

Performance Enhancements for DB2 UDB for z/OS Version 8

Part Two

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Performance Enhancements for DB2 UDB for z/OS Version 8

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Topics for Today

- Trigger Changes
- Runstats Changes
- Sort Changes
- Volatile Tables
- Multi-Row Operations

Work File Changes

- Avoid Work File Creation
 - WHEN Clause is False
 - Trigger not invoked anyway, why create work file
 - Applies to both BEFORE and AFTER triggers
 - By using Buffers
 - Small Buffer created to stored Transition Variables and Table Rows
 - Avoids Work File completely when this is large enough

Work File Changes

- Example Trigger

```
CREATE TRIGGER DOG_TRIG
AFTER INSERT ON DOGS
REFERENCING NEW AS NROW
FOR EACH ROW MODE DB2SQL
WHEN (NROW.NAME = 'FIDO' AND NROW.POUNDS =
      20)
INSERT INTO SPECIAL_PETS(COL1,COL2,COL3,COL4)
VALUES (0, 1, NROW.NAME, 'INSERTED FOR FIDO');
```

Work File Changes

- Example Inserts

```
INSERT INTO DOGS(ID,NAME,POUNDS,C4,C5,C6,C7,C8,C9,C10)
VALUES (1, 'BRUISER', 10, '001',4, 2, 2, 4342, 'PURINA DOG CHOW',
'TOM')
```

```
INSERT INTO DOGS(ID,NAME,POUNDS,C4,C5,C6,C7,C8,C9,C10)
VALUES (2, 'DUKE', 9, '001', 4, 2, 2, 3023, 'KAL KAN', 'DICK')
```

```
INSERT INTO DOGS(ID,NAME,POUNDS,C4,C5,C6,C7,C8,C9,C10)
VALUES (3, 'FIDO', 12, '001', 4, 2, 2, 1000, 'KIBBLES', 'HARRY')
```

Work File Changes

- No Trigger for Insert 1 and 2
 - No Work File at all, did not fire
- Trigger for Insert 3
 - Buffer accommodates
 - Transition Variables
 - All Three Rows
 - No Work File created

Work File Changes

- Significant Performance Enhancement
 - Before
 - the work file would have been created three times
 - CPU, Memory and I/O resources needlessly used
 - V8
 - No Work File created at all
 - Small Buffer uses memory, no CPU or I/O
- No Coding Changes Required

Statistics for the Optimizer

- Distribution Statistics
 - Index Columns Only
- Non-Uniform Distribution Statistics
 - Leading Index Columns Only
- DSTATS
 - Downloadable Offering for Previous Versions
 - [DSTATS Download Link](#)

Runstats Enhancements

- Distribution and Frequency Statistics
 - Any Column (Indexed or Not)
 - User-Defined Groups of Columns
 - Specified at the Table Level
- Cardinality for groups of columns
- Least Frequent as well as Most Frequent Values

New Keywords

- **COLGROUP**
- **MOST**
- **LEAST**
- **BOTH**
- **SORTNUM**
- **SORTDEVT**

Sort Considerations

- SORTDEVT = DASD device type to use
- SORTNUM = the number of sort data sets
- Sizing Calculation
 - $2 * (\text{maximum record length of SYSCOLDISTATS} * \text{number of columns} * (\text{Frequent Values Count} + 2) * \text{number of indexes})$
 - Total Size for all sort data sets

Example 1

```
RUNSTATS TABLESPACE DSN8D81A.DSN8S81E  
TABLE(DSN8810.EMP)  
COLGROUP(EDLEVEL,JOB,SALARY)
```

- Columns are not a part of the Index
- Cardinality Statistics stored in the Catalog
- Optimizer costs are more accurate

Example 1

SYSIBM.SYSCOLDIST

Name	Type	Numcolumns	Colgroupcolno	Cardf
Edlevel	C	3	00090008000C	33

SYSIBM.SYSCOLDISTSTATS

Partition	Name	Type	Numcolumns	Colgroupcolno	Cardf
1	Edlevel	C	3	00090008000C	32
2	Edlevel	C	3	00090008000C	0
3	Edlevel	C	3	00090008000C	10
4	Edlevel	C	3	00090008000C	0
5	Edlevel	C	3	00090008000C	0

Example 2

**RUNSTATS TABLESPACE DSN8D81A.DSN8S81E
TABLE(DSN8810.EMP)**

COLGROUP(EDLEVEL, JOB, SALARY)

