ODD FACTS ABOUT NEW DB2 for z/OS SQL
NEW WAYS OF THINKING ABOUT OLD THINGS
+
STATIC/DYNAMIC SQL CHANGES, PREDICATE APPLICATION
AND LOCKS, LATCHES, CLAIMS, & DRAINS

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• WHAT DOES THE OPTIMIZER CONSIDER?

SQL

SORT SYNTAX & SORT AVOIDANCE

BI-DIRECTIONAL INDEXES

IMPACT OF PI AND NPSI VERSUS DPSI FOR SORT AVOIDANCE

REQUIRED SORT AVOIDANCE? - DYNAMIC SCROLL CURSOR
• WHAT DOES THE OPTIMIZER CONSIDER? continued

SQL

PREDICATE TYPES (STAGE 1 OR STAGE 2)

PREDICATE PUSHDOWN

COLUMN = :HV1 + :HV2

COLUMN COMPARED TO LONGER LITERAL OR HOST VARIABLE

COLUMN COMPARED TO DIFFERENT DATA TYPE
IMPLICIT CASTING VS. EXPLICIT CASTING
• WHAT DOES THE OPTIMIZER CONSIDER?

CATALOG STATISTICAL INFORMATION

CLUSTERRATIO

WITH PARTITIONING/CLUSTER INFO IN INDEX DDL

WITH PARTITIONING INFO IN TABLE DDL & CLUSTER INFO IN INDEX DDL
• INDEX-ONLY ACCESS FOR VARCHAR DATA

SELECT COLB FROM BIGTABLE WHERE COLA = :HVA
INDEX ON COLA, COLB
COLA IS CHAR(30)
COLB IS VARCHAR(40)
COLB WAS “PADDED” IN INDEX AND IN SORT RECORD

NOW COLB CAN BE UNPADDED IN INDEX
BUT IS STILL PADDED IN SORT RECORD
EXAMPLE OF PROBLEM:

SELECT LNAME FROM T1
  WHERE EMPID = :HVEMPID

  INDEX on EMPID, LNAME - - created just for Index-Only

Scene 1:  LNAME DEFINED AS VARCHAR(40)
  LNAME = BAKER
  2-BYTE INDICATOR ON TABLE CONTAINS (5)

What are possible scenarios?
VARCHAR vs. CHAR

- BUT WHAT IF POPULATED INCORRECTLY AT LOAD

BY APPLICATION PROGRAM

LNAME LENGTH IS ALWAYS 40?!??

NO ADVANTAGE TO UNPADDED INDEXES
NO SPACE SAVINGS IN TABLE
NO SPACE SAVINGS IN INDEX
SQL to HELP

TO HELP ESTIMATE SAVINGS
TO DETERMINE CODING/LOADING PRACTICES

1) Select MIN(LENGTH(LNAME)), MAX(LENGTH(LNAME))
   into :HVMIN :HVMININD, :HMAX :HVMAXIND  -- WHY INDICATOR?
   from MYTABLE

   ARE THEY THE SAME?

2) Select LENGTH(LNAME), COUNT(*)
   from MYTABLE
   Group by LENGTH(LNAME)

   ANSWER:
   2       10
   3       15
   4       85
   5       106
   6       110
   7       98
   .       ....
   40      4,673,218

   HOW MANY LNAMEs ARE THERE AT EACH POSSIBLE LENGTH?
VARCHAR vs. CHAR

- **SQL UPDATE TO TRIM TRAILING SPACES AND RESET LENGTH**
  
  ```sql
  UPDATE table
  SET VARCHAR_COL = RTRIM(VARCHAR_COL)
  WHERE ...please use limiting predicates for reasonable UOWs with COMMITS between
  ```

- **V7 UNLOAD**
  
  CAN TRIM TRAILING BLANKS

- **V8/9/10 UNLOAD AND LOAD UTILITIES**
  
  CAN TRIM TRAILING BLANKS

USEFUL IF CONVERTING

- CHAR TO VARCHAR
- VARCHAR TO LONGER VARCHAR
- INCORRECTLY POPULATED TO CORRECTLY POPULATED
• SINGLETON (SEARCHED) SELECT LOCKING CHANGES

