DB2 for z/OS: Data Sharing Technical Deep Dive

Session 17006

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IBM – DB2 for z/OS
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Assumptions

• This is a technical discussion of DB2 for z/OS Data Sharing topics
• The audience should be familiar with DB2 for z/OS Data Sharing concepts, behavior and benefits, based on
  • Experience with a data sharing environment
  • Recent data sharing education
  • DB2 for z/OS publications or Redbooks®
    – Flexible capacity
    – Scalability
    – High availability
    – Dynamic workload balancing
Acronyms

- **CF** – Coupling Facility LPAR
  - ICF – Integrated CF, aka Internal CF
- **CFRM** – CF Resource Management, definitions in CFRM policy
- **CFCC** – CF Control Code
- **CF Links** – connectivity between CF LPAR and ‘host’ CECs
  - ISC – fiber links, medium to long distance
  - ICB – copper links, very short distance
  - PSIFB - InfiniBand® links, short (12X IB) to long (1X IB) distance
  - IC – internal, microcode links for ICFs
- **XCF** – Cross-System Coupling Facility – communication between CECs
- **XES** – Cross-System Extended Services, z/OS component that manages CFs
Agenda

• DB2 Data Sharing
  – Configurations
  – Standard CF interaction
  – Performance monitoring
  – Auto Alter

• Workload growth
  – Lock structure
  – GBPs
  – Changes in configuration
    • CF considerations

• What’s New in DB2 10 and DB2 11
DB2 Data Sharing Starting Configuration

• Starting with DB2 V4
DB2 Data Sharing: Usual Configuration

• Introduction of ICF

  – SCA and LOCK1 on external CF; isolated from DB2 and IRLM members
  – Duplexed GBPs spread across CF01 and ICF2
DB2 Data Sharing: 2-ICF Configuration

- Reduced number of CEC footprints
- Risk of ‘double failure’: DB2 and SCA, IRLM and LOCK1
  - If structure and exploiter fail, other members fail, too.

- Duplexed SCA and LOCK1 strongly recommended in this configuration
  - DB2B remains active, even if CEC on left is lost
  - Additional cost: host CPU, CF CPU, and CF link busy
Data Sharing: Locking

- Global locking using Parallel Sysplex® coupling technology
  - Inter-system concurrency control

- Cost of obtaining lock does not increase when adding 3rd through nth members
- This example assumes no contention
Notes: Lock Structure (LOCK1)

• Used by IRLM to manage global locking

• Holds L-locks and P-locks
  – L-locks to track concurrency
    • Parent L-locks: e.g. table space intent locks
    • Child L-locks: page or row locks
    • Others…
  – P-locks to track coherency. Examples:
    • Page set P-locks: table space, partition, index, index partition
    • Page P-locks: data page (RLL), index leaf page, space map page
    • Others…

• Consists of a lock table (hash table) and a modify lock list
  – Lock table controls access to resources
    • One entry can record multiple readers and one updater (owner)
  – Modify lock list contains detailed information for update-type locks
    • Entries become retained locks in case of an IRLM or DB2 failure
Lock Structure (LOCK1)

- Simplified view

Modify Lock List

- DB2A Tab1 Page 23 Row 2
- DB2B Tab2 Page 37

Lock Table

- ‘S’ lock: several readers
- ‘X’ lock owner: DB2A
- ‘X’ lock owner: DB2B

Modify Lock List entries (RLE) record info for update-type locks
(U, X, IX, SIX)

Lock Table Entries (LTE) correspond to hash classes

* Examples

Complete your session evaluations online at www.SHARE.org/Seattle-Eval
Data Sharing: Managing changed data

- Inter-system buffer coherency control
  - Example: DB2A has write interest in the table space, and page P1 is in DB2A's buffer pool

  ![Diagram showing inter-system buffer coherency control](image)

  - Cross-invalidate (XI) to other member without interrupt

Complete your session evaluations online at www.SHARE.org/Seattle-Eval
Notes: Group Buffer Pools (GBPs)