FREQVAL COUNT 10 MOST

- Add the 10 Most Frequent Values
- Stored in SYSIBM.SYSCOLDIST

Example 2

SYSIBM.SYSCOLDIST

Name	Type	Numcolumns	Colgroupcolno	Cardf	Colvalue	Frequencyf
Edlevel	C	3	00090008000C	33	Null	Null
Edlevel	F	3	00090008000C	10	Unprintable	95
Edlevel	F	3	00090008000C	10	Unprintable	47
Edlevel	F	3	00090008000C	10	Unprintable	24
Edlevel	F	3	00090008000C	10	Unprintable	24
Edlevel	F	3	00090008000C	10	Unprintable	24
Edlevel	F	3	00090008000C	10	Unprintable	24
Edlevel	F	3	00090008000C	10	Unprintable	24
Edlevel	F	3	00090008000C	10	Unprintable	24
Edlevel	F	3	00090008000C	10	Unprintable	24
Edlevel	F	3	00090008000C	10	Unprintable	24
Edlevel	F	3	00090008000C	10	Unprintable	24
Edlevel	F	3	00090008000C	10	Unprintable	24
Edlevel	F	3	00090008000C	10	Unprintable	24

Example 2

- CARDF is meaningless when Type = 'F'
- FREQUENCYF is meaningless when Type = 'C'
- FREQUENCYF is a percentage of rows
- COLVALUE and COLGROUPOCOLNO are
 - VARCHAR and FOR BIT DATA
 - Sometimes unprintable

Trade Offs?

- Runstats Impact
 - More CPU and Elapsed Time for execution
 - More Data in the Catalog Tables
- Optimizer Impact
 - More accurate data for costing formulas
 - Improves access path selection
 - Non-Uniform data distributions
 - Non-Index Columns as predicates
 - Non-Leading Index Columns as predicates

Sort Changes

- V8 Introduces Cost Based Parallel Sort
 - OPTOPSE DSNZPARM
 - Default is ON
 - Disabled if
 - Sort data is < 2MB
 - Sort Data per parallel degree , 100KB
 - Elapsed time improvements
 - More use of Sort work files and Storage

On or Off?

- **OPTOPSE**
 - OFF will work like V7
 - ON and optimizer will make a cost based choice
- **Plan_Table** explains the optimizer choice
 - Examine the Parallel Group ID columns
 - SORTC_PGR_ID for composite table sorts
 - SORTN_PGR_ID for new table sorts

Work Data Sets

- Affects Sort Performance
- Encourage Parallel Sorts by
 - Allocating more data sets in DB07
 - If necessary, make smaller to maintain same space usage
- Optimizer will create more runs and greater parallelism
- Decreased elapsed time

Volatile Tables

- Tables where cardinality varies significantly
- Static SQL affected by Statistics
 - Runstats when the table is near empty
 - Optimizer will chose table scans
 - Access Path is constant
 - Cardinality varies
 - Performance is inconsistent
 - Problems are sure to follow

SQL Specifications

- Create Table Volatile/Not Volatile Cardinality
- Volatile
 - Use an Index Whenever possible
- Not Volatile
 - Based on Statistics
 - The Default
- Cardinality
 - Not used, just for LUW compatibility

SAP usage

- Cluster Tables

- Group of rows that must be processed together in the same sequence
- Matching and non-matching index access cause problems when executed concurrently
- VOLATILE will encourage use of matching index
- Locking and contention is reduced

SAP Usage

- V7 used NPGTHRSH DSNZPARM
 - Subsystem wide affect
- VOLATILE is preferred in V8
 - Specified at the Table level
 - Encourages similar access for all table usage

An Example

- Table Columns for Primary Key
 - First_Name, Last_Name, Sequence Number
 - Sequence_Number is an Identity column

First_Name	Last_Name	Sequence_Number	City
Harry	Fox	1	New York
Harry	Fox	2	Los Angeles
Harry	Fox	3	Dallas
Mary	Lamb	1	Chicago
Mary	Lamb	2	San Francisco
John	Doe	1	Houston

An Example

- Access Path Differences
 - Select * uses a scan
 - Select Where First_Name = “Harry” and Last_Name = “Fox” uses primary index with List Prefetch
 - Deadlocks could occur

An Example

- Changing to a VOLATILE table
 - Both Select statements use index access with no list Prefetch
 - Deadlock possibilities are reduced
 - Rebind required to change access path selection

Alter Implications

- After “Alter Table ... Volatile”
 - Table is defined as Volatile no data is affected
 - Dependent Plans/Packages not invalidated
 - Column “VALID” contains an “A”
 - Rebind is recommended
 - Execution exceptions are –
 - List Prefetch, Hybrid Join and Multiple Index Access are disabled
 - Rebind required to change other access paths

Multi-Row Operations

- Enabling This Option
 - “With Rowset Positioning”
 - New Block on Cursor
- Impacts
 - Local Unit of Works
 - Remote Unit of Works