CURRENTDATA NOW APPLIES TO SEARCHED SELECTS
MORE LOCK AVOIDANCE
LOCK AVOIDANCE

For UNAmbiguous (V3) & Ambiguous (V4) Read-Only SQL Cursors and Singleton Selects (V8)

- Assume Locksize: Row or Page
  - Readable?
    - Stable?
      - YES (S-Latched)
        - Isolation?
          - UR – TO DATA MANAGER WITH “NO MASS DELETE LOCK”
            - CS
              - NO
                - ASK FOR LOCK
                  - CLEAN?
                    - PG/ROW
                      - YES
                          - DM QUALIFIED?
                            - YES
                                CURRENT DATA?
                                    - NO – Process without asking for a lock
                                      - YES
                                          - ASK FOR LOCK & then process
                                            - NO
                                              - ASK FOR LOCK
                                                - CURRENT DATA?
                                                    - YES
                                                        CURRENT DATA?
                                                            - NO – Process without asking for a lock
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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    - ASK FOR LOCK & then process
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     NO
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  ASK FOR LOCK
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  - CURRENT DATA?
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  YES
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CURRENT DATA?
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  - NO – Process without asking for a lock
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   YES
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    - ASK FOR LOCK & then process
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     NO
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  ASK FOR LOCK
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  - CURRENT DATA?
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  YES
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CURRENT DATA?
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  - NO – Process without asking for a lock
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   YES
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    - ASK FOR LOCK & then process
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     NO
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  ASK FOR LOCK
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  - CURRENT DATA?
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  YES
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  CURRENT DATA?
ODD FACTS

• WHAT IF NO CLUSTER INDEX?

INSERTS?  V7 AND PRIOR = FIRST INDEX CREATED
REORGs?  V7 AND PRIOR = NO CLUSTERING ENFORCED
NOW?  TAIL WAGGED THE DOG!
BUT NEW FEATURE OF REORG IS VERY USEFUL!
PARTITIONING METHODS
&
NEW INDEX TYPES
INDEX PARTITIONING

• PI = PARTITIONING + CLUSTER + ONLY 1 ALLOWED + CAN BE UNIQUE OR NOT
• NPI = NON-PARTITIONING + CAN BE MORE THAN ONE + CAN BE UNIQUE OR NOT

CREATE TABLESPACE TSCUSTMASTER
   NUMPARTS 3
   PART 1
      PRIQTY....
   PART 2
      PRIQTY...
   PART 3...

CREATE TABLE CUSTMASTER... in TSCUSTMASTER

CREATE UNIQUE INDEX PARTINDEX ON CUSTMASTER --- WHY UNIQUE?
   (CUSTNAME, CUSTNO)
   CLUSTER
   PART 1
      PRIQTY...
      VALUE ('G999999999...', 9999999999)
   PART 2
      PRIQTY...
      VALUE ('S9999999999...', 9999999999)
   PART 3...

CREATE INDEX INDEX2 ON CUSTMASTER ------ AN NPI
   (CUSTNAME, LAST_ACT_DT)
   PRIQTY...
V7 partitioning value clause in CREATE INDEX CLUSTER

CUSTNAME, CUSTNO = partitioning & cluster
V8 INDEX TYPES FOR PARTITIONED TABLESPACES

- PI = PARTITIONING = New Way = CAN BE MORE THAN ONE PARTITIONING INDEX
- Any index aligned with (BEGINNING WITH) partitioned column data
- AND any index can be the CLUSTER index

CREATE TABLESPACE TSCUSTMASTER
    NUMPARTS 3 --- NOTE - LOCKPART YES REQUIRED IN V8
    PART 1
    PRIQTY....
    PART 2
    PRIQTY...

CREATE TABLE CUSTMASTER in TSCUSTMASTER
    (CUSTNAME ...
    PARTITIONING CLAUSE HERE!

CREATE UNIQUE INDEX INDEX1 ON CUSTMASTER
    (CUSTNAME, CUSTNO)
    --- PARTITIONING INDEX = PI
    --- A UNIQUE INDEX
    PART 1
    PRIQTY...
    PART 2
    PRIQTY...

