QEP ANALYSIS (COMMENTS IN BLUE)

1. Notice that none of the tables have statistics listed. These tables all need to be optimized with the command "optimizedb –zk–zr200 –zu200" to collect the statistics that will hopefully be the best possible.

```
      1. help table accounting


Name:                  accounting
Owner:                 prod_dba
Created:               04-aug-2002 12:31:23
Location:              ingdata
Type:                  user table
Version:               II2.6
Page size:             2048
Cache priority:        0
Alter table version:   0
Alter table totwidth:  77
Row width:             77
Number of rows:        1929165
Storage structure:     btree
Compression:           data
Duplicate Rows:        allowed

Number of pages:       157480
Overflow data pages:   0
Journaling:            enabled
Base table for view:   yes
Optimizer statistics:  none

Column Information:

                                                                  Key
Column Name                    Type        Length Nulls Defaults Seq
uw_year                        integer          2   no      yes     2
polno                          integer          4   no      yes     1
layer                          integer          1   no      yes     3
curr_pay                       varchar          3   no      yes     4
tx_date                        date                 no      yes
quarter                        integer          1   no      yes     5
rev_acct_num                   varchar          7   no      yes
mliterr_code                   integer          1   no      yes
mlicurr_code                   integer          1   no      yes
ins_code                       varchar          3   no      yes
rev_locl_amt                   money                no      yes
rev_book_amt                   money                no      yes
acct_fed                       date                 no      yes
finantxs_id                    integer          4   no      yes
legal_id                       integer          4   no      yes
```

→ It appears that there could be duplicate rows of data returned for a fully qualified keyed select. This could cause singleton select errors.

```
Secondary indexes:
Index Name                      Structure  Keyed On
x_acct_ftxid                    btree      finantxs_id
x_acct_num                      isam       rev_acct_num
```

