

CA IDMS™ Index Tuning

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Abstract

Attendees will learn the physical characteristics that can be assigned to CA IDMS™ indexes and how they impact processing efficiency. They will also become familiar with the CA IDMS utilities that can be used to monitor the health of indexes and those that can be used to tune existing index structures.



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Agenda

- Unique Page Ranges
- Index Block Count (IBC)
- Page Displacement
- Linked vs Unlinked
- Monitoring
- Tuning Operations
- Questions

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Unique Page Ranges

- System owned indexes should always be in their own distinct page range
 - Unique area
 - Distinct sub-page range within an area
- Including an index in the same page range as other indexes or record types tends to nullify the effects of the tuning options available to an index
- Only small or very static indexes should be included in a page range with other records or indexes
- User-owned indexes will always be in the same page range as the set's owner record

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Index Block Count (IBC)

- The IBC determines the maximum number of entries within an SR8 and thereby the maximum size of an SR8 within the index
- Considerations for selecting the index's IBC are
 - Number of levels in the index
 - Potential conflicts
 - SR8 size relative to the index area's page size

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IBC – Index Levels

- As a general rule, indexes should contain 3 to 5 levels
- Fewer levels will generally reduce the number of SR8 records accessed by a binary search and will result in larger IBC values
- A large part of the work done against some indexes just uses level-0 SR8 records and does not perform as many binary searches as anticipated so more levels may be acceptable

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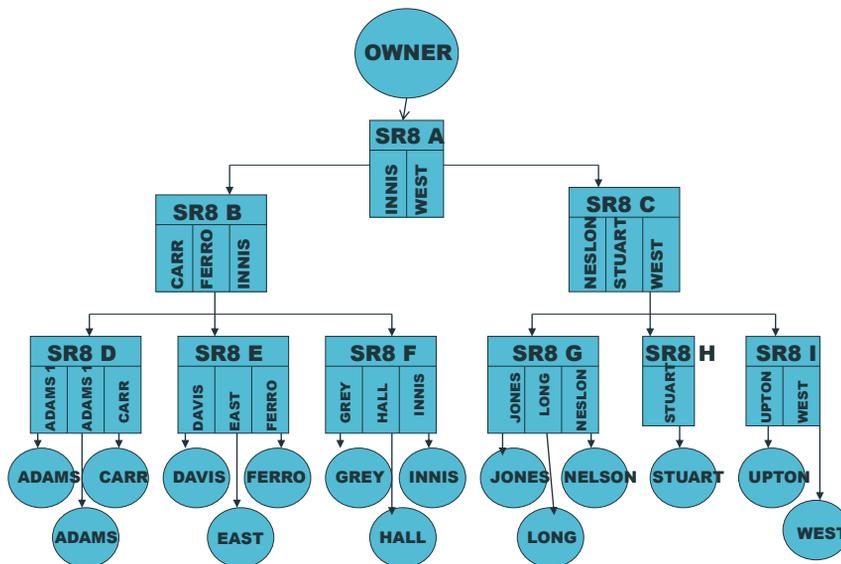


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IBC – Index Levels



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IBC – Potential Conflicts

- SR8 records are subject to record locks just as any other database record
- Indexes with very large IBC values may be subject to a greater possibility of DBKEY record lock conflicts, especially if there are 'hot spots'
- Consider reducing an index's IBC if DBKEY wait messages indicate SR8 records are involved

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IBC – Index Area Page Size

- Never assign an IBC such that 3 SR8 records fit on a page
 - It can cause serious performance problems related to SMP processing
- 4 or 5 SR8 records per page are a common practice
- 1 or 2 SR8's might be acceptable if the index contents are very static and the bulk of processing is serially walking the index

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SR8 Page Displacement

- Level 0 and intermediate SR8s are stored differently on the database
- PAGE DISPLACEMENT provides for the segregation of Level 0 and intermediate SR8 records within the index's page range
- Segregation of the two types of SR8 records results in a better utilization of space and helps reduce excessive SR8 splitting

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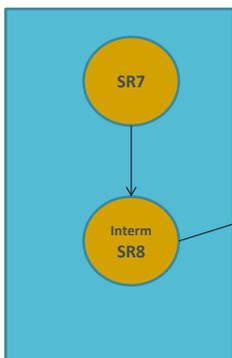
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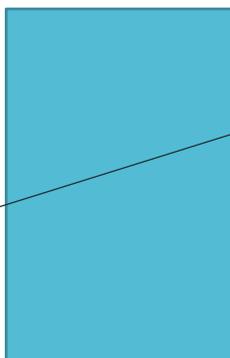
SR8 Page Displacement

- BLOCK CONTAINS x KEY DISPLACEMENT IS 2

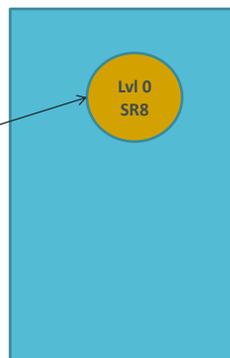
Page 1001



Page 1002



Page 1003



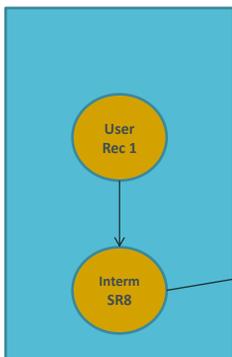
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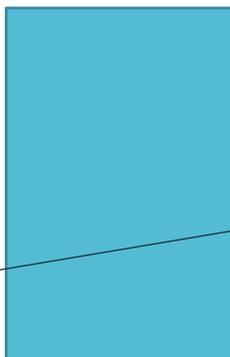
SR8 Page Displacement