CREATE INDEX INDEX2 ON CUSTMASTER
    (CUSTNAME, LAST_ACT_DT)
    --- 2ND PARTITIONING INDEX = PI
    --- A NON-UNIQUE INDEX
    PART 1
    PRIQTY...
    PART 2
    PRIQTY...
V8 partitioned tablespace value clause in CREATE TABLE (CUSTNAME)

Index A = CUSTNAME,CUSTNO = UNIQUE PARTITIONING INDEX

Index B = CUSTNAME,LAST_ACT_DT = NON-UNIQUE PARTITIONING INDEX
V8 INDEX TYPES FOR PARTITIONED TABLESPACES cont.

**DPSI** = DATA PARTITIONED SECONDARY INDEX
Can be more than one
Cannot be physically unique (V9 change)

**NPSI** = NON-PARTITIONED SECONDARY INDEX
Same as old NPI
Can be more than one
Unique is OK

CREATE INDEX INDEX3 ON CUSTMASTER
(ZIPCODE)
--- DATA-PARTITIONED
--- SECONDARY INDEX
--- DPSI
PART 1
PRIQTY...
--- V9 CHANGE: CAN BE UNIQUE IF
PART 2
PRIQTY...
--- ON ZIPCODE, CUSTNAME, CUSTNO
PART 3...

CREATE UNIQUE INDEX INDEX4 ON CUSTMASTER
(CUSTNO)
--- NON-PARTITIONED
--- SECONDARY INDEX
--- NPSI
--- THE UNIQUE INDEX

CLUSTER
PRIQTY...
partitioned tablespace value clause in `CREATE TABLE (CUSTNAME)`

Index A = CUSTNAME, CUSTNO = PARTITIONING INDEX (UNIQUE)

Index B = CUSTNAME, LAST_ACT_DT = PARTITIONING INDEX (NON-UNIQUE)

Index C = ZIPCODE = DATA PARTITIONED SECONDARY INDEX

Index D = CUSTNO = UNIQUE, CLUSTER, NON-PARTITIONED SECONDARY INDEX
PIs, DPSIs, & NPSIs

- PARTITIONING INDEXES

  MAY BE UNIQUE OR NOT

  MAY BE MORE THAN ONE

  IF TS PARTITIONED ON A, B

  INDEX ON ABCDE
  INDEX ON ABQRS
TABLE-CONTROLLED PARTITIONING

CREATE TABLE CUSTOMER
(CUSTNO INTEGER,
CUSTNAME VARCHAR(30),
LAST_ACT_DT DATE,
ZIPCODE SMALLINT)

PARTITION BY (CUSTNAME ASC)
(PARTITION 1 ENDING AT (G9999999999...),
PARTITION 2 ENDING AT (S9999999999...),
PARTITION 3 ENDING AT (Z9999999999... ) Last value is ENFORCED!
);

No indexes are required for partitioning!!

Partitioned Tablespace
Partitioning Indexes

A partitioning index has the same leftmost columns, in the same collating sequence, as the columns which partition the table.

Partitioning Index: A (A1, A2, A3) on (CUSTNAME, CUSTNO)

- **IX A**
  - **PI**
    - TB
      - ADAMS,003029
      - BAKER,123458
      - Chan,102946
      - CLARK,002024
      - DAVIS,456231
      - EVANS,187380
      - GRANT,267334
      - 003029,ADAMS,1998-12-01,13029
      - 123458,BAKER,2006-10-21,10294
      - 102946,CHAN,2005-06-24,56231
      - 002024,CLARK,1999-07-01,10294
      - 456231,DAVIS,2004-07-30,59876
      - 187380,EVANS,1998-12-16,57777
      - 267334,GRANT,2005-09-23,23458