- DB2 uses GBPs to
  - Manage buffer coherency
  - Cache changed pages
    - Optionally cache read-only pages

- GBP consists of directory entries and data elements
  - Directory entries manage coherency by tracking interest in a data or index page by any DB2 member in the data sharing group
    - There is one directory entry for each page in the aggregate pool, no matter how many DB2 members have a copy of that page
  - Data elements are the cached pages that a DB2 member changed
  - In GBP duplexing, data elements exist in both the primary and secondary GBP
    - Directory entries in secondary GBP only exist for the changed pages
Group Buffer Pool (GBP)

- Simplified view

DSNDB20_GBP2

<table>
<thead>
<tr>
<th>Data Elements</th>
<th>Directory Entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Page 1</td>
<td>TS A Pg 1 1011 x y u</td>
</tr>
<tr>
<td>Page 13</td>
<td>TS A Pg 13 1111 z w v s</td>
</tr>
<tr>
<td>Page 27</td>
<td>TS B Pg 27 0001 t</td>
</tr>
</tbody>
</table>
GBP Duplexing

- **DSNDB20_GBP2** – Primary; “Old” on CF01

  - Data Elements
  - Directory Entries

- **DSNDB20_GBP2** – Secondary; “New” on ICF2

  - Data Elements
  - Directory Entries
Monitoring LOCK1

- RMF CF Activity Report
  - Structure Summary

<table>
<thead>
<tr>
<th>STRUCTURE SUMMARY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>LOCK</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
Notes: Key Points – LOCK1 Structure Summary

• Size can be an issue
  – Determines the number of Lock Table entries (LTE) and space for Modify Lock List entries (RLE)

• Requests per second is important
  – “Busy” is relative; < 5K/sec is not very busy
  – Observed: 166K/sec – very busy

• LIST/DIRECT ENTRIES = Modify Lock List entries (RLE)

• LOCK ENTRIES = 2-byte Lock Table entries (LTE)
  – May be 4- or 8-byte entries if > 7 members in the data sharing group
  – IRLM automatically rebuilds the lock structure when the 8th member (4-byte entries) or 23rd member (8-byte entries) joins the data sharing group
### RMF CF Activity Report

#### Structure Activity

<table>
<thead>
<tr>
<th>Structure Name</th>
<th>Type</th>
<th>Status</th>
<th># Req</th>
<th>Total</th>
<th># of % of Delayed Requests</th>
<th>External Request</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSNDB2P_LOCK1</td>
<td>LOCK</td>
<td>ACTIVE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SYSTEM NAME**

<table>
<thead>
<tr>
<th>Name</th>
<th>Avg/Sec</th>
<th>Sync</th>
<th>Async</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYSA</td>
<td>567K</td>
<td>523K</td>
<td>44K</td>
</tr>
<tr>
<td>SYSB</td>
<td>916K</td>
<td>853K</td>
<td>62K</td>
</tr>
</tbody>
</table>

**Structure Activity Details**

<table>
<thead>
<tr>
<th>Name</th>
<th>Avg/Sec</th>
<th>Sync</th>
<th>Async</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYSA</td>
<td>567K</td>
<td>523K</td>
<td>44K</td>
</tr>
<tr>
<td>SYSB</td>
<td>916K</td>
<td>853K</td>
<td>62K</td>
</tr>
</tbody>
</table>

**Change Details**

- **SYSA**: CHNGD 0, INCL IN ASYNC PR CMP 0
- **SYSB**: CHNGD 0, INCL IN ASYNC PR CMP 0

**Cont. Details**

- **SYSA**: FALSE CONT 742
- **SYSB**: FALSE CONT 705

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3/5/2015
# REQ TOTAL
- These are requests on the subchannel
  - Compare with EXTERNAL REQUEST CONTENTIONS: REQ TOTAL, which reflects API requests to XES and should be the higher number

- SERV TIME(MIC) – service time in microseconds
  - SYNC is key metric – ‘good’ number is relative to CF configuration
    - If ASYNC is non-zero it could be ‘block unlock’, or some requests were converted, either due to subchannel busy or heuristic algorithm

