Informix SQL Performance Tuning Tips

By Jeff Filippi

New Informix Tech Talks by the IIUG

We are launching a new channel on YouTube for Informix Users! This will be a place for Informix how-to videos. More information will be coming soon.

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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

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, Informix HQ 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.
- New features with 14.10 for Statement Cache.

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
```

lru	hash	ref_cnt	hits	flag	heap_ptr	database	user
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)
```

lru	hash	ref_cnt	hits	flag	heap_ptr	database	user
0	207	0	6003	-F	a004f820	ntlcom	informix

```
select count ( *) from invoice_state where cde = "CORR" and seq_nbr =?
```

lru	hash	ref_cnt	hits	flag	heap_ptr	database	user
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 =?)
```

Use SQL Statement Cache

Statement cache enhancements

- New sysmaster:syssscelem pseudo table to coincide with onstat -g ssc.
- For more information, see *The sysmaster database*.
- Invalidate specific statement(s) in the Statement Cache.
- For more information, see *Monitoring usage of the SQL statement cache*.
- Lock query plan(s) in the Statement Cache.
- For more information, see *Monitoring usage of the SQL statement cache*.

Use SQL Statement Cache

Dump query plans from Statement Cache

- **New onconfig parameter STMT_CACHE_QUERY_PLAN**
  - **0 – Disabled**
  - **1 – Enabled**
- **Disabled by Default**
- **WILL consume more of your STMT_CACHE_SIZE**
- **Query plan is viewable in sysmaster:syssscelem.queryplan column**

Review Number of Reads on Table/Index

- Use the table SYSPTPROF to look at the buffer reads, page reads, sequential 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 utilizing the tracing of SQL
  - onconfig parameter: SQLTRACE
  - SQL Admin API
  - Informix HQ (NEW)

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)
  - Informix HQ