→ "btree" better choice for this index.

```
      2> help index x_acct_ftxid


Name:                 x_acct_ftxid
Owner:                prod_dba
Created:              04-aug-2002 12:41:21
Location:             ingdata
Type:                 secondary index on accounting
Version:              II2.6
Page size:            2048
Cache priority:       0
Alter table version:  0
Alter table totwidth: 8
Row width:            8
Number of rows:       1929165
Storage structure:    btree
Compression:          none
Duplicate Rows:       allowed
Number of pages:      20285
Overflow data pages:  0
Journaling:           enabled if journaling on the base table is enabled
Base table for view:  no
Optimizer statistics: will use any existing statistics on the base table

Index Column Information:
                                                                  Key
Column Name                     Type       Length Nulls Defaults Seq
finantxs_id                     integer         4   no     yes     1
tidp                            integer         4   no      no     2


      3> help index x_acct_num


Name:                 x_acct_num
Owner:                prod_dba
Created:              04-aug-2002 12:40:44
Location:             ingdata
Type:                 secondary index on accounting
Version:              II2.6
Page size:            2048
Cache priority:       0
Alter table version:  0
Alter table totwidth: 13
Row width:            13
Number of rows:       1929165
Storage structure:    isam
Compression:          none
```

```
3> help index x_acct_num   (continued)

Duplicate Rows:       allowed
Number of pages:      20905
Overflow data pages:  0
Journaling:           enabled if journaling on the base table is enabled
Base table for view:  no
Optimizer statistics: will use any existing statistics on the base table
Index Column Information:
                                                                    Key
Column Name                    Type       Length Nulls Defaults Seq
rev_acct_num                   varchar         7   no     yes     1
tidp                           integer         4   no      no     2


4> help table currency

Name:                 currency
Owner:                prod_dba
Created:              04-aug-2002 12:13:13
Location:             ingdata
Type:                 user table
Version:              II2.6
Page size:            2048
Cache priority:       0
Alter table version:  0
Alter table totwidth: 71
Row width:            71
Number of rows:       69
Storage structure:    btree with unique keys
Compression:          none
Duplicate Rows:       not allowed
Number of pages:      8
Overflow data pages:  0
Journaling:           enabled
Base table for view:  no
Optimizer statistics: none

Column Information:
                                                                    Key
Column Name                    Type       Length Nulls Defaults Seq
curr_abbr                      char            3   no     yes     1
curr_name                      char           30   no     yes
exch_rate                      float           8   no     yes
inflate_fact                   integer         4   no     yes
mlicurr_code                   char            2   no     yes
restricted                     char            1   no     yes
rate_date                      date                no     yes
recip_rate                     float           8   no     yes
rskregn_abbr                   char            3   no     yes


Secondary indexes:    none
```

```
      5> help table contract

Name:                  contract
Owner:                 prod_dba
Created:               04-aug-2002 12:10:27
Location:              ingdata
Type:                  user table
Version:               II2.6
Page size:             2048
Cache priority:        0
Alter table version:   0
Alter table totwidth:  457
Row width:             457
Number of rows:        10003
Storage structure:     btree with unique keys
Compression:           none
Duplicate Rows:        not allowed
Number of pages:       2710
Overflow data pages:   0
Journaling:            enabled
Base table for view:   yes
Optimizer statistics:  none

Column Information:
                                                                      Key
Column Name                      Type       Length Nulls Defaults    Seq
uw_year                          integer         2   no     yes       2
polno                            integer         4   no     yes       1
layer                            integer         1   no     yes       3
curr_pay                         varchar         3   no     yes       4
deal_desc                        varchar        45   no     yes
ref_num                          varchar        20   no     yes
rprt_cls1                        char            3   no     yes
line                             varchar         3   no     yes
nature_protn                     char            3   no     yes
treaty                           varchar         3   no     yes
war_risk                         varchar         3   no     yes
res                              varchar         3   no     yes
misterr_abbr                     varchar         3   no     yes
rsrve_srce                       varchar         3   no     yes
under_freq                       varchar         1   no     yes
loss_method                      varchar         3   no     yes
prem_type                        varchar         3   no     yes
depst_prem                       varchar         3   no     yes
curr_cov                         varchar         3   no     yes
prem_freq                        varchar         1   no     yes
status                           varchar         3   no     yes
ins_code                         varchar         3   no     yes
mgfee_type                       varchar         3   no     yes
mgfee_rate                       float           4   no     yes
commission                       float           4   no     yes
brkr_code                        varchar         4   no     yes
brkrg_rate                       float           4   no     yes
brkrg_type                       varchar         3   no     yes
profit_comm                      float           4   no     yes
effective                        date                no     yes
fst_effctive                     date                no     yes
next_anniv                       date                no     yes
cancel                           date                no     yes
risk_limit                       money               no     yes
retntion_dlr                     money               no     yes
agg_limit                        money               no     yes
max_limit                        money               no     yes
num_lvs_wrty                     integer         1   no     yes
```

```
Column Information: (continued)

Column Name                         Type       Length Nulls Defaults Seq

retntion_pct                        float           4   no     yes
share_pct                           float           4   no     yes
canc_notice                         integer         2   no     yes
fac_reserved                        varchar         1   no     yes
treaty_exist                        varchar         1   no     yes
lst_fincl_tx                        date                no     yes
lst_contr_tx                        date                no     yes
accrual_done                        varchar         1   no     yes
pr_date                             date                no     yes
nxt_pay_due                         date                no     yes
tot_claims                          money               no     yes
asscomp_code                        varchar         3   no     yes
arc_block_id                        integer         4   no     yes
pre_merger_block_id                 varchar         3   no     yes
mgu_code                            varchar         4   no     yes
uw_assigned                         varchar        12   no     yes
last_possible_exp_date              date                no     yes
lastposs_exp_status_code            char            8   no     yes
ultimate_pric_prem_amt              money               no     yes
ultimate_uw_prem_amt                money               no     yes
net_risk_amt                        money               no     yes
retro_direct_type                   char            6   no     yes
pool_facility_type_code             char            9   no     yes
orig_ced_comp_code                  char            3   no     yes
risk_region_code                    char            3   no     yes
uw_risk_type_code                   char           10   no     yes
syndicate_group_id                  integer         4   no     yes
risk_country_abbr                   char            3   no     yes

Secondary indexes:    none


      6> help table dates


Name:                 dates
Owner:                prod_dba
Created:              04-aug-2002 12:13:10
Location:             ingdata
Type:                 user table
Version:              II2.6
Page size:            2048
Cache priority:       0
Alter table version:  0
Alter table totwidth: 68
Row width:            68
Number of rows:       1
Storage structure:    heap
Compression:          data
Duplicate Rows:       allowed
Number of pages:      3
Overflow data pages:  0
Journaling:           enabled
Base table for view:  no
Optimizer statistics: none
```

```
      6> help table dates (continued)

Column Information:
                                                                    Key
Column Name                    Type       Length Nulls Defaults Seq
today_dt                       date              no     yes
monthend_dt                    date              no     yes
accrue_dt                      date              no     yes
mthend_st                      varchar       18  no     yes
arc_cutoff_date                date              no     yes

Secondary indexes:    none

      7> SET QEP


      8> set optimizeonly


      9> SELECT a.uw_year
            ,a.polno
            ,a.layer
            ,a.curr_pay
            ,a.quarter
            ,a.legal_id
            ,prem_due =
            DATE (c.effective)+ DATE (CONCAT (VARCHAR ((a.quarter - 1) * 3),'mos'))
            ,os_prem = SUM (a.rev_locl_amt)
            ,os_prem_book = SUM (a.rev_locl_amt * b.exch_rate)
            ,currency b
            ,contract c
            ,dates d
      WHERE a.curr_pay = b.curr_abbr
        AND DATE (c.effective)+DATE (CONCAT (VARCHAR ((a.quarter - 1) * 3),'mos'))
            < d.monthend_dt - DATE ('180 days')
        AND a.rev_acct_num = '2112.01'
        AND a.uw_year = c.uw_year
        AND a.polno = c.polno
        AND a.layer = c.layer
        AND a.curr_pay = c.curr_pay
      GROUP BY a.uw_year
               ,a.polno
               ,a.layer
               ,a.curr_pay
               ,a.quarter
               ,a.legal_id
               ,c.effective
      HAVING ABS (SUM (a.rev_locl_amt)) > 1000


**********************************************************************

QUERY PLAN 3,4, no timeout, of function aggregate
producing temporary table T4
```