- CONT and FALSE CONT
  - Contention - recommend: CONT/REQ TOTAL < 2%
  - False Contention - recommend: FALSE CONT/REQ TOTAL < 1%
    - If higher, adjust size of LOCK1 to double size of Hash Table
Heuristic Algorithm and LOCK1

- Most LOCK1 requests are synchronous CF requests
  - Synchronous CF request means host CP is busy for duration of request
  - Long synchronous service times = high host CPU overhead

- XES can convert synchronous request to asynchronous
  - Heuristic algorithm based on measured lock service times
  - Host CP can now do other work during CF request
  - There is some host CP cost to setting up asynchronous request
  - Also elapsed time impact on lock requests
### Structure Summary

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>TYPE</th>
<th>NAME</th>
<th>STATUS</th>
<th>CHG</th>
<th>ALLOC SIZE</th>
<th>% OF CF</th>
<th># OF REQ</th>
<th>% OF ALL REQ</th>
<th>% OF CF UTIL</th>
<th>AVG REQ/SEC</th>
<th>LST/DIR ENTRIES</th>
<th>DATA ELEMENTS</th>
<th>LOCK ENTRIES</th>
<th>DIR REC/ENTRIES</th>
<th>XI'S</th>
</tr>
</thead>
<tbody>
<tr>
<td>CACHE</td>
<td></td>
<td>DSNDB2P_GBP0</td>
<td>ACTIVE</td>
<td></td>
<td>34M</td>
<td>0.3</td>
<td>529</td>
<td>0.0</td>
<td>0.0</td>
<td>0.59</td>
<td>29K</td>
<td>5732</td>
<td>N/A</td>
<td>0</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>DSNDB2P_GBP1</td>
<td>ACTIVE</td>
<td></td>
<td>501M</td>
<td>4.1</td>
<td>18380</td>
<td>0.1</td>
<td>0.0</td>
<td>20.41</td>
<td>494K</td>
<td>82K</td>
<td>N/A</td>
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<td></td>
<td></td>
<td>DSNDB2P_GBP16K0</td>
<td>ACTIVE</td>
<td></td>
<td>8M</td>
<td>0.1</td>
<td>120</td>
<td>0.0</td>
<td>0.0</td>
<td>0.13</td>
<td>1596</td>
<td>1270</td>
<td>N/A</td>
<td>0</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>DSNDB2P_GBP16K1</td>
<td>ACTIVE</td>
<td></td>
<td>32M</td>
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<td>42641</td>
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<td>0.0</td>
<td>47.35</td>
<td>50K</td>
<td>2876</td>
<td>N/A</td>
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<td></td>
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<td>DSNDB2P_GBP2</td>
<td>ACTIVE</td>
<td></td>
<td>2G</td>
<td>16.8</td>
<td>8681</td>
<td>0.1</td>
<td>0.0</td>
<td>9.64</td>
<td>1236K</td>
<td>412K</td>
<td>N/A</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DSNDB2P_GBP3</td>
<td>ACTIVE</td>
<td></td>
<td>8M</td>
<td>0.1</td>
<td>94</td>
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<td>0.0</td>
<td>0.10</td>
<td>6008</td>
<td>1201</td>
<td>N/A</td>
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<tr>
<td></td>
<td></td>
<td>DSNDB2P_GBP32K</td>
<td>ACTIVE</td>
<td></td>
<td>10M</td>
<td>0.1</td>
<td>132</td>
<td>0.0</td>
<td>0.0</td>
<td>0.15</td>
<td>840</td>
<td>1344</td>
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<tr>
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<td>DSNDB2P_GBP32K1</td>
<td>ACTIVE</td>
<td></td>
<td>16M</td>
<td>0.1</td>
<td>120</td>
<td>0.0</td>
<td>0.0</td>
<td>0.13</td>
<td>1438</td>
<td>2862</td>
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<tr>
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<td></td>
<td>DSNDB2P_GBP5</td>
<td>ACTIVE</td>
<td></td>
<td>256M</td>
<td>2.1</td>
<td>358</td>
<td>0.0</td>
<td>0.0</td>
<td>0.40</td>
<td>521K</td>
<td>13K</td>
<td>N/A</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Complete your session evaluations online at [www.SHARE.org/Seattle-Eval](http://www.SHARE.org/Seattle-Eval)
Notes: Key Points – GBPs Structure Summary