- **IX A**
  - **PI**
    - TB
      - HUGHES,234567
      - MATTOS,345678
      - NELSON,002891
      - PIETRO,287234
      - RAJIR,654327
      - SINGH,876548
      - 234567,HUGHES,2003-04-13,65432
      - 345678,MATTOS,1991-0101,56231
      - 002891,NELSON,1997-02-17,67303
      - 287234,PIETRO,2006-09-23,33609
      - 654327,RAJIR,2006-01-02,10294
      - 876548,SINGH,2005-08-21,13029

- **IX A**
  - **PI**
    - TB
      - TAYLOR,124569
      - THOMAS,245780
      - ULYSIUS,211132
      - VICTOR,111754
      - WILLIS,009037
      - VITTUONI,752343
      - 124569,TAYLOR,2004-05-31,33609
      - 245780,THOMAS,2003-04-30,26733
      - 211132,ULYSIUS,2005-12-30,56231
      - 111754,VICTOR,2004-03-31,13029
      - 009037,WILLIS,2006-02-14,23458
      - 752343,VITTUONI,191-11-11,37380
## Partitioning Indexes

Potential Partitioning Index B (could be B1, B2, B3) on (CUSTNAME, LAST_ACT_DT)

<table>
<thead>
<tr>
<th>IX B</th>
<th>NPI=</th>
<th>NPSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADAMS, 1998-12-01</td>
<td>003029, ADAMS, 1998-12-01</td>
<td>13029, ADAMS, 1998-12-01</td>
</tr>
<tr>
<td>BAKER, 2006-10-21</td>
<td>123458, BAKER, 2006-10-21</td>
<td>10294, BAKER, 2006-10-21</td>
</tr>
<tr>
<td>EVANS, 1998-12-16</td>
<td>187380, EVANS, 1998-12-16</td>
<td>57777, EVANS, 1998-12-16</td>
</tr>
<tr>
<td>GRANT, 2005-09-23</td>
<td>267334, GRANT, 2005-09-23</td>
<td>23458, GRANT, 2005-09-23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>IX B</th>
<th>TB</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>NELSON, 1997-02-17</td>
<td>002891, NELSON, 1997-02-17, 67303</td>
<td>003029, NELSON, 1997-02-17, 003029</td>
</tr>
<tr>
<td>PIETRO, 2006-09-23</td>
<td>287234, PIETRO, 2006-09-23, 33609</td>
<td>123458, PIETRO, 2006-09-23, 123458</td>
</tr>
<tr>
<td>RAJIR, 2006-01-02</td>
<td>654327, RAJIR, 2006-01-02, 10294</td>
<td>003029, RAJIR, 2006-01-02, 003029</td>
</tr>
<tr>
<td>SINGH, 2005-08-21</td>
<td>876548, SINGH, 2005-08-21, 13029</td>
<td>13029, SINGH, 2005-08-21, 13029</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TB</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>ULYSIUS, 2005-12-30</td>
<td>21132, ULYSIUS, 2005-12-30, 56231</td>
</tr>
<tr>
<td>VICTOR, 2004-03-31</td>
<td>111754, VICTOR, 2004-03-31, 13029</td>
</tr>
<tr>
<td>WILLIS, 2006-02-14</td>
<td>009037, WILLIS, 2006-02-14, 23458</td>
</tr>
</tbody>
</table>
Secondary Index on ZIPCODE as a non-CLUSTER **DPSI**

<table>
<thead>
<tr>
<th>NPSI</th>
<th>Index</th>
<th>DPSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>10294</td>
<td>1-2, 1-4</td>
<td>10000-2</td>
</tr>
<tr>
<td>13029</td>
<td>2-2</td>
<td>15001-6</td>
</tr>
<tr>
<td>23458</td>
<td>1-5</td>
<td>21000-3</td>
</tr>
<tr>
<td>33609</td>
<td>11000-5</td>
<td>59876</td>
</tr>
<tr>
<td>37380</td>
<td>24123-2</td>
<td>67303</td>
</tr>
</tbody>
</table>

**TABLE**

| Secondary Index on ZIPCODE AS NPI = NPSI |
|-----------------|-----------------|-----------------|
| 10294 | 10000-2 | 56231 |
| 13029 | 15001-6 | 8-1, 15000-3, 24000-2 |
| 23458 | 21000-3 | 7-3 |
| 33609 | 11000-5 | 12000-7 |
| 37380 | 24123-2 | 13123-5 |
| 56231 | 24000-2 | 8-1, 15000-3, 24000-2 |

