Informix SQL Performance Tuning Tips

Jeff Filippi

Integrated Data Consulting, LLC

jeff.filippi@itdataconsulting.com

Session: B03

Monday April 27 – 1pm

Introduction

- 25 years of working with Informix products
- 21 years as an Informix DBA
- Worked for Informix for 5 years 1996 – 2001
- Certified Informix DBA
- Started my own company in 2001 specializing in Informix Database Administration consulting
- IBM Business Partner
- OLTP and Data warehouse systems
- Informix 4, 5, 7, 9, 10, 11.10, 11.50, 11.70, 12.10

Overview

- Identify Problem SQL Statements
- Tracing SQL in Informix
- Options Available with Set Explain & Reading sqexplain output with tuning examples
- Methods to use for Improving SQL Performance
- Subquery Support for Update/Delete
- External Tables
- Informix 11 & 12 New SQL Features

Identify Problem SQL Statements

- First you have to identify what SQL statements are the culprits in causing performance issues
  - Use “onstat –g ntt” to identify the last time read/writes occurred
  - Gather slow SQL statements from onstats, OAT and 3rd party tools like Server Studio.
  - Look at how many times SQL statements have been executed using SQL Statement Cache (onstat –g ssc)
  - Informix tracing feature (SQLTRACE)
  - Review with developers known problem areas in the application
  - Verify update statistics are current
  - Review what tables/indexes have the most reads

Use SQL Statement Cache

- onstat –g ssc
- Look at SQL's with a large number of executions.
- Saving even a second on a SQL statement that is executed 1 million times can make a difference in performance.

Use SQL Statement Cache

IBM Informix Dynamic Server Version 11.70.FC7 -- On-Line -- Up 23 days 23:46:38 -- 2530056 Kbytes

Statement Cache Summary:

#lrus	currsize	maxsize	Poolsize	#hits	nolimit
8	22491472	40960000	11710464	10	0

Statement Cache Entries:

lru hash ref_cnt hits flag heap_ptr database user

---

0 140 0 15 -F bb164020 ntlcom informix
select descr, rowid, seq_nbr from fl_cntrl where uid in ('all',
'cschabel') and program_name in ('all', 'cr_inv_dl') and exc_type is not null order by seq_nbr

0 116 0 1011 -F aa23bc20 ntlcom informix
update state_tax set row_status = "V", updt_user_id =? where seq_nbr =? And (rec_type = 6 or rec_type = 7)

0 207 0 6003 -F a004f820 ntlcom informix
select count (*) from invoice_state where cde = "CORR" and seq_nbr =?

2 138 0 **6244** -F afa9ec20 ntlcom informix
select int_comm, int_comm2, updt_user_id from invoice_cmnts where seq_nbr =? and extend (updt_dte, year to second) =
(select max (extend (updt_dte, year to second)) from invoice_cmnts where seq_nbr =?)

Review Number of Reads on Table/Index

- Use the table SYSPTPROF to look at the buffer reads, page reads, sequencial scans.

  – SELECT tabname[1,25], bufreads, pagreads, isreads, seqscans

    FROM sysmaster:sysptprof

    ORDER BY 2 desc

Example - Reads

tabname	bufreads	pagreads	isreads
trnsit_1	**-2122091061**	**429**	**1630786736**
trnsit_1	**-812314372**	**3162**	**-678524115**
trnsit_1	**-110705308**	**233**	**-390409810**
im_p_route_1	**1806427782**	**247**	**865918944**
ed_rl_event	1749246222	23550	1709746386
loc_sup_data	1479941490	39	1108625557
ed_rl_event_3	1186682507	2668713	789739458
460_4902	1125173161	1003575	373042018
ed_rl_event_4	893520660	25725	886704767
im_mv_event	870108889	30477208	780365364

New Index Added

tabname	bufreads	pagreads	isreads
140_409	-845911921	0	1722690950
cntrct_num	1297728722	1	2868878
221_1360	812752007	0	406226191
.....			
trnsit	**17215024**	**22**	**12007375**
trnsit_ix1	**15638629**	**106**	**12898627**
im_p_route_1	**23045**	**347**	**12904**

Tracing SQL in Informix

- There are more ways to find information to tune in Informix 11 utilizing the tracing of SQL
  - onconfig parameter: SQLTRACE
  - SQL Admin API
  - Ability to trace by database (11.50XC3)
  - Ability to save trace buffer (11.50XC4)
  - Open Admin Tool (OAT)

Tracing SQL in Informix

- There are a couple ways to turn tracing on in Informix
  - onconfig parameter: SQLTRACE
    - level = [off,low,med,high]
    - ntraces = [# of traces]
    - size = [size of each trace buffer in kb]
    - mode = [global,user]
    - Example:
      - SQLTRACE level=low,ntraces=1000,size=2,mode= global

      (This allows me to trace the last 1000 sql statements of the instance)
  - Open Admin Tool (OAT)

Tracing SQL in Informix

- Improved SQL tracing with the SQL Admin API in Informix 11.50FC3
  - You can use these new commands to manage SQL tracing by databases.
    - SET SQL TRACING DATABASE ADD {Database}
      CLEAR
      LIST
      REMOVE {Database}
  - You can also suspend and resume all tracing at the server without de-allocating any resources.
    - SET SQL TRACING SUSPEND/RESUME

Tracing SQL in Informix

- Here is how you enable tracing thru the “sysadmin” database by running the following command:
  - EXECUTE FUNCTION task(“set sql tracing on”,1000,2,”low”,”global”)

- To validate that tracing is turned on by:
  - onstat –g his
  - This option prints information about the SQLTRACE configuration parameter.

Tracing SQL in Informix

onstat –g his

IBM Informix Dynamic Server Version 11.70.FC7 -- On-Line -- Up 25 days 23:44:15 -- 2530056 Kbytes

Statement history:

Trace Level	Low
Trace Mode	Global
Number of traces	3000
Current Stmt ID	939412632
Trace Buffer size	2024
Duration of buffer	8241 Seconds
Trace Flags	0x00001611
Control Block	9df53018

Tracing SQL in Informix

Statement # 94653656: @ 9df68cb0

Database: 0x1700002

Statement text:

SELECT * FROM invc_state WHERE seq_nbr = ?

Iterator/Explain

==========

ID	Left	Right	Est Cost	Est Rows	Num Rows	Type
1	0	0	26	4	6	Index Scan

Statement information:

Sess_id	User_id	Stmt Type	Finish Time	Run Time
7640	1001	SELECT	18:44:20	0.0006

Tracing SQL in Informix

Statement Statistics:

Page Read	Buffer Read	Read % Cache	Buffer IDX Read	Page Write	Buffer Write	Write % Cache
0	17	100.00	0	0	0	0.00

Lock Requests	Lock Waits	LK Wait Time (S)	Log Space	Num Sorts	Disk Sorts	Memory Sorts
13	0	0.0000	0.000 B	0	0	0

Total Executions	Total Time (S)	Avg Time (S)	Max Time (S)	Avg IO Wait	I/O Wait Time (S)	Avg Rows Per Sec
7294	6.6040	0.0009	0.0015	0.000000	0.000000	10869.5652

Estimated Cost	Estimated Rows ,	Actual Rows	SQL Error	ISAM Error	Isolation Level	SQL Memory
26	4	6	0	0	LC	13416

Tracing in Informix

- You can also get information on the tracing thru the **"syssqltrace"** table in the sysmaster database.
  - Ex. {# of queries that ran > 2 seconds)

```
SELECT count(*)
FROM syssqltrace
WHERE sql_totaltime > 2;
```

- Another useful table is the **"syssqltrace_iter"** which gives information in the form of an iteration tree for each SQL. It allows you to identify which part of the query plan took the most time to run.