- Size and requests per second important
- LIST/DIR ENTRIES = directory entries
- DATA ELEMENTS = data pages
  - If current directory entries = current data pages, probably secondary GBP (GBP duplexing)
    - Could also be the effect of Auto Alter
- DIR REC/DIR REC XI’S = directory reclaims / cross-invalidations (XI’s) due to directory reclaims
  - Should be zero! Investigate if non-zero, especially XI’s
    - If DIR REC XI’S non-zero, potential performance impact
  - CF report does not have directory reclaim details
    - Use –DIS GBPOOL GDETAIL
### RMF CF Activity Report

#### Structure Activity

<table>
<thead>
<tr>
<th>System Name</th>
<th>Total #</th>
<th>Total AVG/SEC</th>
<th>% of Total</th>
<th>% of Avg</th>
<th>Avg Serv Time (MIC)</th>
<th>Delayed Requests</th>
<th>% of Delayed</th>
<th>Avg Time (MIC)</th>
<th>Delayed Avg Time (MIC)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SYNCH</td>
<td>19</td>
<td>0.1</td>
<td>12.0</td>
<td>6.8</td>
<td>NO SCH</td>
<td>34</td>
<td>0.3</td>
<td>853.4</td>
<td>837.8</td>
</tr>
<tr>
<td>ASYNCH</td>
<td>12K</td>
<td>67.6</td>
<td>73.2</td>
<td>297.3</td>
<td>PR WT</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>CHNGD</td>
<td>0</td>
<td>0.0</td>
<td>INCLUDED IN ASYNCH</td>
<td>PR CMP 0</td>
<td>0.0</td>
<td>0.0</td>
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<td>0.0</td>
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<tr>
<td>DUMP</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>SYSB</td>
<td>54</td>
<td>54</td>
<td>54.9</td>
<td>100</td>
<td>NO SCH</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td>ASYNCH</td>
<td>5887</td>
<td>32.0</td>
<td>34.7</td>
<td>235.9</td>
<td>PR WT</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td>CHNGD</td>
<td>0</td>
<td>0.0</td>
<td>INCLUDED IN ASYNCH</td>
<td>PR CMP 0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
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<td>0.0</td>
</tr>
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<td>DUMP</td>
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<td>0.0</td>
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<tr>
<td>TOTAL</td>
<td>18380</td>
<td>63</td>
<td>41.9</td>
<td>205.9</td>
<td>NO SCH</td>
<td>34</td>
<td>0.2</td>
<td>853.4</td>
<td>837.8</td>
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</table>

**Secondary GBP**

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3/5/2015
### RMF CF Activity Report

#### Structure Activity

<table>
<thead>
<tr>
<th>Structure Name</th>
<th>Type</th>
<th>Status</th>
<th># Req</th>
<th>Avg/sec</th>
<th>% of All</th>
<th>Avg Serv Time (MIC)</th>
<th>Reason</th>
<th>% of Req</th>
<th>Delayed #</th>
<th>Avg Time (MIC)</th>
<th>Std_DEV</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSNDB2P_GBP1</td>
<td>CACHE</td>
<td>ACTIVE</td>
<td>599K</td>
<td>565.9</td>
<td>90.9</td>
<td>16.6 66.7</td>
<td>NO SCH</td>
<td>0.2</td>
<td>1266</td>
<td>2665</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>

*Primary GBP*

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*Complete your session evaluations online at www.SHARE.org/Seattle-Eval*
Notes: Key Points – GBPs Structure Activity

• SERV TIME(MIC)
  – SYNC is key metric – ‘good’ number is relative to CF configuration
    • If REQ/SEC < 100, variations in service time probably not significant
      – ASYNC requests are expected, especially in secondary GBPs
  – XI’s in lower right are not necessarily reclaims
    • Most likely business as usual
Monitoring GBPs: -DIS GBPOOL