- Secondary Index on ZIPCODE as a non-CLUSTER **DPSI**
- Secondary Index on ZIPCODE AS NPI = **NPSI**
Non-Partitioned Secondary Index

NPSI D on (CUSTNO) CLUSTER & UNIQUE

<table>
<thead>
<tr>
<th>CUSTNO</th>
<th>CLUSTER</th>
<th>UNIQUE</th>
<th>CUSTNO</th>
</tr>
</thead>
<tbody>
<tr>
<td>002024</td>
<td>1-4</td>
<td>111754</td>
<td>234567</td>
</tr>
<tr>
<td>002891</td>
<td>13123-5</td>
<td>123458</td>
<td>245780</td>
</tr>
<tr>
<td>003029</td>
<td>2-2</td>
<td>124569</td>
<td>267334</td>
</tr>
<tr>
<td>009037</td>
<td>21000-3</td>
<td>187380</td>
<td>287234</td>
</tr>
<tr>
<td>102946</td>
<td>8-1</td>
<td>211132</td>
<td>345678</td>
</tr>
</tbody>
</table>

NOTE: After a REORG the table data is now in order by CUSTNO, not CUSTNAME within each partition.

INDEX D IS UNIQUE AND CANNOT BE A DPSI IN V8

It can only be a PI or an NPSI.

In V9 a UNIQUE index can be a DPSI if it is a SUPERset of the partitioning COLUMN(s).

25
Parallel Partition Load / Reorg / Rebuild with DPSI versus (NPI(V7) and NPSI(V8))

C

V7 NPI OR V8 NPSI

DPSI
C1

DPSI
C2

DPSI
Cn

PI 1

Tablesapce Partition 1

PI 2

Tablesapce Partition 2

PI n

Tablesapce Partition n

V8
PIS, DPSIs, & NPSIs

DPSIs

- FOUR **HUGE** DISADVANTAGES

1) IF INDEX IS NEEDED TO AVOID SORT

2) IF INDEX IS NEEDED TO MAINTAIN POSITION OF A DYNAMIC SCROLL CURSOR

3) IF PROGRAM ACCESSES ALL PARTITIONS

   WHERE $B = :HVB$

   UP TO 4096 INDEX TREES TO PROBE
   USE NPSIs – SAME AS OLD NPIs

4) DPSIs lose the advantage of INDEX LOOKASIDE and SEQUENTIAL DETECTION
A FEW OTHER THINGS cont.

ORDER BY ON SEARCHED SINGLETON SELECTS

REMEMBER LOCK AVOIDANCE FOR SINGLETON SELECTS?

SELECT... INTO ...
FROM...WHERE LASTNAME LIKE :HV
ORDER BY ZIPCODE
FETCH FIRST ROW ONLY

UPDATE OF PARTITION INDEX DATA WITHOUT DRAIN

V7 vs. V8 TECHNIQUE
Base Table

Accessed by many

DB2 Table

1) Own changes if DECLARE sensitive
   &
2) other’s changes if FETCH sensitive

Result Table

Exclusive access by agent

DB2 Declared Temp Table

Fixed number of rows with delete holes and update holes if sensitive

Goes away at Close Cursor

In V7 & V8 requires TEMP database and predefined table spaces

V7 STATIC SCROLL CURSORS

Base Table & Result Table are kept in sync
STATIC SCROLL VS. DYNAMIC SCROLL

User table

Static Result
Table copy in

?  COPY

Static scroll
Cursor Position

Dynamic scroll
Cursor Position

Index
PI

Unique
Index

DPSI Index

Tablescape
Scan

Dynamic scroll
Cursor Position

Dynamic scroll
Cursor Position

Dynamic scroll
Cursor Position

Dynamic scroll
Cursor Position
DECLARE CURSOR SYNTAX – V8 UPDATE

```sql
>>-DECLARE-cursor-name--+------------------------------------------------------------>
|                               |
| | -ASENSITIVE- (default)-     |
| ++-----------------------------|-----SCROLL+-
| -INSENSITIVE-------------------|
| -SENSITIVE---STATIC----------|
|                              |
| ++DYNAMIC-----+

>-CURSOR-------------------------+-select-statement--+-<
  ++WITH HOLD-----+         ++statement-name+++ 
  ++WITH RETURN++
```
**ASENSITIVE**