- Page Displacement is ineffective for user owned indexes

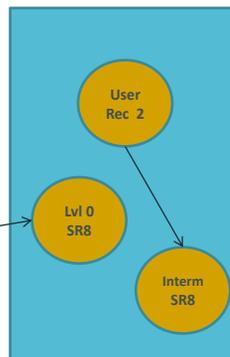
Page 1001



Page 1002



Page 1003



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Linked vs Unlinked Indexes

- When an SR8 splits, orphan records may be created to allow CA IDMS to resolve affected UP pointers in data records or lower level SR8 records
- An unlinked index is an index that does not maintain UP pointers in the data records
- When a Level 0 SR8 splits no orphan data records are created, but orphans in intermediate level SR8 records can still occur

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Linked vs Unlinked Indexes

- In high activity indexes an excessive orphan count can result in an increase in I/O to locate record entries and resolve orphan conditions
- Excessive orphan counts may necessitate the constant need to tune or rebuild indexes
- Making these indexes unlinked can reduce the impact of orphans by eliminating orphan records within the Level 0 SR8 records

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Linked vs Unlinked Indexes

- Unlinked indexes can result in more binary search activity when walking an index
- Static indexes should always be defined as linked since the creation of orphans is minimal and the UP pointer can result in a more efficient navigation of the index

Monitoring

- The best way to monitor the health of an index is to use the SUMMARY option of the PRINT INDEX utility

```
PRINT INDEX REC6-INDEX1 SEGMENT ISPDSMAL USING ISPDSSUB SUMMARY;
SET Name: REC6-INDEX1
  IBC 10                               Displacement  10
  Sort option SORTED SYM DSC           Key length    10
  Duplicates DBKey                      Compression   No
OWNER: SR7
  AREA ISPDSMAL.INDEX-AREA2           Low Page (SUB- 310497
  Page size 4276                       High page AREA) 310550
MEMBER: ISP-RECORD6                   Set membership  Mandatory Automatic
  Located VIA index Yes Displ't 0      Index is       Linked
  AREA ISPDSMAL.AREA-2                 Low page       310101
  Page size 4276                       High page      310200
```

Monitoring

```
OWNER X'04BD0401' on page 310532
  Top level SR8 on page 310532      utilization  80.0%
Intermediate Level
  Nr of SR8s                        77           37 Minimum
  Nr of pages with SR8s             6           3 Minimum
  Nr of displaced SR8s              0           0.0%
  Nr of entries in use               545        70.7%
  Nr of Orphans                     23         22.5%
  Total size of all SR8s            21252
Bottom Level
  Nr of SR8s                        469         312 Minimum
  Nr of pages with SR8s             14          11 Minimum
  Nr of displaced SR8s              0           0.0%
  Nr of entries in use               3111       66.3%
  Nr of Orphans                     540        17.3%
  Total size of all SR8s            50348
```

Monitoring

```
Index occurrence totals
  Nr of members                      3111
  Nr of levels                        4           4 Minimum
  Size of largest SR8                 276
  Nr of SR8s                          546         349 Minimum
  Nr of pages with SR8s               20          14 Minimum
  Nr of displaced                      0           0.0%
  Nr of entries in use                 3656       66.9%
  Nr of Orphans                       663        18.1%
  Total size of all SR8s              71600

Nr of Buffers versus Estimated IOs for Sequential Bottom Level access
-----
  1                                212
  2                                112
  3                                 81
  4                                 54
  5                                 43
```

Tuning – MAINTAIN INDEX

- The MAINTAIN INDEX utility deletes an existing index structure and builds a new one
- The REBUILD FROM INDEX is the most efficient method and can be used if the integrity of the index structure is assured
- MAINTAIN INDEX must be run in local mode and the index areas must be offline from other CA IDMS access

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Tuning - TUNE INDEX

- Adopts orphans at all levels of the index structure
- Moves the top level SR8 to its optimal location
- Optionally rebalances the index structure
- Optionally resequences the index structure
- Can be executed local or via the CV while other processing is occurring

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REBUILD Tuning Procedure

- When an index is rebuilt the SR8 records are created with the number of entries specified for the index's IBC
- Upon the first insertion of a new entry into an SR8 that SR8 will be split because the SR8 was already at the maximum number of entries
- Index's should be rebuilt using an altered IBC and using a PAGE RESERVE for the index area

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REBUILD Tuning Procedure

- Reduce the IBC used by the index during normal processing to a smaller value
 - For example if the IBC is usually 100 rebuild with an IBC of 90
- Assign a PAGE RESERVE to the index's area equal to the amount of space accounted for by the reduced IBC
 - If an IBC of 90 reduces the size of an SR8 by 100 bytes and you would normally have 5 SR8 records per page use a PAGE RESERVE of 500
- Run the REBUILD or REBALANCE process
- Restore the IBC to its normal value and remove the area's PAGE RESERVE for normal processing

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REBUILD Tuning Procedure

- Using the procedure allows for 10 new entries to be inserted into an SR8 before a split occurs
- REBUILD operations using MAINTAIN INDEX require changes to a DMCL/SUBSCHEMA to use the procedure
- REBALANCE operations using TUNE INDEX can supply the alternate IBC and PAGE RESERVE using utility syntax

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Summary

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