Tracing in Informix

- You can run the following SQL statement to get the SQL for the ones that have a higher run time than ½ a second.

```
select sql_runtime, sql_statement
from sysmaster:syssqltrace
where sql_runtime > .5
order by 1 desc
```

Tracing in Informix

- Here is what the “syssqltrace” table looks like

```
sql_id          9894804
sql_address     13746521704
sql_sid         26646
sql_uid         668
sql_stmttype    2
sql_stmtname    SELECT
sql_finishtime  1396011341
sql_begintxtime 301590260
sql_runtime     4.7
sql_pgreads     0
sql_bfreads     5
sql_rdcache     100.0000000000
sql_bfidxreads  0
```

Tracing in Informix

```
sql_pgwrites      0
sql_bfwrites      0
sql_wrcache       0.00
sql_lockreq       1
sql_lockwaits     0
sql_lockwttime    0.00
sql_logspace      0
sql_sorttotal     0
sql_sortdisk      0
sql_sortmem       0
sql_executions    1
sql_totaltime     4.7
sql_avgtime       4.7
sql_maxtime       4.7
sql_numiowaits    0
sql_avgiowaits    0.00
sql_totaliowaits  0.00
sql_rowspersec    20898.94078138
```

Tracing in Informix

```
sql_estcost       23
sql_estrows       46
sql_actualrows    1
sql_sqlerror      0
sql_isamerror     0
sql_isollevel     1
sql_sqlmemory     24200
sql_numiterators  1
sql_database      ir_live2
sql_numtables     4
sql_tablelist     systables
sql_statement     select owner,tabname,tabtype,tabid from informix.systables
sql_stmtlen       117
sql_stmthash      206750675
sql_pdq           0
sql_num_hvars     0
sql_dbspartnum    10488544
sql_aqt           None
sql_aqtinfo       -26500
```

Tracing in Informix

- Starting in 11.50XC4 you can now save the history of the SQL tracing information. **NOTE**: Caution when using this, it can use a lot of space very quickly. I had a customer fill a 20 gig dbspace in 24 hours.

- In the Scheduler there is a new task “Save SQL Trace”.

- Information is saved in the following tables in the sysadmin database:
  - mon_syssqltrace (SQL Statement text and profile info)
  - mon_syssqltrace_info (SQL Statement tracing setup info)
  - mon_sqltrace_iter (SQL Statement iterators)

Tracing in Informix

- Here is an alternative to saving ALL tracing information.
- Create a task which saves SQL trace information for SQL's that have a run time of greater than 10 seconds.
- This allows you to still trace SQL statements, but only show you the really long running SQL statements

Tracing in Informix

- Create a Table to save the SQL Trace information
- Create a new dbspace to put the table in so that if it does fill up a dbspace it does not affect any other processes.

```
create raw table "informix".save_sqltrace
 (
 date_time datetime year to second,
sql_id int8,
sql_runtime float,
sql_sid int8,
sql_uid int8,
sql_statement char(11000),
sql_database char(30)
) in sqltrace  extent size 100000 next size 50000 lock mode row;


create index "informix".idx_savesql1 on "informix".save_sqltrace (date_time) in sqltrace;
create index "informix".idx_savesql2 on "informix".save_sqltrace (sql_runtime) in sqltrace;
create index "informix".idx_savesql3 on "informix".save_sqltrace  (sql_id) in sqltrace;
```

Tracing in Informix

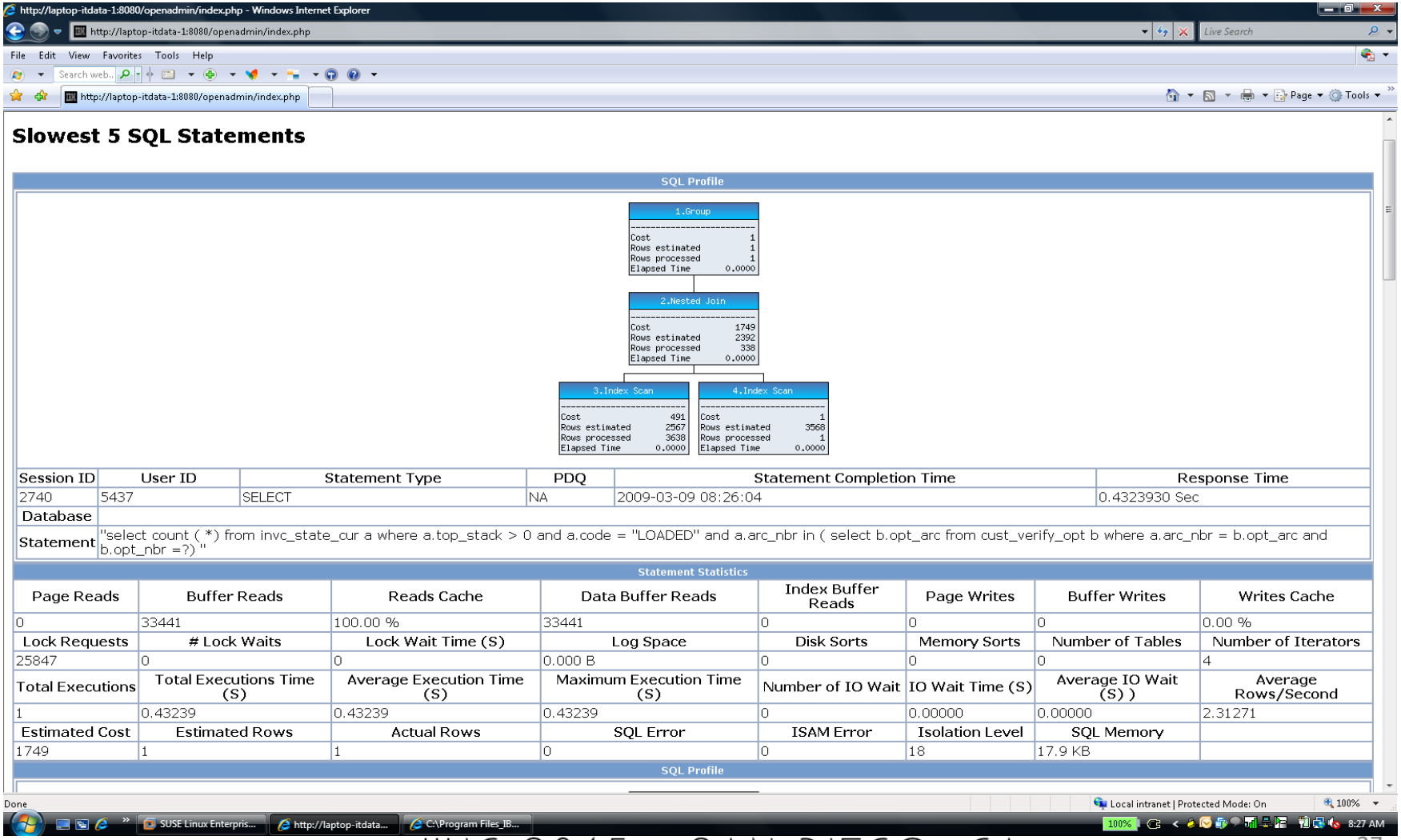
- Here is the information that needs to be inserted into the “ph_task” table to activate the task.
- In my case I was running it every minute.
- You will want to see what the shortest time that your trace buffer is and make the frequency the task runs smaller than that.

0|save_trace|Saves SQL Trace when run time greater than set value.|TASK|9251|||sysadmin|insert into save_sqltrace **select current, sql_id, sql_runtime, sql_sid, sql_uid,sql_statement,sql_database from sysmaster:syssqltrace where sql_runtime > 10 and sql_id > (select max(sql_id) from save_sqltrace**)| 30 00:00:00|00:00:00|| 0 00:01:00|2014-03-27 14:54:17|9237|0|t|t|t|t|t|t|400|PERFORMANCE|t|0|

Use Open Admin Tool (OAT)

- Use the Open Admin Tool to find slow SQL statements.
  - Under “System Reports” there is an option to show the Slowest SQL Statements.