- Highest sensitivity based off SELECT statement
  
  A IS FOR "AMBIGUOUS"

- IF NO *SCROLL* keyword in CURSOR declaration
  
  The CURSOR we have been using for years

  DECLARE C1 CURSOR FOR
  
  SELECT * FROM EMP

  will result in "SENSITIVE DYNAMIC" (NO MATERIALIZED DATA)

  DECLARE C1 CURSOR FOR
  
  SELECT * FROM EMP
  
  GROUP BY WORKDEPT
  
  ORDER BY EMPNO

  will result in "INSENSITIVE STATIC" (SORTOUT FILE AT FETCH)

**UNDERSTANDING WHAT HAPPENS AT OPEN CURSOR IS KEY TO UNDERSTANDING ASENSITIVE CURSORS**
Application Program

DECLARE CAND CURSOR FOR SELECT....
OPEN CAND
FETCH CAND INTO....

:EMPID

:UPD_TIMESTAMP

PLAN

BUFFER POOL

REAL PAGE

DATA

SENSITIVE

DB2
Application Program

DECLARE CAND CURSOR FOR SELECT... order by sal desc
OPEN CAND
FETCH CAND INTO....

:EMPID

:Salary

DB2

PLAN

REALPAGE

BUFFER

PQO

DB2 SORT

Your Data

DB2 Work

DB2 OUT
OTHER IMPLICATIONS of DYNAMIC SCROLL CURSORS

- Predicate evaluation
  Occurs at every **FETCH** (in all directions)

- If Cursor is **NOT** defined “FOR UPDATE OF…” BUT you are using
  **UPDATE(DELETE) WHERE CURRENT OF…**

  CS & CURRENTDATA(NO) = predicates are reevaluated at UPDATE/DELETE to make sure that row still qualifies BUT other columns (including those selected) are **NOT** reevaluated
OTHER IMPLICATIONS of DYNAMIC SCROLL CURSORS

- If Cursor is coded with "FOR UPDATE OF…" followed by UPDATE(DELETE) WHERE CURRENT OF

  No need for DB2 to reevaluate predicates; **Pessimistic technique** to ensure that row will not change or be deleted, a U-lock will be held between the FETCH and UPDATE/DELETE WHERE CURRENT OF…

- Serialization
  - No “built-in optimistic locking” with DYNAMIC SCROLL CURSORS
    Only SENSITIVE STATIC cursors have “built-in optimistic locking” where both the WHERE clause predicates as well as all columns SELECTed are reevaluated at UPDATE/DELETE WHERE CURRENT OF…

  - **Standard locking semantics, including lock avoidance options, apply to current ROW(SET)**
INTERSECTION WITH OTHER NEW V8 FUNCTIONS

- Data Partitioning Secondary Indexes (DPSIs)

  Dynamic scrolling is supported using a DPSI

  If selected as the access path by the optimizer
  DPSI can be used in two ways
  Nuance – SORT syntax or no SORT syntax?

  Externally, DPSI is like any other index

  However, DB2 has specific code to accommodate SORT
  AVOIDANCE & SCROLLing with DPSIs
BASIC DECISIONS FOR APPLICATION DESIGN

- What “result” type?
  - STATIC - fixed answer set in result table
    - **Sensitive** Static allows UPDATE WHERE CURRENT OF CURSOR (if ambiguous) and provides “built-in optimistic locking”
  - DYNAMIC – no result set
    Answer changes as rows are inserted or deleted

BIND SUCCESS? Access Path dependent SYNTAX CHECK
If SORT SYNTAX index must be available to avoid sort
No joins, functions, complex SQL
No built-in optimistic locking (only WHERE PREDs are reapplied)
OPEN WITH STATIC SCROLL CURSORS

Application Program

DECLARE CAND SENSITIVE
STATIC SCROLL CURSOR
FOR...