- DIS GBPOOL(*) TYPE(GCONN) GDETAIL(*)
  - Contains status and definition information as well as statistics
  - Reports statistics since GBP allocation

- DIS GBPOOL(*) TYPE(GCONN) GDETAIL( INTERVAL )
  - To monitor an interval, execute this command before and after the desired interval.
  - Output messages from second command will show GBP statistics for the interval

- Typical problems due to incorrectly defined GBP
  - Directory entry reclaims
  - XIs due to directory entry reclaims
  - Writes failed due to lack of storage
07.57.32 STC34822 DSNB784I -DB2A GROUP DETAIL STATISTICS 362
362 READS
362 DATA RETURNED = 1842830
07.57.32 STC34822 DSNB785I -DB2A DATA NOT RETURNED 363
363 DIRECTORY ENTRY EXISTED = 1490516
363 DIRECTORY ENTRY CREATED = 9995482
363 DIRECTORY ENTRY NOT CREATED = 26712646, 0
07.57.32 STC34822 DSNB786I -DB2A WRITES 364
364 CHANGED PAGES = 50473770
364 CLEAN PAGES = 3408467
364 FAILED DUE TO LACK OF STORAGE = 48
364 CHANGED PAGES SNAPSHOT VALUE = 5568
07.57.32 STC34822 DSNB787I -DB2A RECLAIMS 365
365 FOR DIRECTORY ENTRIES = 80726
365 FOR DATA ENTRIES = 28878053
365 CASTOUTS = 28679918
07.57.32 STC34822 DSNB788I -DB2A CROSS INVALIDATIONS 366
366 DUE TO DIRECTORY RECLAIMS = 56680
366 DUE TO WRITES = 2666240
366 EXPLICIT = 0
07.57.32 STC34822 DSNB762I -DB2A DUPLEXING STATISTICS FOR GBP11-SEC 367
367 WRITES
367 CHANGED PAGES = 50072797
367 FAILED DUE TO LACK OF STORAGE = 48
367 CHANGED PAGES SNAPSHOT VALUE = 5568
Notes: Sizing CF Structures

  - CF Structure Sizer Tool
- *DB2 Version 9.1 for z/OS Installation Guide*, GC18-9846
- *DB2 10 for z/OS Installation and Migration Guide*, GC19-2974
- *DB2 11 for z/OS Installation and Migration Guide*, GC19-4056
  - Knowledge Center: [cf sizing for DB2 10 or 11](#)
- Rule of thumb for GBPs
  - Start with CFSizer INITSIZE
  - Round up
  - Make that result INITSIZE; make SIZE at least 20% larger than INITSIZE
    - But no larger than 2 times INITSIZE
  - Use Auto Alter
Auto Alter – What is it?

• Autonomic effort by XES to avoid filling up any kind of structure. For GBPs:
  – If all data elements (pages) are changed, writes cannot occur
  – If all directory entries are marked changed, new pages cannot be registered
• Auto Alter has algorithms that
  – can increase or decrease number of entries and/or elements to avoid structure full conditions
  – can increase or decrease the size of the structure
• Can alter, dynamically, the precise directory to data ratio for GBPs
• Design point is for gradual growth, not spikes
Auto Alter and DB2

• DB2 Structures support Auto Alter
• LOCK1 – effective on Modify Lock List entries (RLEs)
  – Lock Table entries (LTE) cannot be changed without a rebuild
• SCA – can be increased
• Main value is for Group Buffer Pools (GBPs). Why?
  – People tend not to tune GBPs
    • Organizational division of labor
      – DB2 DBAs responsible for local BPs – may forget about GBPs
      – z/OS responsible for GBPs – and they own the CFRM Policy
  – DB2 needs ?? more directory entries than data page elements
  – Each –ALTER to change directory entries means manual GBP rebuild
• Works for duplexed GBPs
Auto Alter – When not to use it