Tracing SQL in Informix

- Improved SQL tracing with the SQL Admin API in Informix
  - 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 14.10.FC5 -- On-Line -- Up 5 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 SQL 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 SQL 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 SQL 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 SQL 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 SQL 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 SQL in Informix

- You can also 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 SQL 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 SQL 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 SQL in Informix

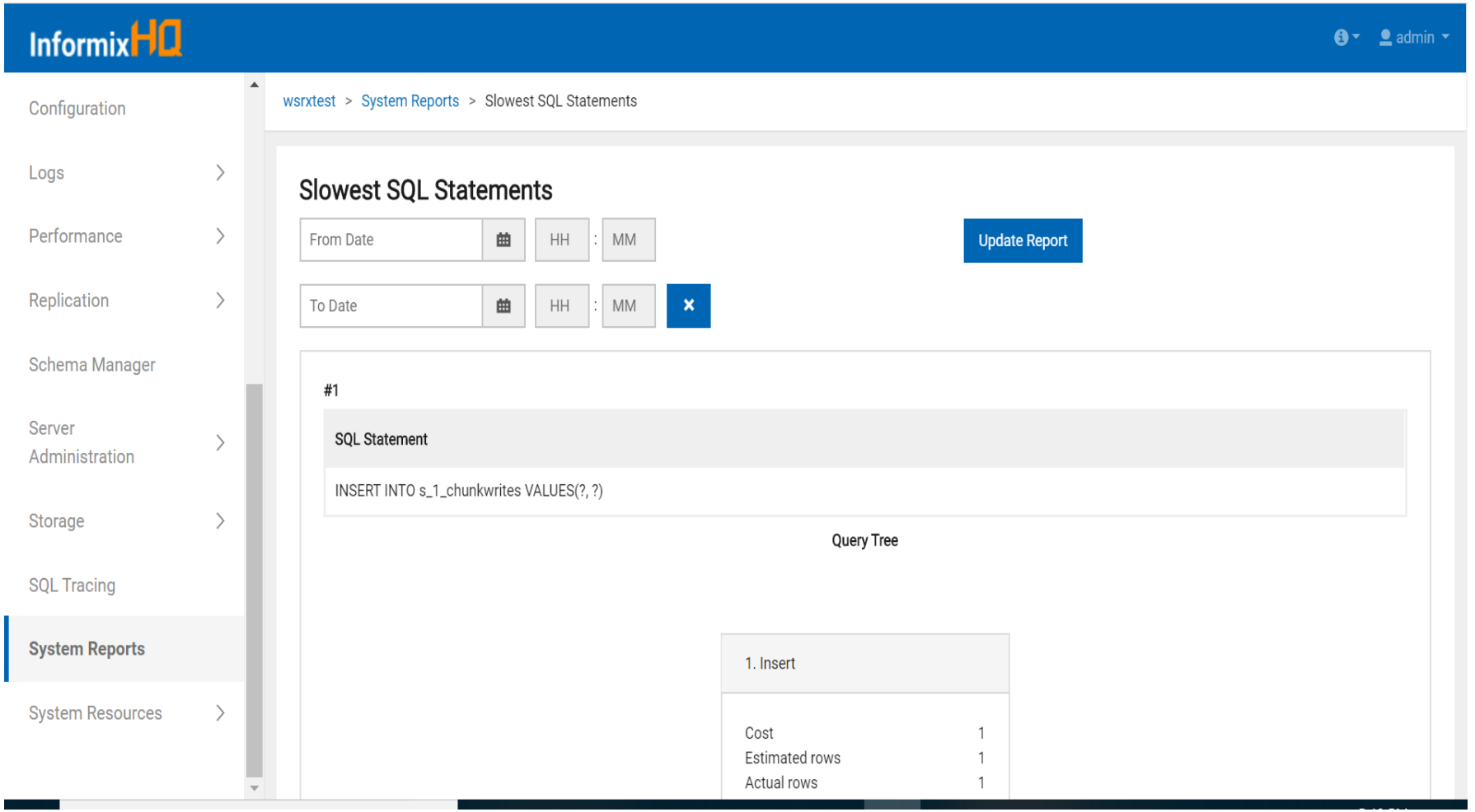
- Here is the information that needs to be inserted into the “ph_task” table to activate the task.
- In my case I was running it every minute.
- You will want to see what the shortest time that your trace buffer is and make the frequency the task runs smaller than that.

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_finishtime, sql_sid, sql_uid, sql_statement, sql_database from sysmaster:syssqltrace where (sql_runtime > 5 and (sql_finishtime > (select max(sql_finishtime) from save_sqltrace)) or (sql_runtime > 5 and ((select count(*) from save_sqltrace) = 0)))**;| 30 00:00:00|00:00:00|| 0 00:01:00|2021-02-27 14:54:17|9237|0|t|t|t|t|t|t|t|400|PERFORMANCE|t|0|

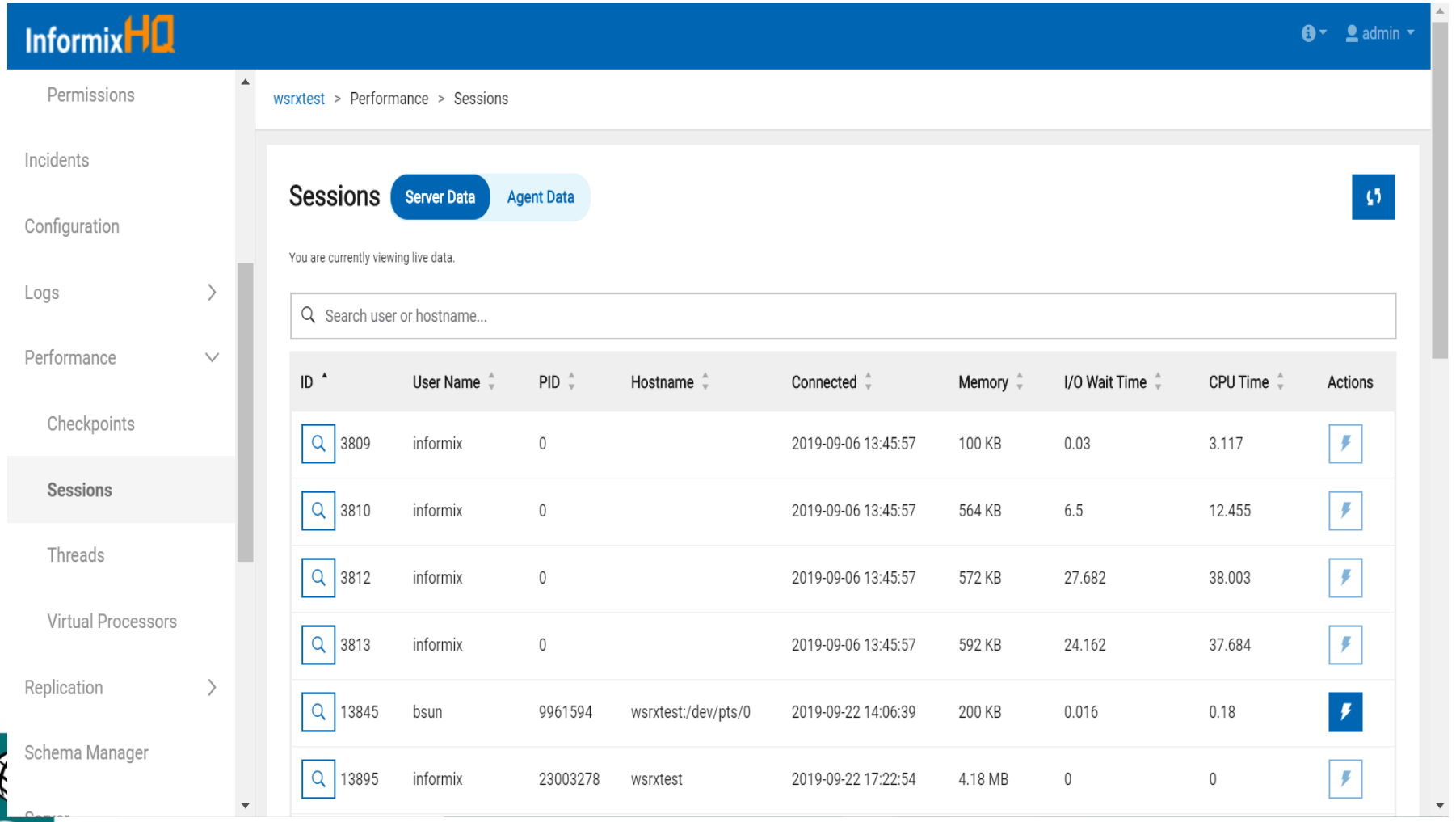
Use Informix HQ

- Use Informix HQ to look at session information to see long running SQL.

Use Informix HQ



Use Informix HQ



Options Available with SQEXPLAIN

- Optimizer Directives – AVOID_EXECUTE
  - 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

  - 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

  - 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

  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
- 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

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 ;
```