Using OAT


http://laptop-itdata-1:8080/openadmin/index.php - Windows Internet Explorer
http://laptop-itdata-1:8080/openadmin/index.php
File Edit View Favorites Tools Help
Slowest 5 SQL Statements
SQL Profile
1.Group
Cost 1
Rows estimated 1
Rows processed 1
Elapsed Time 0.0000
2.Nested Join
Cost 1749
Rows estimated 2392
Rows processed 338
Elapsed Time 0.0000
3.Index Scan
Cost 491
Rows estimated 2567
Rows processed 3638
Elapsed Time 0.0000
4.Index Scan
Cost 1
Rows estimated 3568
Rows processed 1
Elapsed Time 0.0000
Session ID | User ID | Statement Type | PDQ | Statement Completion Time | Response Time
2740 | 5437 | SELECT | NA | 2009-03-09 08:26:04 | 0.4323930 Sec
Database
Statement "select count (*) from invc_state_cur a where a.top_stack > 0 and a.code = "LOADED" and a.arc_nbr in (select b.opt_arc from cust_verify_opt b where a.arc_nbr = b.opt_arc and b.opt_nbr =?) '"
Statement Statistics
Page Reads | Buffer Reads | Reads Cache | Data Buffer Reads | Index Buffer Reads | Page Writes | Buffer Writes | Writes Cache
0 | 33441 | 100.00 % | 33441 | 0 | 0 | 0 | 0.00 %
Lock Requests | # Lock Waits | Lock Wait Time (S) | Log Space | Disk Sorts | Memory Sorts | Number of Tables | Number of Iterators
25847 | 0 | 0 | 0.000 B | 0 | 0 | 0 | 4
Total Executions | Total Executions Time (S) | Average Execution Time (S) | Maximum Execution Time (S) | Number of IO Wait | IO Wait Time (S) | Average IO Wait (S)) | Average Rows/Second
1 | 0.43239 | 0.43239 | 0.43239 | 0 | 0.00000 | 0.00000 | 2.31271
Estimated Cost | Estimated Rows | Actual Rows | SQL Error | ISAM Error | Isolation Level | SQL Memory
1749 | 1 | 1 | 0 | 0 | 18 | 17.9 KB
SQL Profile
Done
Local intranet | Protected Mode: On
100%
8:27 AM

Options Available with SQEXPLAIN

- Optimizer Directives – AVOID_EXECUTE
  - Introduced in Informix 9.30
  - Generate query plan without executing SQL, useful for getting query plans for inserts, updates and delete where data is manipulated, but you do not want to change data
  - Example:
    - set explain on AVOID_EXECUTE;
    - SQL Statement

Options Available with Set Explain

- Set Explain Enhancements

  - Another improvement with Informix 11.10 is that you can turn on/off explain statistics thru the onconfig parameter “EXPLAIN_STAT”.
    - 0 – Disables the display of query statistics
    - 1 – Enables the display of query statistics
  - FYI, this is an undocumented feature in Informix 10.
  - You can also set it with the following statement:
    - SET EXPLAIN STATISTICS
  - When this is enabled, the inclusion of the “Query Statistics” section in the explain output file. It shows the query plan’s estimated number of rows and the actual number of rows returned.

Options Available with Set Explain - Query Statistics

```
QUERY:
------
select *
from partsupp
where ps_partkey >= 1 and ps_partkey <= 100 and ps_suppkey >= 0 and ps_suppkey <= 100000 and ps_availqty >= 1000 and ps_availqty <= 1000000

Estimated Cost: 49
Estimated # of Rows Returned: 360

 1) informix.partsupp: INDEX PATH
  (1) Index Keys: ps_partkey ps_suppkey ps_availqty   (Key-First)  (Serial, fragments: ALL)
     Lower Index Filter: informix.partsupp.ps_partkey >= 1 AND (informix.partsupp.ps_availqty >= 1000 ) AND (informix.partsupp.ps_suppkey >= 0 )
     Upper Index Filter: informix.partsupp.ps_partkey <= 100 AND (informix.partsupp.ps_availqty <= 1000000 ) AND (informix.partsupp.ps_suppkey
        <=100000 )
     Index Key Filters:  (informix.partsupp.ps_availqty >= 1000 ) AND   (informix.partsupp.ps_availqty <= 1000000 ) AND
                 (informix.partsupp.ps_suppkey <= 100000 ) AND  (informix.partsupp.ps_suppkey >= 0 )

Query statistics:
-----------------
 Table map :
 ----------------------------
 Internal name    Table name
 ----------------------------------------
 t1               partsupp

 type    table  rows_prod  est_rows  rows_scan    time      est_cost
 ------------------------------------------------------------------------------------------------------
 scan    t1         26        360         26        00:00:00     49
```

Dynamic Set Explain

- Dynamically set explain on for a session
  (Introduced in 9.40)
  - onmode –Y {session id} {0|1} (0 – Off/1 – On)
  - Output is to a file “sqexplain.out.{session id}
  - With Informix 11 there are a couple changes:
    - An additional value “2” (explain without statistics for session, displays query plan only)
    - Also you can specify the file name and directory that you want the explain output to be sent:
      - onmode –Y {session id} {0|1|2} {filename}

- This is a great feature to allow you to see the SQL statements executed and the explain plan for each SQL statement.
  - **NOTE**: make sure that you only have this turned on for a short period of time, it creates a large file.

Set Explain Output

- Add “set explain on” before the statement you want to examine

- Starting in Informix 11.10 you can specify the directory that you want the file to go:
  - set explain file to “filename”

- Review the “set explain” output:
  - UNIX: The file “sqexplain.out” will be generated in the directory that you run the query from
  - Windows: Look for a file “username.out” in the directory on the UNIX server %INFORMIXDIR%\sqexpln

Set Explain Output

- **Query** – Displays the executed query and indicates whether “set optimization” was set to high or low
- **Directives Followed** – Lists any directives used for the query
- **Estimated Cost** – An estimated of the amount of work for the query. The number does not translate into time. Only compare to same query not others.
- **Estimated number of rows returned** – An estimate of the number of rows returned, number based on information from system catalog tables

Set Explain Output

- **Numbered List** – The order in which tables are accessed, followed by the access method (index or sequential scan)
- **Index Keys** – The columns used as filters or indexes
- **Query Statistics** – Enabled by onconfig parameter “EXPLAIN_STAT”

Examples of Explain Plans

- The following slides will show tuning of SQL based on the following scenarios:
  - Functions causing index to not be used
  - Criteria from views causing sequential scans
  - Using “in” causes sequential scans
  - Use of Directives
  - Use of substrings in queries
  - Use of functions in queries
  - Using a better index (Creation of new index)

Functions cause index to not be used

QUERY:

SELECT DISTINCT BUSINESS_UNIT, VOUCHER_ID, INVOICE_ID, GROSS_AMT,
INVOICE_DT, VENDOR_NAME_SHORT, VENDOR_ID, NAME1, VOUCHER_STYLE,
ENTRY_STATUS_SRH
FROM PS_VOUCHER_SRCH_VW
WHERE BUSINESS_UNIT='GH'
AND **UPPER(INVOICE_ID) LIKE UPPER('KURT') || '%' ESCAPE '\'**
ORDER BY INVOICE_ID, BUSINESS_UNIT, VOUCHER_ID DESC FOR READ ONLY

Estimated Cost: 55943
Estimated # of Rows Returned: 1
Temporary Files Required For: Order By

1) sysadm.ps_vendor: SEQUENTIAL SCAN

2) sysadm.ps_voucher: INDEX PATH

Filters: (sysadm.ps_voucher.entry_status IN ('P' , 'R' , 'T')AND UPPER(sysadm.ps_voucher.invoice_id) LIKE 'KURT%' ESCAPE '\')

(1) Index Keys: vendor_id vendor_setid business_unit (Serial, fragments: ALL)
Lower Index Filter: ((sysadm.ps_voucher.vendor_id = sysadm.ps_vendor.vendor_id AND sysadm.ps_voucher.vendor_setid = sysadm.ps_vendor.setid) AND sysadm.ps_voucher.business_unit = 'GH')
NESTED LOOP JOIN

Resolution: Function causes index to not be used

```
QUERY:
------
SELECT DISTINCT BUSINESS_UNIT, VOUCHER_ID, INVOICE_ID, GROSS_AMT,
   INVOICE_DT, VENDOR_NAME_SHORT, VENDOR_ID, NAME1, VOUCHER_STYLE,
   ENTRY_STATUS_SRH
FROM PS_VOUCHER_SRCH_VW
WHERE BUSINESS_UNIT='GH'
AND INVOICE_ID LIKE 'KURT' || '%' ESCAPE '\'
ORDER BY INVOICE_ID, BUSINESS_UNIT, VOUCHER_ID DESC FOR READ ONLY

Estimated Cost: 35009
Estimated # of Rows Returned: 1
Temporary Files Required For: Order By

 1) sysadm.ps_voucher: INDEX PATH

      Filters: sysadm.ps_voucher.entry_status IN ('P' , 'R' , 'T' )

   (1) Index Keys: business_unit invoice_id   (Serial, fragments: ALL)
      Lower Index Filter: (sysadm.ps_voucher.business_unit = 'GH' AND sysadm.ps_voucher.invoice_id LIKE 'KURT%'
       ESCAPE '\' )

 2) sysadm.ps_vendor: INDEX PATH

   (1) Index Keys: vendor_id setid   (Serial, fragments: ALL)
      Lower Index Filter: (sysadm.ps_voucher.vendor_id = sysadm.ps_vendor.vendor_id AND
       sysadm.ps_voucher.vendor_setid = sysadm.ps_vendor.setid )
NESTED LOOP JOIN
```

