Performance Enhancements for DB2 UDB for z/OS Version 8

Part Two

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LIGHTYEAR

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 * (maximum record length of SYSCOLDISTATS * number of columns * (Frequent Values Count + 2) * 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

Example 2

- CARDF is meaningless when Type = ‘F’
- FREQUECYF is meaningless when Type = ‘C’
- FREQUENCYF is a percentage of rows
- COLVALUE and COLGROUPCOLNO 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 processes 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

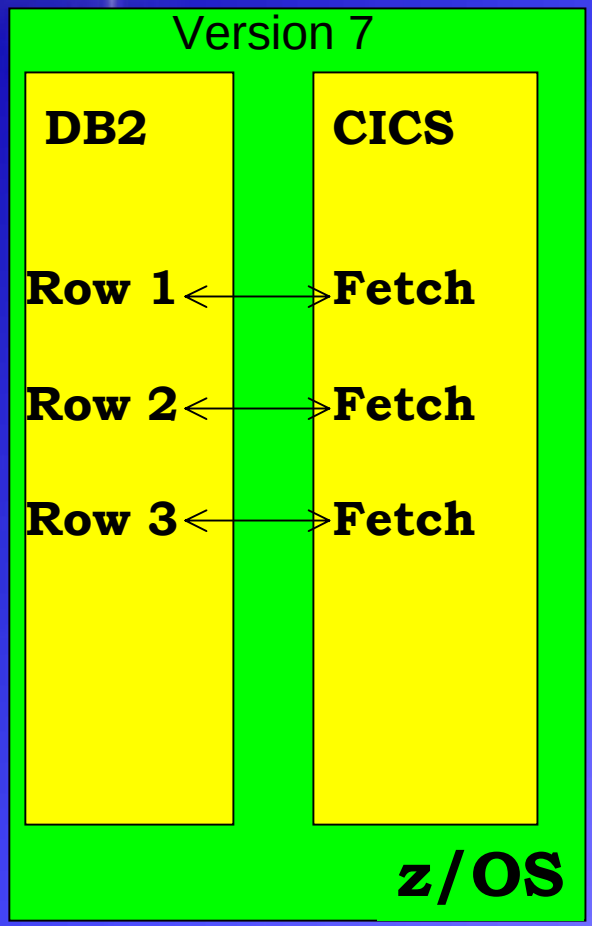
An Example

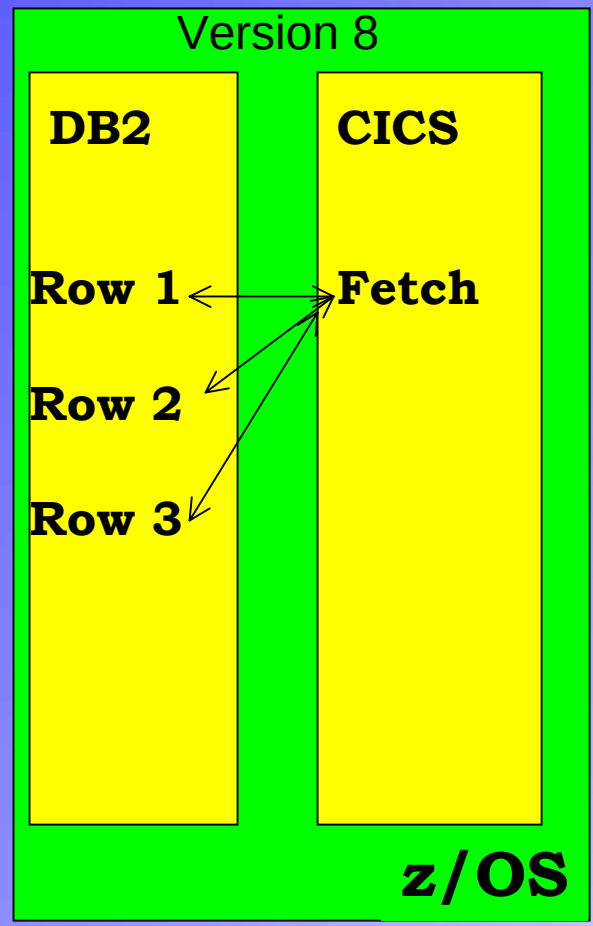
```
Declare Cursor_One Cursor
   With Rowset Positioning
   For
   Select Name,Dept,Title
   From Employees;
Open Cursor_One;
Fetch First Rowset from Cursor_One
   For 3 Rows
   Into :Name:NI,:Dept:DI,:Title:TI;
```