An Example

```
Declare Cursor_One Cursor  
  With Rowset Positioning  
  For  
  Select Name,Dept,Title  
  From Employees;  
Open Cursor_One;  
Fetch First Rowset from Cursor_One  
  For 3 Rows  
  Into :Name:NI,:Dept:DI,:Title:TI;
```

COBOL Code

01 OUTPUT-VARS.

05 NAME OCCURS 3 TIMES.

49 NAME-LEN PIC S9(4) USAGE COMP.

49 NAME-TEXT PIC X(40).

05 DEPT OCCURS 3 TIMES.

49 DEPT-LEN PIC S9(4) USAGE COMP.

49 DEPT-TEXT PIC X(10).

05 TITLE OCCURS 3 TIMES.

49 TITLE-LEN PIC S9(4) USAGE COMP.

49 TITLE-TEXT PIC X(30).

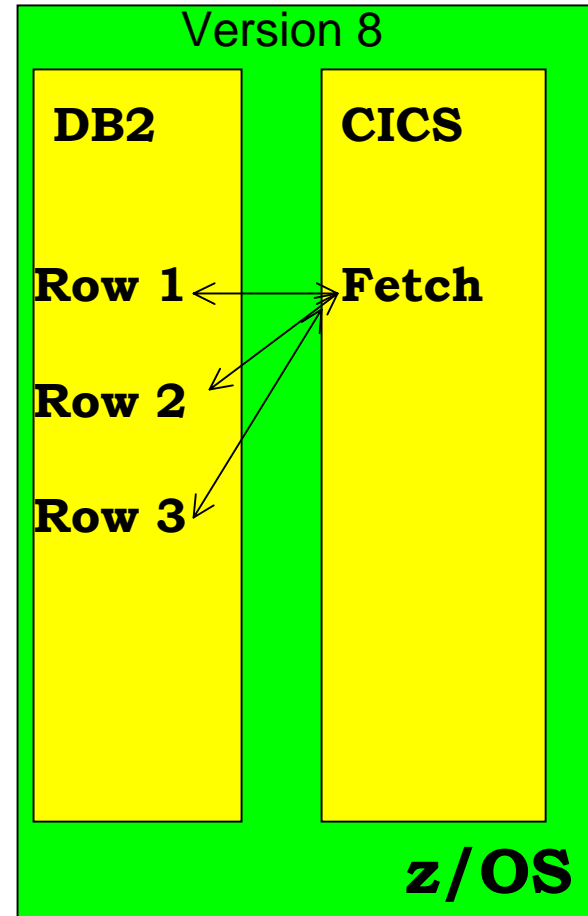
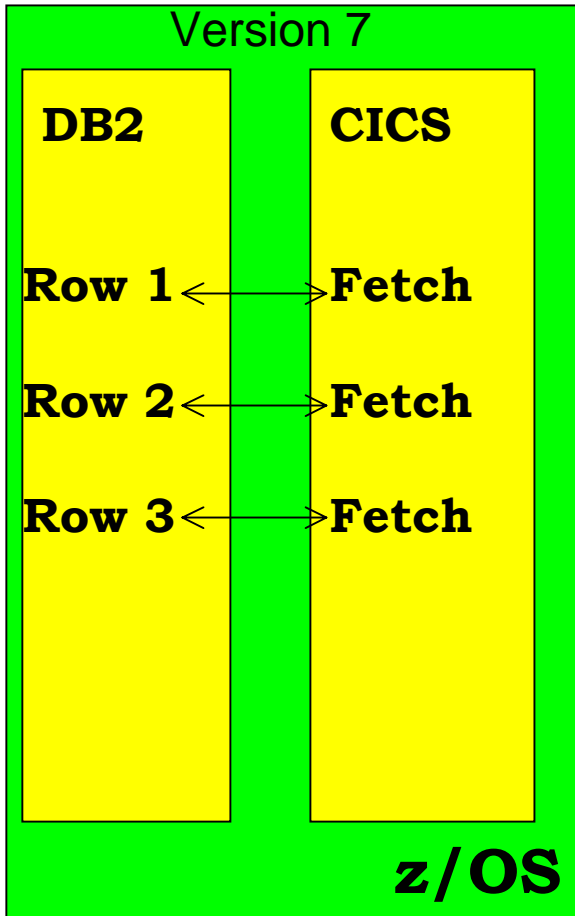
01 IND-VARS.