• CF available storage is <10%
  – Auto Alter reduces the size of “alterable” structures below INITSIZE (to MINSIZE), attempting to get 10% available storage in the CF

• Not enough storage for size of structure, especially in Test environments
  – XES reaches SIZE quickly
  – Reclaim avoidance results in constant XES attempts to increase directory entries and reduce data pages
  • Reclaim avoidance alone does not allow structure size increase
    – Attempts usually fruitless - produce alarming console messages
    – Hint: test one structure, correctly sized, instead of all
Workload Growth

- Increased transaction, batch and/or query volumes
- New applications
- Mergers
- New business opportunities
- Regulatory compliance
- Technology advances
Workload Changes and LOCK1

• Increased lock requests may lead to
  – Higher CF CPU busy
  – Higher synchronous service time, and host CPU cost
  – Higher transaction or query elapsed time, higher job run time

• New applications may not follow standards
  – Less lock avoidance by new applications may mean more locking for existing applications
  – Long commit scopes hold Modify Lock List entries (RLEs) longer
  – Row level locking increases demand for RLEs

• False contention could increase, requiring more Lock Table Entries (LTEs)
Workload Changes and LOCK1

- Possible solutions
  - Increase CF CPU capacity
    - More CPs and/or faster CPs
  - Increase the number of RLEs
    - SETXCF START,ALTER,strnm=&,SIZE=& to increase the size of LOCK1
      - Assumes allocation < SIZE in CFRM policy
      - Else change CFRM policy definition, rebuild structure
  - Increase the number of LTEs
    - Requires a structure rebuild with larger allocation
      - CFRM policy change required if allocation already = SIZE
    - CF storage increase unlikely to be necessary in a production environment
## LOCK1 Example

### RMF CF Activity Report

#### Structure Activity

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>TYPE</th>
<th>STATUS</th>
<th>STRUCTURE NAME</th>
<th>REQUESTS</th>
<th>DELAYED REQUESTS</th>
<th>EXTERNAL REQUEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVG/SEC</td>
<td>AVG</td>
<td>STD_DEV</td>
<td>REQ</td>
<td>ALL</td>
<td>AVG</td>
<td>STD_DEV</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>SYNC</strong></td>
<td><strong>ASYNC</strong></td>
<td><strong>CHNGD</strong></td>
<td><strong>-FALSE CONT</strong></td>
<td><strong>TOTAL</strong></td>
<td><strong>SYNC</strong></td>
</tr>
<tr>
<td><strong>232M</strong></td>
<td><strong>SYNC</strong></td>
<td><strong>232M</strong></td>
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<td><strong>5.8</strong></td>
<td><strong>NO SCH</strong></td>
<td><strong>88K</strong></td>
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<tr>
<td><strong>64403</strong></td>
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<td><strong>413.5</strong></td>
<td><strong>PR WT</strong></td>
<td><strong>0.0</strong></td>
</tr>
<tr>
<td><strong>CHNGD</strong></td>
<td><strong>0</strong></td>
<td><strong>0.0</strong></td>
<td><strong>INCLUDED IN ASYNC</strong></td>
<td><strong>PR CMP</strong></td>
<td><strong>0</strong></td>
<td><strong>0.0</strong></td>
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<tr>
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<td><strong>0.0</strong></td>
<td><strong>0.0</strong></td>
<td><strong>PR WT</strong></td>
<td><strong>0</strong></td>
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<td><strong>87.7</strong></td>
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<td><strong>0</strong></td>
</tr>
<tr>
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<td><strong>249.4</strong></td>
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<td><strong>PR CMP</strong></td>
<td><strong>0</strong></td>
</tr>
</tbody>
</table>

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Workload Changes and GBPs

• Increased GBP requests may lead to
  – Higher CF CPU busy
  – Higher synchronous service time, and host CPU cost
  – Higher transaction or query elapsed time, higher job run time
• New applications may
  – Change access patterns of existing tables or indexes
  – Add tables and indexes to existing buffer pools
• Local buffer pool allocations may increase
  – GBPs might be forgotten
Workload Changes and GBPs

• Possible solutions
  – Increase CF CPU capacity
  • More CPs and/or faster CPs
  – Increase the size of the GBPs
  – Tune local buffer pool thresholds and GBP thresholds
  – CF storage increase may be necessary
GBPs and Impact of CF Busy

- ICF has two CPs
- CF (external) has three CPs

![Graph showing CF Busy and GBP Service Time]
GBPs and Impact of CF Busy, cont.