Resolution: Function causes index to not be used

- Another way is to add a function which converts a character to all upper case and change the index to include the use of the function.

```
CREATE FUNCTION upper_idx(char_up char(20))
    RETURNING char(20) WITH (not variant);
    DEFINE char_out char(20);
    LET char_out = upper(char_up);
    RETURN char_out;
END FUNCTION;
```

```
CREATE INDEX upper_idx on ps_vendor(business_unit, (upper_idx(invoice_id))
    USING btree;
```

Criteria used to select from views causes Sequential Scans

QUERY:

```
SELECT BUSINESS_UNIT,INV_ITEM_ID,CM_BOOK,DT_TIMESTAMP,SEQ_NBR,
  CM_DT_TIMESTAMP_A,CM_SEQ_NBR_A,CM_ORIG_TRANS_DATE,CONSIGNED_FLAG,
  STORAGE_AREA,INV_LOT_ID,SERIAL_ID,CM_RECEIPT_QTY,CM_DEPLETE_QTY, CM_ONHAND_QTY
FROM PS_CM_ONHAND_VW
WHERE BUSINESS_UNIT = 'RPRO'
AND INV_ITEM_ID = '05-04-CVC-6-KINS'
AND CM_BOOK = 'FIN'
AND CONSIGNED_FLAG = 'N'
AND CM_ONHAND_QTY > 0
ORDER BY CM_ORIG_TRANS_DATE, CM_DT_TIMESTAMP_A, CM_SEQ_NBR_A FOR READ ONLY

Estimated Cost: 8425
Estimated # of Rows Returned: 1
Temporary Files Required For: Order By  Group By

 1) sysadm.ps_cm_deplete: SEQUENTIAL SCAN

 2) sysadm.ps_cm_receipts: INDEX PATH

  (1) Index Keys: business_unit inv_item_id cm_book dt_timestamp seq_nbr cm_dt_timestamp_a cm_seq_nbr_a
      (Serial, fragments: ALL)
     Lower Index Filter: ((((((sysadm.ps_cm_receipts.dt_timestamp = sysadm.ps_cm_deplete.cm_dt_timestamp AND
      sysadm.ps_cm_receipts.cm_dt_timestamp_a = sysadm.ps_cm_deplete.cm_dt_timestamp_a ) AND
      sysadm.ps_cm_receipts.inv_item_id = sysadm.ps_cm_deplete.inv_item_id ) AND sysadm.ps_cm_receipts.seq_nbr
      = sysadm.ps_cm_deplete.cm_seq_nbr ) AND sysadm.ps_cm_receipts.cm_seq_nbr_a =
      sysadm.ps_cm_deplete.cm_seq_nbr_a ) AND sysadm.ps_cm_receipts.business_unit =
      sysadm.ps_cm_deplete.business_unit ) AND sysadm.ps_cm_receipts.cm_book = sysadm.ps_cm_deplete.cm_book
      )
NESTED LOOP JOIN
```

Resolution to Criteria used for view causes Sequential Scans

```
QUERY:
------
SELECT BUSINESS_UNIT,INV_ITEM_ID,CM_BOOK,DT_TIMESTAMP,SEQ_NBR,
     CM_DT_TIMESTAMP_A,CM_SEQ_NBR_A,CM_ORIG_TRANS_DATE,CONSIGNED_FLAG,
     STORAGE_AREA,INV_LOT_ID,SERIAL_ID,CM_RECEIPT_QTY,CM_DEPLETE_QTY,
     CM_ONHAND_QTY
FROM PS_CM_ONHAND_VW
WHERE BUSINESS_UNIT = 'RPRO'
AND INV_ITEM_ID = '04X35-X-042'
AND CM_BOOK = 'FIN'
AND CONSIGNED_FLAG = 'N'
--AND CM_ONHAND_QTY > 0
ORDER BY CM_ORIG_TRANS_DATE, CM_DT_TIMESTAMP_A, CM_SEQ_NBR_A FOR READ ONLY

Estimated Cost: 10
Estimated # of Rows Returned: 1
Temporary Files Required For: Order By  Group By

  1) sysadm.ps_cm_deplete: INDEX PATH

    (1) Index Keys: business_unit inv_item_id cm_book dt_timestamp seq_nbr cm_dt_timestamp cm_seq_nbr cm_dt_timestamp_a cm_seq_nbr_a   (Serial,
        fragments: ALL)
       Lower Index Filter: ((sysadm.ps_cm_deplete.inv_item_id = '04X35-X-042' AND sysadm.ps_cm_deplete.business_unit = 'RPRO' ) AND
        sysadm.ps_cm_deplete.cm_book = 'FIN' )

  2) sysadm.ps_cm_receipts: INDEX PATH

       Filters: sysadm.ps_cm_receipts.consigned_flag = 'N'

    (1) Index Keys: business_unit inv_item_id cm_book dt_timestamp seq_nbr cm_dt_timestamp_a cm_seq_nbr_a   (Serial, fragments: ALL)
       Lower Index Filter: ((((((sysadm.ps_cm_receipts.inv_item_id = sysadm.ps_cm_deplete.inv_item_id AND sysadm.ps_cm_receipts.dt_timestamp =
        sysadm.ps_cm_deplete.cm_dt_timestamp ) AND sysadm.ps_cm_receipts.seq_nbr = sysadm.ps_cm_deplete.cm_seq_nbr ) AND
        sysadm.ps_cm_receipts.cm_dt_timestamp_a = sysadm.ps_cm_deplete.cm_dt_timestamp_a ) AND sysadm.ps_cm_receipts.cm_seq_nbr_a =
        sysadm.ps_cm_deplete.cm_seq_nbr_a ) AND sysadm.ps_cm_receipts.business_unit = sysadm.ps_cm_deplete.business_unit ) AND
        sysadm.ps_cm_receipts.cm_book = sysadm.ps_cm_deplete.cm_book )
NESTED LOOP JOIN
```

Using “in” causes sequential scans

QUERY:

SELECT inv3_invno
FROM inv3
WHERE 448050 IN (inv3_physcode,inv3_altphys1,inv3_altphys2)

Estimated Cost: 157852
Estimated # of Rows Returned: 566880

1) informix.cus3: **SEQUENTIAL SCAN**
Filters: 448050 IN (informix.inv3.inv3_physcode , informix.inv3.inv3_altphys1 , informix.inv3.inv3_altphys2
)

Query statistics:

Table map :

Internal name Table name
---
t1 inv3

type	table	rows_prod	est_rows	rows_scan	time	est_cost
scan	t1	21	566880	2096652	00:01.26	157852

Resolution to Criteria used for Using "in" causes sequential scans

- First I create two new indexes
  - create index ixinv3_altphys1 on inv3(inv3_altphys1)
  - create index ixinv3_altphys2 on inv3(inv3_altphys2)
- Then I changed the query to use "or" instead of "in"

Resolution to Criteria used for Using "in" causes sequential scans

QUERY:

SELECT inv3_invno
FROM inv3
WHERE (inv3_physcode = 448050
or inv3_altphys1 = 448050
or inv3_altphys2 = 448050)

Estimated Cost: 13
Estimated # of Rows Returned: 9

1) informix.inv3: INDEX PATH

(1) Index Name: informix.ixinv3_physcode
Index Keys: inv3_physcode (Serial, fragments: ALL)
Lower Index Filter: informix.inv3.inv3_physcode = 448050

(2) Index Name: informix.ixinv3_altphys2
Index Keys: inv3_altphys2 (Serial, fragments: ALL)
Lower Index Filter: informix.inv3.inv3_altphys2 = 448050

(3) Index Name: informix.ixinv3_altphys1
Index Keys: inv3_altphys1 (Serial, fragments: ALL)
Lower Index Filter: informix.inv3.inv3_altphys1 = 448050