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

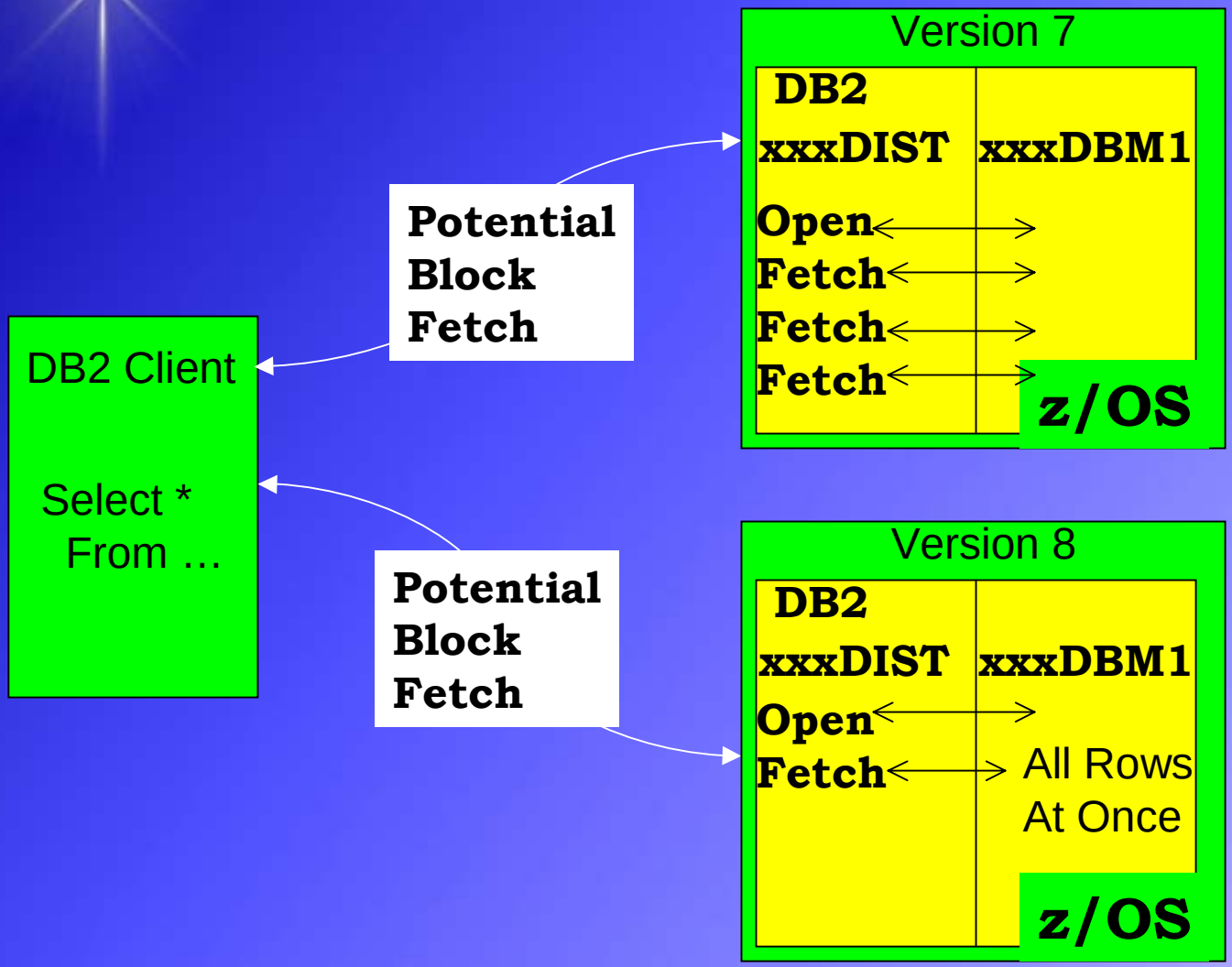
Distributed Connections

- 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



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

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- These presentations will be given to just one customer at a time and will be tailored to that customer.
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Questions …