10 NI PIC S9(4) USAGE COMP OCCURS 3 TIMES.

10 DI PIC S9(4) USAGE COMP OCCURS 3 TIMES.

10 TI PIC S9(4) USAGE COMP OCCURS 3 TIMES.

Local Connections



Coding Changes

- New Error handling must be coded
- SQLCODE +100 has new meaning
- End of Result set could still return rows to process
 - SQLERRD(3) contains the number of rows returned by the fetch
 - “Get Diagnostics” will also return the same information

Expectations

- One API trip as opposed to many
- CPU savings based on
 - Number of Rows Fetched
 - Number of Columns
 - Application Processing for each row
 - Up to 50% savings for Fetch
 - Up to 30% savings for Insert

Insert Processing

- All or None processing Option by Default
 - Atomic Clause Defaults
- Savepoint created at the start of the insert
 - Insures undo of inserts if one fails
- Minimal Overhead

Distributed Connections

- DB2 for z/OS to DB2 for z/OS
 - Effective when Block Fetch not possible
 - Fetch if it is not
 - Read Only or
 - Currentdata(No) and Ambiguous Cursor
 - Update or Delete with Cursor
 - Insert
 - Remember the locks you are holding
 - Commit Frequently

Distributed Connections

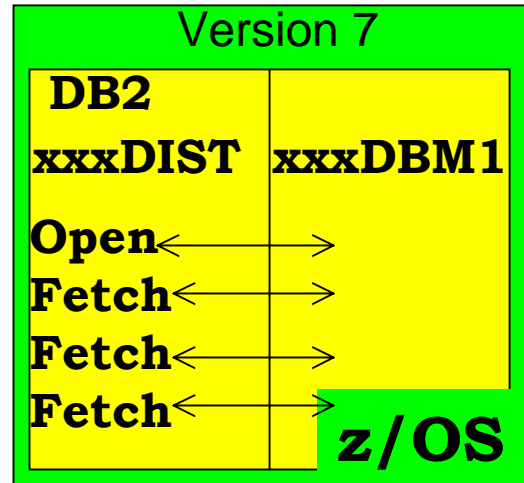
- Client to DB2 for z/OS
 - Insert Processing
 - Currently all inserts bundled for network transmission
 - With V8, DB2 connect processes all inserts as Multi-Row
 - Savings
 - Eliminates the call to the DB2 API
 - Fetch, Insert, Update or Delete
 - Dynamic Scrollable Cursors
 - V8 Enables Multi-Row Fetch to save Network traffic

DDF Usage

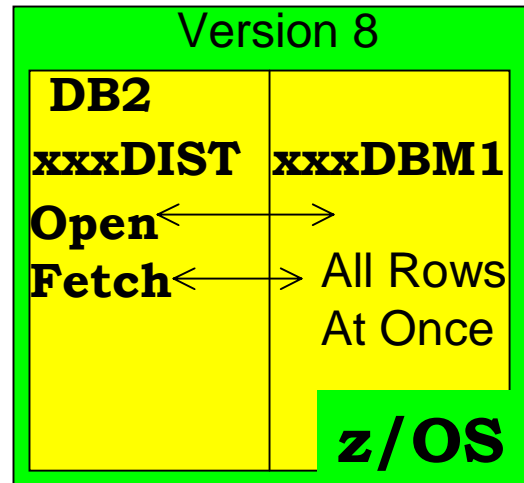
DB2 Client

Select *
From ...

Potential
Block
Fetch



Potential
Block
Fetch



Summary

- Wow! A Lot of Information to Digest
- Points to Remember
 - NCCR – No Coding Changes Required
 - Significant Performance Improvements
 - Many changes are easy to implement in V8
- Questions Anyone

Next Steps with DB2 V8 and Lightyear

- Our series of detailed presentations on various DB2 V8 topics:

Pre-requisites	V7 to V8 Migration
Unicode	Utilities
Access Path Review	Highlights of New Functionality
Schema Evolution	In Depth Review of the "Top" 5 New Functions
Catalog Changes	Enhancements to SQL

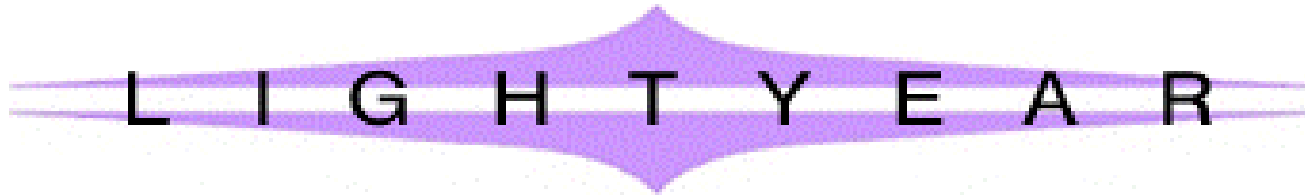
Next Steps with DB2 V8 and Lightyear

- FREE presentations available NOW.
- These presentations will be given to just one customer at a time and will be tailored to that customer.
- Presentations will vary in length, dependent upon topic and tailoring.
- A 15 minute “prep” call will be required.

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- Access Path Review is a performance factor
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 - Predictive Report of potential problem SQL
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Questions ...