Resolution to Criteria used for Using "in" causes sequential scans

Query statistics:

Table map :

Internal name Table name
---
t1 inv3

type	table	rows_prod	est_rows	rows_scan	time	est_cost
scan	**t1**	**21**	**9**	**21**	**00:00.24**	**13**

View used in Query

```
CREATE VIEW "sysadm".ps_cm_onhand_vw
  (business_unit,inv_item_id,cm_book,dt_timestamp,seq_nbr,cm_dt_timestamp_a,
      …….

cm_onhand_qty) AS

SELECT x1.business_unit ,x1.inv_item_id ,x1.cm_book ,x1.cm_dt_timestamp, …….

 (x0.qty_base - sum(x1.qty_base) )

FROM "sysadm".ps_cm_receipts x0 ,"sysadm".ps_cm_deplete x1
WHERE (((((((x0.business_unit = x1.business_unit )
AND (x0.inv_item_id = x1.inv_item_id ) )
AND (x0.cm_book = x1.cm_book) )
AND (x0.dt_timestamp = x1.cm_dt_timestamp ) )
AND (x0.seq_nbr = x1.cm_seq_nbr ) )
AND (x0.cm_dt_timestamp_a = x1.cm_dt_timestamp_a) )
AND (x0.cm_seq_nbr_a = x1.cm_seq_nbr_a ) )
GROUP BY x1.business_unit ,x1.inv_item_id ,x1.cm_book ,x1.cm_dt_timestamp ,
       x1.cm_seq_nbr,x0.cm_dt_timestamp_a ,x0.cm_seq_nbr_a ,
       x0.cm_orig_trans_date,x0.consigned_flag ,x0.storage_area ,
       x0.inv_lot_id ,x0.serial_id,x0.qty_base ;
```

Use of Directives for Queries

```
QUERY:
------
SELECT D.BUSINESS_UNIT, D.VENDOR_SETID, E.VENDOR_ID, E.NAME1, E.NAME2, VNDR_LOC
FROM PS_PAYMENT_TBL A, PS_PYMNT_VCHR_XREF B, PS_VOUCHER_LINE C,
        PS_VOUCHER D, PS_VENDOR E, PS_VENDOR_LOC F
WHERE A.BANK_SETID = B.BANK_SETID
    AND A.BANK_CD = B.BANK_CD
    AND A.BANK_ACCT_KEY = B.BANK_ACCT_KEY
    AND A.PYMNT_ID = B.PYMNT_ID
    AND B.BUSINESS_UNIT = C.BUSINESS_UNIT
    AND B.VOUCHER_ID = C.VOUCHER_ID
    AND C.BUSINESS_UNIT = D.BUSINESS_UNIT
    AND C.VOUCHER_ID = D.VOUCHER_ID
    AND E.VENDOR_ID = D.VENDOR_ID
    AND A.PYMNT_STATUS = 'P'
    AND A.PYMNT_DT BETWEEN '01-01-2003' AND '12-31-2003'
    AND D.BUSINESS_UNIT IN ('CAT',‘SNCPY')
    AND E.SETID = F.SETID
    AND E.VENDOR_ID = F.VENDOR_ID
    AND C.WTHD_CD <> F.WTHD_CD

Estimated Cost: 57005
Estimated # of Rows Returned: 1
```

Use of Directives in Queries

```
1) informix.f: INDEX PATH
        Filters: informix.f.effdt = <subquery>
    (1) Index Keys: setid vendor_id vndr_loc effdt (desc) eff_status   (Serial, fragments: ALL)
 2) informix.e: INDEX PATH
    (1) Index Keys: vendor_id setid   (Serial, fragments: ALL)
        Lower Index Filter: (informix.e.vendor_id = informix.f.vendor_id AND informix.e.setid = informix.f.setid ) NESTED
         LOOP JOIN
 3) informix.d: INDEX PATH
        Filters: informix.d.business_unit IN ('CAT' , 'SNCPY' )
    (1) Index Keys: vendor_id vendor_setid entry_status   (Serial, fragments: ALL)
        Lower Index Filter: informix.d.vendor_id = informix.f.vendor_id NESTED LOOP JOIN
 4) informix.c: INDEX PATH
        Filters: informix.c.wthd_cd != informix.f.wthd_cd
    (1) Index Keys: business_unit voucher_id (desc) voucher_line_num   (Serial, fragments: ALL)
        Lower Index Filter: (informix.c.voucher_id = informix.d.voucher_id AND informix.c.business_unit =
         informix.d.business_unit ) NESTED LOOP JOIN
 5) informix.b: INDEX PATH
    (1) Index Keys: business_unit voucher_id (desc) pymnt_id bank_cd bank_acct_key   (Serial, fragments: ALL)
        Lower Index Filter: (informix.b.voucher_id = informix.c.voucher_id AND informix.b.business_unit =
         informix.d.business_unit )
NESTED LOOP JOIN
 6) informix.a: INDEX PATH
        Filters: ((informix.a.pymnt_dt >= 01/01/2003 AND informix.a.pymnt_status = 'P' ) AND informix.a.pymnt_dt <=
         12/31/2003 )

    (1) Index Keys: pymnt_id (desc) bank_acct_key bank_cd bank_setid   (Serial, fragments: ALL)
        Lower Index Filter: (((informix.a.pymnt_id = informix.b.pymnt_id AND informix.a.bank_acct_key =
         informix.b.bank_acct_key ) AND informix.a.bank_cd = informix.b.bank_cd ) AND informix.a.bank_setid =
         informix.b.bank_setid ) NESTED LOOP JOIN
```

Use of Directives in Queries

```
QUERY:
------
SELECT --+ORDERED
D.BUSINESS_UNIT, D.VENDOR_SETID, E.VENDOR_ID, E.NAME1, E.NAME2,   B.VNDR_LOC
FROM PS_PAYMENT_TBL A, PS_PYMNT_VCHR_XREF B, PS_VOUCHER_LINE C,
    PS_VOUCHER D, PS_VENDOR E, PS_VENDOR_LOC F
WHERE A.BANK_SETID = B.BANK_SETID
    AND A.BANK_CD = B.BANK_CD
    AND A.BANK_ACCT_KEY = B.BANK_ACCT_KEY
    AND A.PYMNT_ID = B.PYMNT_ID
    AND B.BUSINESS_UNIT = C.BUSINESS_UNIT
    AND B.VOUCHER_ID = C.VOUCHER_ID
    AND C.BUSINESS_UNIT = D.BUSINESS_UNIT
    AND C.VOUCHER_ID = D.VOUCHER_ID
    AND E.VENDOR_ID = D.VENDOR_ID
    AND A.PYMNT_STATUS = 'P'
    AND A.PYMNT_DT BETWEEN '01-01-2003' AND '12-31-2003'
    AND D.BUSINESS_UNIT IN ('CAT','SNCPY')
    AND E.SETID = F.SETID
    AND E.VENDOR_ID = F.VENDOR_ID
    AND C.WTHD_CD <> F.WTHD_CD

DIRECTIVES FOLLOWED:
ORDERED
DIRECTIVES NOT FOLLOWED:

Estimated Cost: 70888              (Cost of Original Query: 57005)
Estimated # of Rows Returned: 1
```