SELECT
EMPID,
PHONE...
WHERE
M_STATUS = 'S' AND
GENDER = 'M' AND
WEALTHY = 'YES'

OPEN CAND

Buffer Pool

Plan

1?

Table

2

Real Table

4

Accum Rows

5

Sensitive Result

3

Real Page
FETCH WITH STATIC SCROLL CURSORS

Application Program

FETCH SENSITIVE CAND INTO….

(SEE IF THE ROW STILL QUALIFIES AND TO SEE IF ANYONE HAS UPDATED

SELECTED COLUMNS
EMPID = :HVEMPID
PHONE = :PHONE

WHERE COLUMNS
M_STATUS = ‘S’
GENDER = ‘M’
WEALTHY = ‘YES’

:EMPID
:PHONE

DB2

PLAN

BUFFER POOL

SENSITIVE RESULT

REAL TABLE

1

2

3

4
UPDATE TABLE A
SET PHONE = ?
WHERE CURRENT OF CURSOR CAND AND ???
AND EMPID = :HVEMPID
AND PHONE = :PHONE
AND M_STATUS = ‘S’
AND GENDER = ‘M’
AND WEALTHY = ‘YES’

“BUILT-IN OPTIMISTIC LOCKING”
UPDATE WITH DYNAMIC SCROLL CURSOR

Application

DECLARE C1
DYNAMIC SCROLL CURSOR FOR SELECT
EMPID, PHONE
WHERE
M_STATUS = ‘S’ AND
GENDER = ‘M’ AND
WEALTHY= ‘YES’
OPEN CAND
FETCH INTO….

DB2

PLAN/PKG

BUFFER POOL

DATA

UPDATE TBLA
SET SAL = SAL x 2
WHERE CURRENT OF
C1 AND?
WHERE
M_STATUS = ‘S’ AND
GENDER = ‘M’ AND
WEALTHY= ‘YES’

???

:X

REAL PAGE

BUT WE MAY HAVE INCORRECT INFO

:X

:X

:X

:X

:X

:X

:X

:X

:X

:X
PREDICATE EVALUATION

IN WHAT ORDER ARE PREDICATES APPLIED?
V9 vs. V10

RDS
2. STAGE 2 INDEX
4. STAGE 2 TABLE

DATA MANAGER
1. STAGE 1 INDEX
3. STAGE 1 TABLE

INDEX

BP

L TABLE PAGE

L INDEX PAGE

TABLE
# PREDICATE EVALUATION

## IN WHAT ORDER ARE PREDICATES APPLIED?

### INDEX ON B, D, A, E, F

<table>
<thead>
<tr>
<th>V10</th>
<th>V9</th>
</tr>
</thead>
<tbody>
<tr>
<td>A =</td>
<td>A =</td>
</tr>
<tr>
<td>B =</td>
<td>B =</td>
</tr>
<tr>
<td>D &gt;</td>
<td>D &gt;</td>
</tr>
<tr>
<td>E + F =</td>
<td>E + F =</td>
</tr>
<tr>
<td>G =</td>
<td>G =</td>
</tr>
<tr>
<td>H &gt;</td>
<td>H &gt;</td>
</tr>
<tr>
<td>I =</td>
<td>I =</td>
</tr>
<tr>
<td>J BETWEEN</td>
<td>J BETWEEN</td>
</tr>
<tr>
<td>K IN (...)</td>
<td>K IN (...)</td>
</tr>
<tr>
<td>L LIKE</td>
<td>L LIKE</td>
</tr>
<tr>
<td>M + N =</td>
<td>M + N</td>
</tr>
</tbody>
</table>
LATCHES, LOCKS, CLAIMS, & DRAINS

LATCHES: WHAT ARE THEY AND WHY DO WE NEED THEM?

LOCKS: THE NEGATIVE AND THE POSITIVE

AND THEN WE HAVE

CLAIMS: WHEN AND WHY?

DRAINS: WHAT COMPONENT USES THESE?