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 created 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

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 '01-01-2020' AND '12-31-2020'
    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 >= 01/01/2020 AND informix.a.pymnt_status = 'P') AND informix.a.pymnt_dt <= 12/31/2020)

(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 '01-01-2020' AND '12-31-2020'
    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 >= 01/01/2020

Upper Index Filter: informix.a.pymnt_dt <= 12/31/2020

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 Index 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 to be used

1) informix.od: INDEX PATH

Filters: (EXTEND (informix.od.create_ts ,year to day) = datetime(2020-05-17) 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 Using 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 >= ‘2020-05-17 00:00:00.000‘ AND od.create_ts <= ‘2020-05-17 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 Using 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(2020-05-17 00:00:00.000) year to fraction(3)
Upper Index Filter: informix.od.create_ts <= datetime(2020-05-17 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

Resolution to Using 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(2020-05-17 00:00:00.000) year to fraction(3)
Upper Index Filter: informix.od.create_ts <= datetime(2020-05-17 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 >= ‘2020-09-30 00:00:00.000‘   and create_ts < ‘2020-10-02 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(2020-09-30 00:00:00.000) year to fraction(3)
AND (informix.order_detail.create_ts < datetime(2020-10-02 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 >= '2020-09-30 00:00:00.000'
  and create_ts < '2020-10-02 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(2020-09-30 00:00:00.000) year to fraction(3)
Upper Index Filter: informix.order_detail.create_ts < datetime(2020-10-02 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'

Subquery – Slows Query

ORIGINAL QUERY:

```
SELECT   *
FROM doc
WHERE doc_date  BETWEEN ‘2020-03-15 09:00'
   AND ‘2020-03-31 09:00'
  AND doc_num IN (SELECT DISTINCT r_doc_num
                          FROM rev
                          WHERE re_op_id= ‘johnsmith')
ORDER BY doc_num DESC;
```

Subquery – Slows Query

CHANGED QUERY:

```
SELECT   *
FROM doc
WHERE doc_date  BETWEEN ‘2020-02-15 08:42'
  AND ‘2020-02-29 08:42'
  AND doc_num IN (SELECT DISTINCT r_doc_num
                        FROM rev
                        WHERE re_op_id= ‘johnsmith'
                        AND doc_num = r_doc_num)
ORDER BY doc_num DESC;
```

Methods for Improving SQL Performance

- Use Multi-Index Scans
- Utilize temp tables when have large “IN” clause
- Utilize PDQPRIORITY
- Utilize DS_NONPDQ_QUERY_MEM

Methods for Improving SQL Performance

MULTI-INDEX SCANS

- With Multi-Index scans if you have a query that has multiple criteria in the where clause and you have indexes with those columns, the optimizer can utilize multiple indexes at once to improve the performance of the query.