→ The optimizer found the plan that it felt was best.

```
aggregate expression ->  → This is from the "HAVING" clause – just informational.
T4A9 =
sum
(agg expr)

   aggregate expression ->  → This is from the "GROUP BY" clause – just informational.
T4A8 =
sum
(rev_locl_amt)

    by expression attribute -> T4A7
 = effective
    by expression attribute -> T4A6
 = legal_id
    by expression attribute -> T4A5
 = quarter
    by expression attribute -> T4A4
 = curr_pay
    by expression attribute -> T4A3
 = layer
    by expression attribute -> T4A2
 = polno
    by expression attribute -> T4A1
 = uw_year
```

```
                                        Sort Keep dups
                                         Pages 3 Tups 111    → You will see these again!
                                         D19728 C6160          Disk I/O count is high.

                                  /
                                  Cart-Prod →          RED FLAG! Caused by a disjoint query.
                                  Heap                  In this case it is the 'dates' table
                                  Pages 3 Tups 111     only contains a single row of data.
                                  D19728 C6149

 /                                                  \
                        K Join(curr_abbr)   → Key join = good          Proj-rest
                        Heap                                           Heap
                        Pages 6 Tups 221                               Pages 1 Tups 1
                        D19727 C6144                                   D1 C0
                  /                        \                          /
                  FSM Join(polno,           currency                  dates
                  uw_year,                  (b)                      (d)
                  layer,                    B-Tree(curr_abbr)        cHeap
                  curr_pay)                 Pages 8 Tups 69          Pages 3 Tups 1
                  Partial(FA0 curr_pay)
                  Pages 48 Tups 2214
                  D19723 C6102
/                          \
Proj-rest                   T Join(tidp)          →  Disk estimates are cumulative moving up
Sorted(polno,              Sort on(polno,             the tree.  We see that the biggest in crease
uw_year,                   uw_year,                   occurs at this node.  That indicates that
layer,                     layer,                     the index used might not have been the
curr_pay)                  curr_pay)                  best choice.  The best way to address this
Pages 130 Tups 10003       Pages 288 Tups 19292       would be to add other supporting data
D1355 C100                 D18368 C388                columns to this  index  (adding curr_pay,
                                                      polno, layer, quarter, uw_year, and rev_acct_
                                                      num would add 22 bytes per row to the index,
                                                      but then the index would satisfy most of the
                                                      query and  significantly reduce I/O, thereby
                                                      improving performance.
```

→ Contract table is being scanned

```
 /                      /                      \
contract               Proj-rest              accounting
(c)                    Heap                   (a)
B-Tree(NU)             Pages 144 Tups 19292   cB-Tree(NU)
Pages 2710 Tups 10003  D211 C2                Pages 157480 Tups 1929165
```

→ The 'accounting' table shows that its primary key is not being used (NU). This is OK since you can see that it earlier selected data from an index on this table (see T Join above).

```
            /
            x_acct_num


            I(a)
            Isam(rev_acct_num)
            Pages 20905 Tups 1929165
```

→ Start here and work your way up. Once you get to the top then look at the query below. What you should see is the most restrictive part of the query "pushed down" to this level. The goal is to minimize the result set of data as quickly as possible.

This is showing us that 'x_acct_num' is an index (I) on the table alias "a" ('account', from the query above), that the storage structure of the index is isam, and that it has an estimated 1,929,165 rows of data on 20.905 Ingres pages (data and index).

```
QUERY PLAN 1,1, no timeout, of main query

            Proj-rest
            Sorted(T4A1 uw_year,
             T4A2 polno,
             T4A3 layer,
             T4A4 curr_pay,
T4A5 quarter,
             T4A6 legal_id,
             T4A7 effective,
             T4A9 rev_locl_amt)
             Pages 2 Tups 55
            D19729 C6161
```

→ Shows the sort order of the data set.

→ These are the estimated query. There was only one additional Disk I/O over the base query (above).

```
 /
T4

Heap
Pages 3 Tups 111
```

→ This is the temporary table created by the first step (above).
The default result structure is heap.
The optimizer estimates that there will be 111 rows of data on 3 data pages.

Notes:

1. Make sure that the table that you feel is the most restrictive is pushed down to the bottom of the query.

2. Always look at the estimates at each level to see if they are reasonable. When an estimate is too high or too low that generally indicates an issue with statistics.

3. