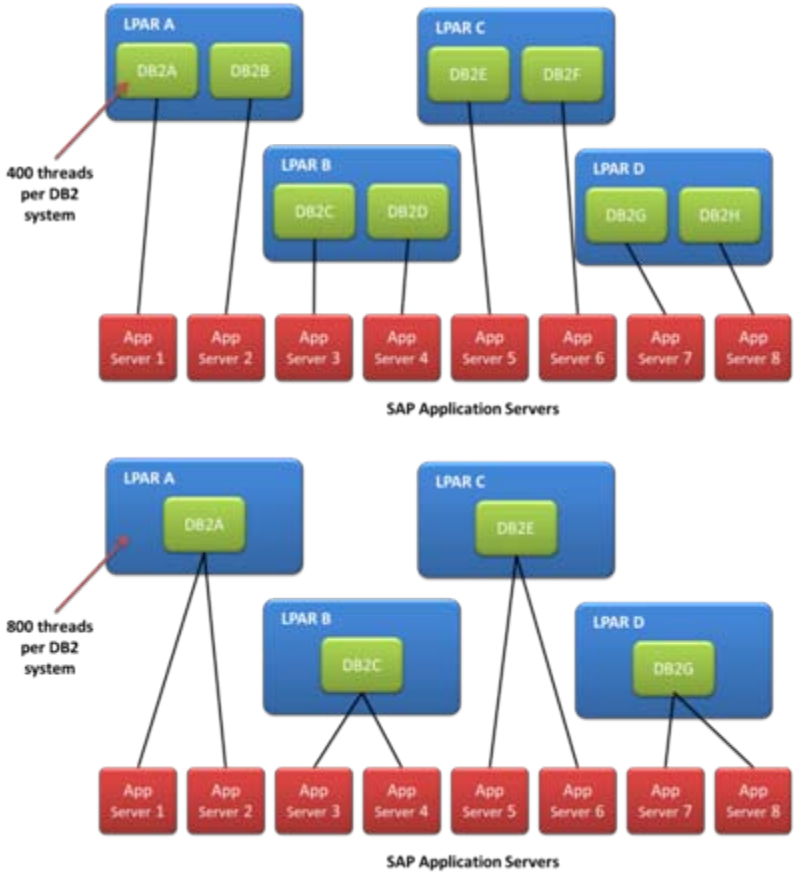
V10

Enabled in CM



Virtual Storage Enhancements

- **Possibility for less DB2 subsystems (and possibly less LPARs) in a data sharing environment**
  - Lower data sharing overhead
  - Less systems to manage / maintain
  - Delete of data sharing member is coming! See:
    - PM31003
    - PM31009
    - PM54873

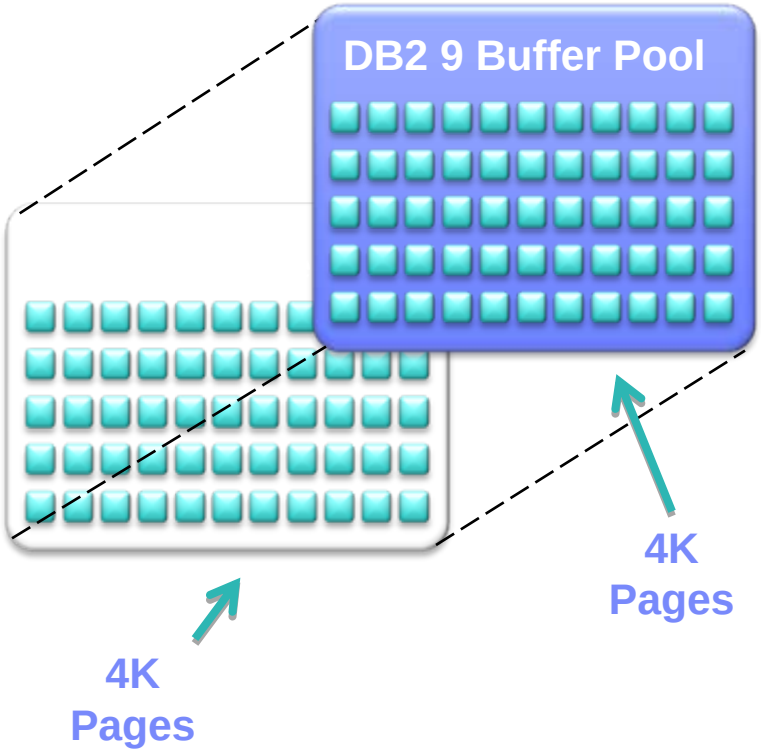


Virtual Storage Enhancements

- **More space for performance critical storage objects such as dynamic statement cache**
- **Potential to reduce legacy OLTP CPU cost through**
  - More use of CICS protected entry threads
  - More use of RELEASE(DEALLOCATE) with persistent threads (with trade-off on concurrency)
  - DB2 10 High-Performance DBATs
    - -**MODIFY DDF PKGREL(BINDOPT | COMMIT)**
- **Other limiting factors on vertical scalability still remain**
  - Real storage
    - Plan on additional 10-30% real memory following migration
  - ESQA/ECSA (31-bit) storage
  - Active log write

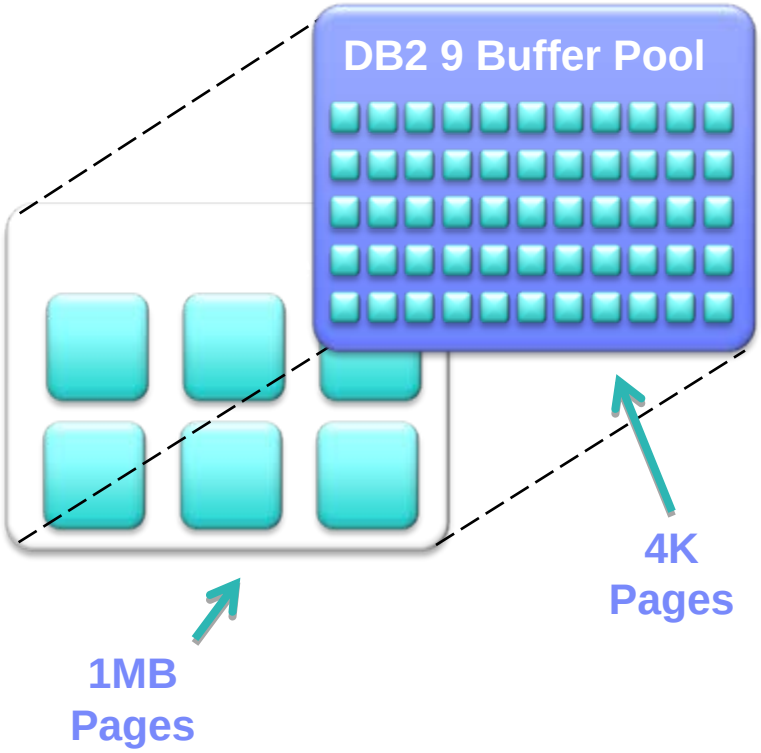
Real Storage Enhancements

- **For prior releases, z/OS always managed DB2 bufferpool pages as 4K frames**
- **Move to 64-bit architecture made much larger buffer pools viable**
  - Bufferpools can use many millions of pages
  - Increased z/OS overheads for page management



Real Storage Enhancements

- **DB2 10 introduces support for 1MB pages to reduce z/OS page management overheads**
  - Needs z10 or newer z196 server
  - Needs bufferpool to be defined with PGFIX=YES
    - Buffer Pool intensity can help determine
    - PGREADS + PGWRITES / # of Pages
  - z/OS Sysprogs must partition real storage between 1K and 1MB frames (LFAREA in IESYSnn / PARMLIB)
- **Customer testing during beta program showed CPU reductions of 0-6% with this feature enabled**



Storage Enhancements

- **Remains critical to ensure that there is no paging in DB2 address spaces**
- **Focus changes from virtual memory constraints & monitoring to real memory constraints & monitoring**
  - See (PM24723) for real storage monitoring and contraction enhancements – advised not to go into production without this!
- **Ensure use of PGFIX=YES to exploit 1MB real storage frames**
  - Many customers still haven't exploited this feature in their DB2 8 and DB2 9 systems – significant CPU savings!
  - Support for 1MB non page-fixed bufferpools in future release
- **Ensure you are up to date on z/OS maintenance before using 1MB pages**
  - OA31116, OA33702, OA33529, check for others.

Latch contention reduction

- **Latch: DB2 mechanism for controlling concurrent events or the use of system resources**
  - Reported in accounting and statistics traces
  - Latch wait time can be significant for high-volume environments
- **DB2 10 reduces latch contention for a large number of situations, including:**
  - LC12: Global Transaction ID serialization
  - LC14: Buffer Manager serialization
  - LC19: Log write in both data sharing and non data sharing
  - LC24: EDM thread storage serialization
  - LC24: Buffer Manager serialization
  - LC27: WLM serialization latch for stored procedures and UDF
  - LC32: Storage Manager serialization
  - IRLM: IRLM hash contention
  - CML: z/OS Cross Memory Local suspend lock
  - UTSERIAL: Utility serialization lock for SYSLGRNG (removed in NFM)

Catalog Concurrency

- **Contention on DB2 catalog is a major ongoing pain for most large DB2 customers**
- **DB2 10 introduces UTS PBG format for catalog tablespaces in NFM**
  - Internal hashes and links are removed during ENFM processing
  - Use of row-level locking and reordered row format
  - Use of new currently committed semantics and other lock avoidance techniques
  - SMS pre-reqs for migration
- **Greatly improves access to catalog/directory**
  - REORG SHRLEVEL(CHANGE) for complete catalog/directory
  - BIND concurrency much improved, but more work required in future releases – especially with heavy parallel DDL against different databases

Catalog Contention Issues

- **Be prepared for some short-term degradation on entry to CM for single-thread BIND/REBIND processes, until you get to NFM**
  - PLANMGMT=EXTENDED the default, so multiple copies of access plan kept in catalog
  - New indexes are defined, in preparation for hash links to be removed in NFM
  - No concurrency improvement until catalog restructure in ENFM
  - Redbook testing showed REBIND elapsed time increases CPU increases of 50-70%

SMF compression

- **High transaction volume usually means high SMF volume, which can become a limiting factor**
- **Some customers forced to switch off useful accounting data, or resort to SMF rollup (via ACCUMACC ZPARM)**
- **New SMF compression feature can provide increased throughput due to I/O efficiency improvement**
  - Uses z/OS compression service to deliver approx. 60%-90% compression for 1% CPU cost

SMF compression

- Enabled via new SMFCOMP DSNZPARM (member scope)
- All data after SMF header is compressed
- Needs vendor support to allow compressed SMF records to be processed
- New sample DSNTSMFD application to uncompress SMF data (via PM27872)
- Can be used in conjunction with accounting rollup to achieve up to 99% reduction

Other scalability enhancements

- **Others enhancements in DB2 10**
  - SPT01 restructured: split into several pieces with LOBs used for larger package sections
    - Inlined BLOB with PM27811 for performance
    - Reported in **–DIS GROUP DETAIL**
  - Workfile enhancements: support for spanned records to increase maximum record length, better use of in-memory workfiles, use of PBG tablespaces
  - Support for Extended Address Volumes: EAVs theoretically allow up to 221TB per volume (223GB in z/OS 1.10)
  - Decrease dataset allocation/deallocation times: using new function in z/OS 1.12 DB2 startup/shutdown times can be improved

Other scalability enhancements

- **Concurrency**
  - Access Currently Committed
    - With UPDATE / DELETE workloads
  - XML storage restructure (Multi-Versioned Format)
- **Index Enhancements**
  - Parallel Index Maintenance
    - For tables with 3 or more indexes
    - Measures 50% ET reduction during the beta
      - Table with 6 indexes, during 2000 INSERTs
  - INCLUDE Columns
    - Added columns to unique indexes
      - Not part of the unique constraint
      - Enhance index only access
      - Eliminate some indexes
  - Sequential INSERT improvements in DB2 9 & 10

Other scalability enhancements

- **Multirow Operations for Data Sharing**
  - LRSN changes for Multirow Insert
- **LOBs**
  - Streaming & INLINE(ing)
- **Hash Organization**
  - Use caution in determining the right table candidates
  - Significant savings given the correct workload
    - Performance Redbook reports 13 – 37% CPU savings, slightly less if the application was getting index only access
- **Optimization / Operation**
  - Literal Replacement
  - Dynamic Index List Prefetch for disorganized indexes