Use of Directives in Queries

1) informix.a: INDEX PATH
Filters: informix.a.pymnt_status = 'P'
(1) Index Keys: pymnt_dt name1 remit_setid currency_pymnt (Serial, fragments: ALL)
Lower Index Filter: informix.a.pymnt_dt >= 01/01/2003
Upper Index Filter: informix.a.pymnt_dt <= 12/31/2003
2) informix.b: INDEX PATH
Filters: informix.b.business_unit IN ('CAT' , 'SNCPY')
(1) Index Keys: bank_setid bank_cd bank_acct_key pymnt_id (Serial, fragments: ALL)
Lower Index Filter: (((informix.a.pymnt_id = informix.b.pymnt_id AND informix.a.bank_acct_key = informix.b.bank_acct_key) AND informix.a.bank_cd = informix.b.bank_cd) AND informix.a.bank_setid = informix.b.bank_setid) NESTED LOOP JOIN
3) informix.c: INDEX PATH
(1) Index Keys: business_unit voucher_id (desc) voucher_line_num (Serial, fragments: ALL)
Lower Index Filter: (informix.b.voucher_id = informix.c.voucher_id AND informix.b.business_unit = informix.c.business_unit) NESTED LOOP JOIN
4) informix.d: INDEX PATH
(1) Index Keys: voucher_id (desc) business_unit invoice_id (Serial, fragments: ALL)
Lower Index Filter: (informix.b.voucher_id = informix.d.voucher_id AND informix.b.business_unit = informix.d.business_unit) NESTED LOOP JOIN
5) informix.e: INDEX PATH
(1) Index Keys: vendor_id setid (Serial, fragments: ALL)
Lower Index Filter: informix.e.vendor_id = informix.d.vendor_id NESTED LOOP JOIN
6) informix.f: INDEX PATH
Filters: (informix.c.wthd_cd != informix.f.wthd_cd AND informix.f.effdt = <subquery>)
(1) Index Keys: setid vendor_id vndr_loc effdt (desc) eff_status (Serial, fragments: ALL)
Lower Index Filter: (informix.e.vendor_id = informix.f.vendor_id AND informix.e.setid = informix.f.setid) NESTED LOOP JOIN

Use of Substrings – Best Index not Used

QUERY:

SELECT ACLNL.MONETARY_AMOUNT
FROM PS_CM_ACCTG_LINE ACLNL
WHERE ACLNL.BUSINESS_UNIT = 'ABCDE'
AND ACLNL.PRODUCTION_ID = '12334'
AND SUBSTR(ACLNL.ACCOUNT,1,3) IN ('085' , '334', '072')

Estimated Cost: 49722
Estimated # of Rows Returned: 1

1) informix.aclnl: INDEX PATH

Filters: (informix.aclnl.production_id = '12334' AND SUBSTR (informix.aclnl.account , 1 , 3) IN ('085' , '334' , '072'))

(1) Index Keys: business_unit cm_book gl_distrib_status budget_hdr_status cm_iu_status (Serial, fragments: ALL)
Lower Index Filter: informix.aclnl.business_unit = 'ABCDE'

Resolution for Substrings

QUERY:

SELECT ACLNL.MONETARY_AMOUNT
FROM PS_CM_ACCTG_LINE ACLNL
WHERE ACLNL.BUSINESS_UNIT = ‘ABCDE'
AND ACLNL.PRODUCTION_ID = '12334'
AND (ACLNL.ACCOUNT matches '085*'
OR ACLNL.ACCOUNT matches '334*'
OR ACLNL.ACCOUNT matches '072*')

Estimated Cost: 3
Estimated # of Rows Returned: 1

1) informix.aclnl: INDEX PATH

(1) Index Keys: business_unit production_id account (Key-First) (Serial, fragments: ALL)
Lower Index Filter: (informix.aclnl.production_id = '12334' AND informix.aclnl.business_unit = ‘ABCDE')
Key-First Filters: (((informix.aclnl.account MATCHES '085*' OR informix.aclnl.account MATCHES '334*') OR informix.aclnl.account MATCHES '072*'))

Use of Functions in Queries cause specific Indexes not to be used

QUERY:

```
SELECT od.order_id AS order_id,od.club_model_id AS
    club_model_id,od.purchase_type_cd AS purchase_type_cd,od.order_status_cd AS
    order_status_cd,
    EXTEND(od.create_ts, YEAR TO DAY) AS create_ts,price AS price,
    shipping_amt AS shipping_amt,od.session_id AS session_id
FROM order_detail od, order_header oh
WHERE oh.source_id != -1
AND oh.source_id IS NOT NULL
AND oh.source_id != 23150010

AND EXTEND(od.create_ts, YEAR TO DAY) = '2004-05-17'

AND od.order_id = oh.order_id
AND club_model_id = 10
AND (purchase_type_cd = 'CLUB' OR purchase_type_cd = 'SEYMOS'
OR purchase_type_cd = 'DCSSORC' OR purchase_type_cd = 'SHVSSORC'
OR purchase_type_cd = 'DDVSSORC' OR purchase_type_cd = 'HSACNUF')
```

Estimated Cost: 546168
Estimated # of Rows Returned: 67774

Use of Functions in Queries cause specific Indexes not be used

1) informix.od: INDEX PATH
Filters: (EXTEND (informix.od.create_ts ,year to day) = datetime(2004-05-17) year to day

AND (((((informix.od.purchase_type_cd = 'CLUB'
OR informix.od.purchase_type_cd = 'SEYMOS')
OR informix.od.purchase_type_cd = 'DCSSORC')
OR informix.od.purchase_type_cd = 'SHVSSORC')
OR informix.od.purchase_type_cd = 'DDVSSORC')
OR informix.od.purchase_type_cd = 'HSACNUF'))

(1) Index Keys: club_model_id (Serial, fragments: ALL)
Lower Index Filter: informix.od.club_model_id = 10

2) informix.oh: INDEX PATH
Filters: (informix.oh.source_id != -1 AND (informix.oh.source_id IS NOT NULL
AND informix.oh.source_id != 23150010))

(1) Index Keys: order_id (Serial, fragments: ALL)
Lower Index Filter: informix.oh.order_id = informix.od.order_id
NESTED LOOP JOIN

Resolution to Use of Functions in Queries

QUERY:

```
SELECT od.order_id AS order_id,od.club_model_id AS club_model_id,
    od.purchase_type_cd AS purchase_type_cd,od.order_status_cd AS
    order_status_cd,
    EXTEND(od.create_ts, YEAR TO DAY) AS create_ts,price AS price, shipping_amt
    ASshipping_amt,od.session_id AS session_id
FROM order_detail od, order_header oh
WHERE oh.source_id != -1
AND oh.source_id IS NOT NULL
AND oh.source_id != 23150010

AND (od.create_ts >= '2004-05-17 00:00:00.000‘ AND od.create_ts <= '2004-05-17
    23:59:59.999')

AND od.order_id = oh.order_id
AND club_model_id = 10
AND (purchase_type_cd = 'CLUB' OR purchase_type_cd = 'SEYMOS'
OR purchase_type_cd = 'DCSSORC' OR purchase_type_cd = 'SHVSSORC'
OR purchase_type_cd = 'DDVSSORC' OR purchase_type_cd = 'HSACNUF')
```

Estimated Cost: 2 **(Original Query Cost: 546168)**
Estimated # of Rows Returned: 1

Resolution to Use of Functions in Queries

1) informix.od: INDEX PATH

(1) Index Keys: create_ts purchase_type_cd order_status_cd club_model_id
(Key-First) (Serial, fragments: ALL)
Lower Index Filter: informix.od.create_ts >= datetime(2004-05-17 00:00:00.000) year to fraction(3)
Upper Index Filter: informix.od.create_ts <= datetime(2004-05-17 23:59:59.999) year to fraction(3)
Key-First Filters: ((((((informix.od.purchase_type_cd = 'CLUB'
OR informix.od.purchase_type_cd = 'SEYMOS')
OR informix.od.purchase_type_cd = 'DCSSORC')
OR informix.od.purchase_type_cd = 'SHVSSORC')
OR informix.od.purchase_type_cd = 'DDVSSORC')
OR informix.od.purchase_type_cd = 'HSACNUF'))
AND (informix.od.club_model_id = 10)

2) informix.oh: INDEX PATH

Filters: (informix.oh.source_id != -1 AND (informix.oh.source_id IS NOT NULL
AND informix.oh.source_id != 23150010))

(1) Index Keys: order_id (Serial, fragments: ALL)
Lower Index Filter: informix.oh.order_id = informix.od.order_id
NESTED LOOP JOIN

Using a Better Index

QUERY:
------
select club_model_id, order_status_cd, count(distinct order_id) as
order_count
from order_detail
where create_ts >= '2004-09-30 00:00:00.000‘ and create_ts < '2004-10-02 00:00:00.000'
and purchase_type_cd = 'CASH'
and order_status_cd not in ('REJ', ‘ACCP')
group by 1,2
order by 1,2

Estimated Cost: 407
Estimated # of Rows Returned: 1
Temporary Files Required For: Order By Group By

1) informix.order_detail: INDEX PATH

Filters: (informix.order_detail.create_ts >= datetime(2004-09-30 00:00:00.000) year to fraction(3)
AND (informix.order_detail.create_ts < datetime(2004-10-02 00:00:00.000) year to fraction(3) AND
informix.order_detail.order_status_cd NOT IN (‘REJ' , ‘ACCP')))

(1) **Index Keys: purchase_type_cd** (Serial, fragments: ALL)
Lower Index Filter: informix.order_detail.purchase_type_cd = 'CASH'

Resolution to Using a Better Index

QUERY: (AFTER ADDING A NEW INDEX)

```
------
select club_model_id, order_status_cd, count(distinct order_id) as
   order_count
from order_detail
where create_ts >= '2004-09-30 00:00:00.000'
  and create_ts < '2004-10-02 00:00:00.000'
  and purchase_type_cd = 'CASH'
  and order_status_cd not in ('REJ', 'ACCP')
group by 1,2
order by 1,2
```

Estimated Cost: 3
Estimated # of Rows Returned: 1
Temporary Files Required For: Order By Group By

1) informix.order_detail: INDEX PATH

(1) Index Keys: create_ts purchase_type_cd order_status_cd club_model_id (Key-First) (Serial, fragments: ALL)
Lower Index Filter: informix.order_detail.create_ts >= datetime(2004-09-30 00:00:00.000) year to fraction(3)
Upper Index Filter: informix.order_detail.create_ts < datetime(2004-10-02 00:00:00.000) year to fraction(3)
Key-First Filters: (informix.order_detail.order_status_cd NOT IN ('REJ' , 'ACCP')) AND
(informix.order_detail.purchase_type_cd = 'CASH'

Methods for Improving SQL Performance

- Utilize “UNIONS” when you have “OR” in where clause
- Utilize temp tables when have large “IN” clause
- Utilize temp tables in optimizing queries by splitting the query into multiple queries
- Utilize PDQPRIORITY
- Utilize DS_NONPDQ_QUERY_MEM (V 9.40/10.00)
- Fragment tables (Understand the use of the data) to eliminate fragments from selection of the data

Utilize Unions

```
SELECT a.email_template_id, b.description, a.club_model_id, a.email_log_id,
    efd.field_id
FROM email_log a, email_template b, email_field_data efd
WHERE a.email_template_id = b.email_template_id
AND a.email_template_id = efd.email_template_id
AND efd.email_log_id = a.email_log_id
AND efd.field_id in (561, 558)
AND a.club_model_id in ('1', '2')
AND a.email_template_id in ('275','128')
UNION
SELECT a.email_template_id, b.description, a.club_model_id, 0 as email_log_id, 0 as
    field_id
FROM email_log a, email_template b
WHERE a.email_template_id = b.email_template_id
AND a.club_model_id in ('1', '2')
AND a.email_template_id in ('125','2171')
UNION
SELECT a.email_template_id, b.description, a.club_model_id, 1 as email_log_id, 1 as
    field_id
FROM email_log a, email_template b
WHERE a.email_template_id = b.email_template_id
AND a.club_model_id in (‘3', ‘4')
AND a.email_template_id = '2152';
```

Utilize Temp Tables with "IN" – Use SELECT

```
QUERY: (OPTIMIZATION TIMESTAMP: 03-31-2015 09:28:31)
------
select *
from bike_cycle
where bike_serial in (5259604,12127443,12778188,
23600326,23600442,23600600,23600784,23600791,
23600795,23600806,23600809,23600815,23600821,
23600830,23600834,23921848,24712379,24712587,
24893059,24893065,24893069,24893071,24893073,
24893077,24893080,24893082,24893084,24893088,
24893092,24893096,24893097,24893100,24893103,.....)

Estimated Cost: 14722
Estimated # of Rows Returned: 36240

  1) informix.bike_cycle: INDEX PATH

    (1) Index Name: informix.accy_idx_1a
        Index Keys: bike_serial reported_dt   (Serial, fragments: ALL)
        Lower Index Filter: informix.bike_cycle.bike_serial = 5259604

    (2) Index Name: informix.accy_idx_1a
        Index Keys: bike_serial reported_dt   (Serial, fragments: ALL)
        Lower Index Filter: informix.bike_cycle.bike_serial = 12127443
Query statistics:
-----------------
  Table map :
  ----------------------------
  Internal name     Table name
  ----------------------------
  t1                bike_cycle

  type    table  rows_prod  est_rows  rows_scan  time      est_cost
  ------------------------------------------------------------------
  scan    t1     3788       36176     3788       00:18.86  19527
```

Utilize Temp Tables with “IN” Use “Temp Table”

```
QUERY: (OPTIMIZATION TIMESTAMP: 04-08-2015 14:35:48)
------
select * from tst

Estimated Cost: 1
Estimated # of Rows Returned: 1

  1) informix.tst: SEQUENTIAL SCAN

Query statistics:
-----------------
  Table map :
  ----------------------------
  Internal name     Table name
  ----------------------------
  t1                tst

  type     table  rows_ins   time
  ----------------------------------
  insert   t1     1936       00:00.00
```

Utilize Temp Tables with “IN”

CREATE INDEX:
==========
Index: tst_x1 on informix.tst
STATISTICS CREATED AUTOMATICALLY:
Column Distribution for: informix.tst.ac
Mode: HIGH
Number of Bins: 102 Bin size: 19.0
Sort data: 0.0 MB
Completed building distribution in: 0 minutes 0 seconds

Index LOW statistics gathered during index build

QUERY: (OPTIMIZATION TIMESTAMP: 04-08-2015 14:35:48)
------
select * from bike_cycle where bike_serial in (
select ac from tst
)

Estimated Cost: 12459
Estimated # of Rows Returned: 24726

1) informix.bike_cycle: INDEX PATH

(1) Index Name: informix.accy_idx_1a
Index Keys: bike_serial reported_dt (Serial, fragments: ALL)
Lower Index Filter: informix.bike_cycle.bike_serial = ANY <subquery>

Utilize Temp Tables with “IN”

```
Subquery:
---------
Estimated Cost: 64
Estimated # of Rows Returned: 1936

  1) informix.tst: INDEX PATH

    (1) Index Name: tst_x1
        Index Keys: ac   (Key-Only)  (Serial, fragments: ALL)
```

```
Query statistics:
-----------------

  Table map :
  ----------------------------
  Internal name     Table name
  ----------------------------
  t1                bike_cycle

  type    table  rows_prod  est_rows  rows_scan  time      est_cost
  ------------------------------------------------------------------
  scan    t1     3788       24726     3788       00:00.04  12459
```

Utilize Temp Tables with “IN”

Subquery statistics:

Table map :

Internal name Table name

---

t1 tst

type table rows_prod est_rows rows_scan time est_cost

---

scan t1 1936 1936 1936 00:00.00 64

type rows_sort est_rows rows_cons time

---

sort 1936 0 1936 00:00.00

Utilize Temp Tables

```
SET PDQPRIORITY 100;
SELECT acct_n, gender
FROM v_master
WHERE acct_n MATCHES '90*' AND mbr_phase_cde IN ('E','F','M','R')
INTO TEMP tmp_v_master WITH NO LOG;
        NOTE: With V11.10, you can globally set the onconfig parameter "TEMPTAB_NOLOG"
                0 – Off (Enable logical logging on temp tables)
                1 – On (Disable logical logging on temp tables)
CREATE INDEX idx_vidmaster ON tmp_v_master(acct_n);
UPDATE STATISTICS LOW FOR TABLE tmp_v_master;
        NOTE: With V11.10 you no longer need to run update statistics on a temp table
SELECT pull, equip, type_equip
FROM cat_pull
WHERE equip in ('S','W','T','M')
INTO TEMP temp_cat_pull WITH NO LOG;

CREATE INDEX idx_cat_pull ON temp_cat_pull(pull, equip);
UPDATE STATISTICS LOW FOR TABLE temp_cat_pull;

SELECT --+ORDERED
     account, m.gender, c.type_equip,
FROM v_trans v, tmp_v_master m, temp_cat_pull c
WHERE cntrl_num >= 118265 AND cntrl_num < 118786
AND m.acct_n = v.account
AND (v.selection = c.pulland v.equip = c.equip)
AND (uimm > 0 OR upos > 0 OR udis > 0 OR ubon > 0 OR udoc > 0 OR ugaf > 0
      OR uxdoc > 0 OR ues > 0 OR ufso > 0 OR urain > 0 OR ufree > 0)
INTO TEMP tst WITH NO LOG;
```