Methods for Improving SQL Performance

```
SELECT *
FROM fmexcp
WHERE (fxc_catno = 'JJMA028'
   OR fxc_manuno =        1789
   OR fxc_vendno =           0
   OR fxc_custno =    34514112
   OR fxc_referral =      173225
   OR fxc_prodcode =     199
   OR fxc_hcpcs = 'A6021'
   OR fxc_inscode = 14
   OR (fxc_agency = 0  AND fxc_agencyloc = 0)
   OR (fxc_custtype =   4510)
AND TODAY between fxc_begdate AND fxc_enddate
```

Estimated Cost: 179383

Estimated # of Rows Returned: 24343

1) informix.fmexcp: SEQUENTIAL SCAN

```
    Filters: ((((((((((informix.fmexcp.fxc_hcpcs = 'A6021' OR informix.fmexcp.fxc_catno = 'JJMA028' )
    OR informix.fmexcp.fxc_prodcode = 199 ) OR informix.fmexcp.fxc_inscode = 14 )
    OR informix.fmexcp.fxc_referral = 173225 ) OR informix.fmexcp.fxc_manuno = 1789 )
    OR informix.fmexcp.fxc_vendno = 0 ) OR informix.fmexcp.fxc_custtype = 4510 )
    OR informix.fmexcp.fxc_custno = 34514112) OR (informix.fmexcp.fxc_agency = 0
     AND informix.fmexcp.fxc_agencyloc = 0 ) ) AND informix.fmexcp.fxc_enddate >= TODAY )
     AND informix.fmexcp.fxc_begdate <= TODAY )
```

Methods for Improving SQL Performance

Query statistics:

Table map :

Internal name Table name

---

t1 fmexcp

type	table	rows_prod	est_rows	rows_scan	time	est_cost
scan	t1	4979	24343	20	96794	00:03.10	179383

Methods for Improving SQL Performance

Here are the current indexes on the table:

```
create index fxc_idx0 on fmexcp (fxc_catno)    using btree  in indx;
create index fxc_idx1 on fmexcp (fxc_manuno)    using btree  in indx;
create index fxc_idx2 on fmexcp (fxc_vendno)    using btree  in indx;
create index fxc_idx3 on fmexcp (fxc_custno)    using btree  in indx;
create index fxc_idx4 on fmexcp (fxc_referral)    using btree  in indx;
create index fxc_idx5 on fmexcp (fxc_prodcode)    using btree  in indx;
create index fxc_idx6 on fmexcp (fxc_inscode)    using btree  in indx;
create index fxc_idx7 on fmexcp (fxc_agency)    using btree  in indx;
create index fxc_idx8 on fmexcp (fxc_agencyloc)    using btree  in indx;
create index fxc_idx9 on fmexcp (fxc_custtype)    using btree  in indx;
```

Methods for Improving SQL Performance

```
SELECT *
FROM fmexcp
WHERE (fxc_catno = 'JJMA028‘                                    Index
   OR fxc_manuno =        1789                                  Index
   OR fxc_vendno =          0                                   Index
   OR fxc_custno =    34514112                                  Index
   OR fxc_referral =     173225                                 Index
   OR fxc_prodcode =    199                                     Index
   OR fxc_hcpcs = 'A6021‘
   OR fxc_inscode = 14                                          Index
   OR (fxc_agency = 0  AND fxc_agencyloc = 0)                   Index
   OR (fxc_custtype =   4510)                                   Index
AND TODAY between fxc_begdate AND fxc_enddate
```

```
create index fxc_idx0 on fmexcp (fxc_catno)    using btree  in indx;
create index fxc_idx1 on fmexcp (fxc_manuno)    using btree  in indx;
create index fxc_idx2 on fmexcp (fxc_vendno)    using btree  in indx;
create index fxc_idx3 on fmexcp (fxc_custno)    using btree  in indx;
create index fxc_idx4 on fmexcp (fxc_referral)    using btree  in indx;
create index fxc_idx5 on fmexcp (fxc_prodcode)    using btree  in indx;
create index fxc_idx6 on fmexcp (fxc_inscode)    using btree  in indx;
create index fxc_idx7 on fmexcp (fxc_agency)    using btree  in indx;
create index fxc_idx8 on fmexcp (fxc_agencyloc)    using btree  in indx;
create index fxc_idx9 on fmexcp (fxc_custtype)    using btree  in indx;
```

Methods for Improving SQL Performance

Added the following index:

```
create index fxc_idx10 on fmexcp (fxc_hcpcs)    using btree  in indx;
```

Methods for Improving SQL Performance

```
SELECT *
FROM fmexcp
WHERE (fxc_catno = 'JJMA028'
    OR fxc_manuno =         1789
    OR fxc_vendno =           0
    OR fxc_custno =    34514112
    OR fxc_referral =      173225
    OR fxc_prodcode =    199
    OR fxc_hcpcs = 'A6021'
    OR fxc_inscode = 14
    OR (fxc_agency = 0  AND fxc_agencyloc = 0)
    OR (fxc_custtype =   4510)
AND TODAY between fxc_begdate AND fxc_enddate
```

Estimated Cost: 1166

Estimated # of Rows Returned: 1445

Methods for Improving SQL Performance

1) informix.fmexcp: INDEX PATH

Filters: (informix.fmexcp.fxc_enddate >= TODAY AND informix.fmexcp.fxc_begdate <= TODAY)

(1) Index Name: root.fxc_idx0
Index Keys: fxc_catno (Serial, fragments: ALL)
Lower Index Filter: informix.fmexcp.fxc_catno = 'JJMA028'

(2) Index Name: root.fxc_idx5
Index Keys: fxc_prodcode (Serial, fragments: ALL)
Lower Index Filter: informix.fmexcp.fxc_prodcode = 199

(3) Index Name: root.fxc_idx6
Index Keys: fxc_inscode (Serial, fragments: ALL)
Lower Index Filter: informix.fmexcp.fxc_inscode = 14

(4) Index Name: informix.fxc_idx10
Index Keys: fxc_hcpcs (Serial, fragments: ALL)
Lower Index Filter: informix.fmexcp.fxc_hcpcs = 'A6021'

(5) Index Name: root.fxc_idx4
Index Keys: fxc_referral (Serial, fragments: ALL)
Lower Index Filter: informix.fmexcp.fxc_referral = 173225

Methods for Improving SQL Performance

(6) Index Name: root.fxc_idx1
Index Keys: fxc_manuno (Serial, fragments: ALL)
Lower Index Filter: informix.fmexcp.fxc_manuno = 1789

(7) Index Name: root.fxc_idx2
Index Keys: fxc_vendno (Serial, fragments: ALL)
Lower Index Filter: informix.fmexcp.fxc_vendno = 0

(8) Index Name: root.fxc_idx9
Index Keys: fxc_custtype (Serial, fragments: ALL)
Lower Index Filter: informix.fmexcp.fxc_custtype = 4510
(9) Index Name: root.fxc_idx3
Index Keys: fxc_custno (Serial, fragments: ALL)
Lower Index Filter: informix.fmexcp.fxc_custno = 34514112

(10) Index Name: root.fxc_idx7
Index Keys: fxc_agency (Serial, fragments: ALL)
Lower Index Filter: informix.fmexcp.fxc_agency = 0
PostIndex Filter:informix.fmexcp.fxc_agencyloc = 0

Methods for Improving SQL Performance

Query statistics:

Table map :

Internal name Table name
---
t1 fmexcp

type	table	rows_prod	est_rows	rows_	scan time	est_cost
scan	**t1**	**4979**	**1445**	**4979**	**00:00.02**	**1167**

Utilize Temp Tables with “IN” for 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,
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 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
```

Utilize DS_NONPDQ_QUERY_MEM

In one case at a client, by increasing DS_NONPDQ_QUERY_MEM

From 128 to 50000

The query time for a specific query went from 2.5 seconds down to .25 seconds.

Also, the wait on I/O from “top” output went from 2% to basically 0.

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

Questions?

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Thank You

Informix Tech Talks by the IIUG

We are launching a new channel on YouTube for Informix Users! This will be a place for Informix how-to videos. More information will be coming soon.