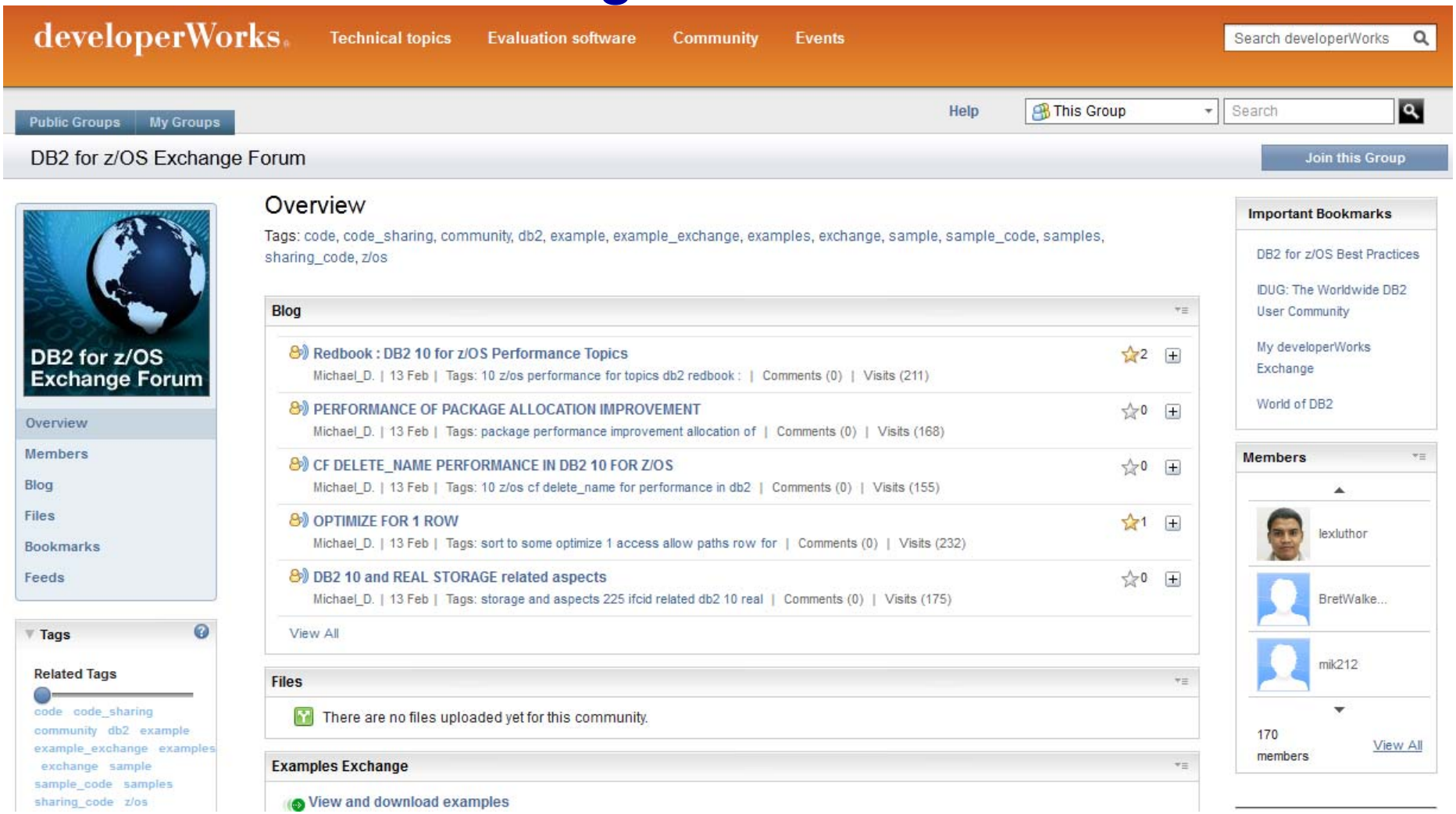
Other scalability enhancements

- **Additional zIIP Exploitation**
  - Buffer operations
    - Prefetch
    - Deferred Write
  - RUNSTATS
    - Simple statements
  - DB2 9 added
    - Native SQL Procedures called remotely
    - zIIP exploitation for DFSort for Utilities
    - XML Serialization / Parsing