Utilize PDQ Priority

SET PDQPRIORITY 100;

```
SELECT accnt, pc, cntrl_wd, mfree, uauto, salestype
FROM vid_tran
WHERE substr(accnt,11,1) = '7'
AND (magz <> '' OR magz IS NOT NULL)
AND (pc LIKE 'BV1%' OR pc LIKE 'DA2%'
       OR pc LIKE 'DVM%' )
AND (cntrl_wd BETWEEN 118530 AND 119335)
```

Estimated Cost: 2485223
Estimated # of Rows Returned: 6067559

Maximum Threads: 3

Utilize DS_NONPDQ_QUERY_MEM

DS_NONPDQ_QUERY_MEM = 50,000

```
session                          #RSAM    total      used       dynamic
id      user     tty      pid     hostname threads  memory     memory     explain
324499  indprod  -        27952   prodtu   1        2367488    2328592    off

tid      name     rstcb            flags    curstk   status
25339601 sqlexec  c0000002b2c9ac18 ---PR--  1842583336 sleeping(Forever)

Memory pools    count 2
name         class addr             totalsize  freesize   #allocfrag #freefrag
324499       V     c0000002b60be040 2306048    34848      4315       157
324499_SORT  V     c0000002b59a3040 61440      4048       7          1

name          free      used          name          free      used
sort          0         34144         sqscb         0         41344
sql           0         80            srtmembuf     0         20384

sqscb info
scb              sqscb            optofc   pdqpriority sqlstats optcompind  directives
c0000002b5be61d0 c0000002cb9d7030 0        0           0        0           1

Sess  SQL          Current          Iso Lock       SQL  ISAM F.E.
Id    Stmt type    Database         Lvl Mode       ERR  ERR  Vers Explain
324499 SELECT      elstest          CR  Wait 600   0    0    9.03 Off

Current SQL statement :
  select  unique b.* from tmp_fids a, name_init b where a.fid = b.fid
```

Utilize DS_NONPDQ_QUERY_MEM

DS_NONPDQ_QUERY_MEM 500,000

```
session                                 #RSAM   total     used      dynamic
id      user    tty     pid     hostname threads  memory    memory    explain
16354   vijays  -       16777   prodtu  1       2490368   2458128   off

Memory pools    count 2
name        class addr            totalsize  freesize   #allocfrag #freefrag
16354       V     c0000001a12a4040 2244608    27536      4211       82
16354_SORT_ V     c0000001b3df5040 245760     4704       7          2

name          free      used          name          free      used
sort          0         34128         sqscb         0         56080
sql           0         80            srtmembuf     0         204064
```

(vs 20384 with 50,000 DS_NONPDQ_QUERY_MEM)

```
sqscb info
scb              sqscb            optofc   pdqpriority sqlstats optcompind  directives
c0000001ad54a8c0 c0000001a12af030 0        0           0        0           1

Sess  SQL          Current          Iso Lock       SQL  ISAM F.E.
Id    Stmt type    Database         Lvl Mode       ERR  ERR  Vers Explain
16354 SELECT       elstest          CR  Wait 600   0    0    9.03 Off


Current SQL statement :
  select  unique b.* from tmp_fids a, name_init b where a.fid = b.fid and     a.fid > 0
```

Fragment Tables

```
SELECT UNIQUE fid, serial_num, total_nos
FROM addridx b
WHERE name  = “JOHN"
  AND b.state = 27
  AND value IN (12345, 98765)
  AND total_nos = 1;
```

Estimated Cost: 1
Estimated # of Rows Returned: 1

1) informix.b: INDEX PATH
(1) Index Keys: state value name total_nos serial_num fid
(Key-Only) (**Serial, fragments: 26**)
Lower Index Filter: (((informix.b.name = ‘JOHN' AND informix.b.value = 12345) AND informix.b.state = 27) AND informix.b.total_nos = 1)

(2) Index Keys: state value name total_nos serial_num fid
(Key-Only) (**Serial, fragments: 26**)
Lower Index Filter: (((informix.b.name = ‘JOHN' AND informix.b.value = 98765) AND informix.b.state = 27) AND informix.b.total_nos = 1)

Subquery Support (Update/Delete)

- The FROM clause of a subquery in the WHERE clause of the UPDATE statement can specify as a data source the same table or view that the Table Options clause of the UPDATE statement specifies.

- UPDATE operations with subqueries that reference the same table object are supported only if all of the following conditions are true:
  - The subquery either returns a single row,
  - Has no correlated column references.

- No SPL routine in the subquery can reference the same table that UPDATE is modifying.

Subquery Support (Update/Delete)

- Example: Updates the stock table by reducing the unit_price value by 5% for a subset of prices. The WHERE clause specifies which prices to reduce by applying the IN operator to the rows returned by a subquery that selects only the rows of the stock table where the unit_price value is greater than 50:

```
UPDATE stock
SET unit_price = unit_price * 0.95
WHERE unit_price IN (SELECT unit_price
                     FROM stock
                     WHERE unit_price > 50);
```

External Tables

- Ways to use External Tables
  - Creating external tables
    - » Create table ext_xyz (col1 integer, col2 char(20))
      USING (DATAFILES (“DISK:/data/xyz.unl”),
      FORMAT “DELIMITED”)
    - » Create table ext_xyz SAMEAS xyz
      USING (DATAFILES (“DISK:/data/xyz.unl”),
      FORMAT “DELIMITED”)

External Tables

- Ways to use External Tables
  - Load data from external table into database table
    - »insert into xyz select * from ext_xyz;
  - Unload data to external table
    - »insert into ext_xyz select * from xyz;

External Tables

- Using PIPE feature
  - When you do not want to unload to a flat file, but pipe the data to another server/table you can use the PIPE feature.
  - Here is what the create table statement looks like:
    - » Create external table ext_xyz SAMEAS xyz
      USING (DATAFILES("PIPE:/data/ext_xyz1"))
  - To improve performance using PIPES make sure that there are enough FIFO VP's defined. The database server uses one FIFO VP for each named pipe that specify in the DATAFILES clause.
    - » To add a FIFO VP – onmode –p + {# to add} FIFO

New Features – Optimizer Directives

- **11.70xC1 – NEW OPTIMIZER DIRECTIVES**
  - Query optimizer support for star-schema and snowflake-schema queries. A primary key column in each dimension table must correspond to a foreign key in the fact table.
    - New optimizer directives have been added:
      - » STAR_JOIN, FACT, AVOID_STAR_JOIN & AVOID_FACT
      - » Can also enable with SET OPTIMIZATION

New Features – Optimizer Directives

- **11.70xC1 – NEW OPTIMIZER DIRECTIVES**
  - Syntax support for DDL statement with IF [NOT] EXISTS:
    - Can include “IF [NOT] EXISTS” condition to SQL statements that create a database object or a database.

New Features – Optimizer Directives

- **11.70xC2**
  - Table and column Aliases in DML statements.
    - SELECT – statements and subqueries can declare an alias in the projection clause for columns in the select list.
    - DELETE / UPDATE – can declare an alias for a local or remote target table.

Informix 12 SQL Features

- **Faster ANSI join queries**
  - ANSI outer join queries that have equality joins can run faster because the Informix optimizer now uses either a hash join or a nested loop on a cost basis. In earlier releases, Informix used only nested loop joins in ANSI outer joins.
- **Temporary table projection optimization for views and derived tables**
  - Applications and analytic tools can define a query in which a derived table contains multiple views joined with base tables, potentially including hundreds of columns. The database server materializes this query in a system-generated temporary table. The parent query, however, might project only a few columns.
  - The database server creates internally generated temporary tables that include only the columns that are specified in the Projection list, the WHERE clause, the ORDER BY clause, and in other clauses of the immediate parent query. By excluding unnecessary columns from the temporary table, the database server uses storage resources efficiently and avoids I/O operations on the columns that do not contribute to the query result.

Summary

- Identify Problem SQL Statements
- Tracing SQL in Informix
- Options Available with Set Explain & Reading sqexplain output with tuning examples
- Methods to use for Improving SQL performance
- Subquery Support for Update/Delete
- External Tables
- Informix 11 & 12 New SQL Features

Questions?

Jeff Filippi

jeff.filippi@itdataconsulting.com

www.itdataconsulting.com