• GBP1 on ICF was very busy over a 10 hour interval
  – S1: 178 M synchronous requests
  – S3: 144.5 M synchronous requests
  – If 10 µsec saved from each request, over 300 CPU seconds per hour of ‘host effect’ could be saved from GBP1 alone

• How could 10 µsec be saved?
  – Increase number of CPs on ICF to reduce CF busy and improve service time
  – Upgrade CEC with ICF to reduce CF service times
Workload Changes and SCA

- New applications or new workloads may add tables and indexes
- New clients may require additional databases
- Auto Alter may be able to handle most of the increase
- Use CF Structure Sizer Tool to validate CFRM policy definition
When New Members Join the Data Sharing Group

• GBP – review sizes
  – Increased demand for directory entries and data elements
  – Auto Alter alone may not be sufficient to handle multiple new members

• LOCK1
  – 4-byte LTEs required when 8th member joins the group
    • Automatic rebuild will normally result in half as many LTEs, so false contention will increase
    • Prepare for larger LTEs before adding 8th member
  – 8-byte LTEs required when 23rd member joins the group
    • Automatic rebuild has same considerations
Configuration Changes

• CF Considerations
  – Balanced performance: CF technology = CEC technology
  – Unbalanced configuration examples:
    • zEC12 CF and z196 CEC – good for the CEC
    • z196 CF and zEC12 CEC – more Host Effect cost to CEC
    • z10 CF and zEC12 CEC – ‘heuristic algorithm’ likely to convert many synchronous requests to asynchronous
      – Algorithm represents tradeoff of host effect versus cost of conversion
      – Elapsed times, contention, and time outs likely to increase
  – Increase in distance between CF and CEC can have similar effect
    • Asynchronous conversion frequently observed as distance between CEC and CF increases
Creative Use of CF Storage

- As more DB2 members join the group
  - Consider GBPCACHE ALL
    - Each page is read into GBP on first access
    - Only one member incurs I/O cost for each page
    - Local buffers can be smaller – GBP acts as very fast cache

- If large objects with very random access and minimal page re-reference
  - Consider GBPCACHE NONE
    - Saves GBP access on local page miss
    - Enforces ‘store through cache’: synchronous writes to disk at commit
      - Modern cache controllers minimize negative impact
DB2 10 for z/OS
Data Sharing Highlights
DB2 10 for z/OS and Data Sharing

- Deleting member of data sharing group
  - Offline utility
- Deleting structures during group restart
  - DEL_CFSTRUCTS_ON_RESTART - DSNZPARM for DR
- Sub-group attach
- DDF Restart Light – handle indoubts
- MEMBER CLUSTER for UTS
- -MODIFY DDF – online changes for LOCATION ALIAS

- LRSN spin avoidance
- IFCID 359 – index split
- GBP DELETE_NAME processing
- BP scan avoidance
DB2 11 for z/OS
Data Sharing Highlights
DB2 11 for z/OS Data Sharing Enhancements

- Castout enhancements: New CLASST setting – similar to VDWQT
- RESTART LIGHT Enhancements
- Buffer pool enhancements

- GBP Write-around
  - If GBP / CF busy, write new pages to directly to disk
  - Reduce impact of flood of new pages on rest of GBP
- Automatic LPL or GRECP recovery
- CF DELETE_NAME
- Locking enhancements
- Index split performance
- LRSN spin avoidance – extended LRSN
Additional Resources

• *Data Sharing: Planning and Administration*
  – DB2 9 for z/OS: SC18-9845
  – DB2 10 for z/OS: SC19-2973
  – DB2 11 for z/OS: SC19-4055
  – KC db2 data sharing planning
Questions?

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Thank you!