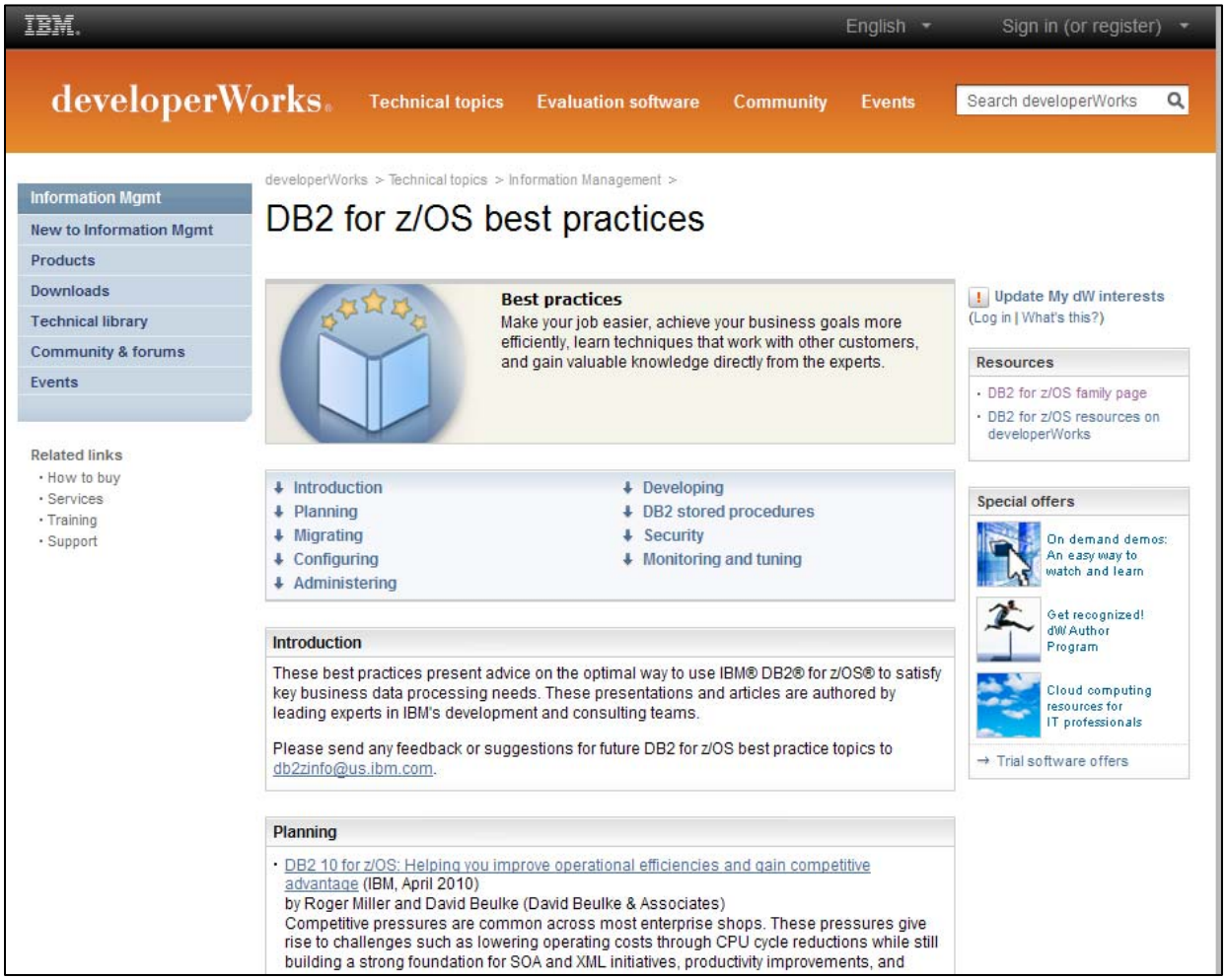
Summary

- **DB2 10 delivers some very significant enhancements for increasing throughput, supporting more users and reducing planned downtime**
  - Many of these enhancements available in Conversion Mode (CM)
- **Remember that sufficient real storage is needed to back any increase in virtual**
- **If you are still on DB2 V8, remember that support ends in April 2012**
  - DB2 9 EOS announced for June 2014

DB2 for z/OS Exchange



DB2 for z/OS Best Practices



https://www.ibm.com/developerworks/data/bestpractices/db2zos/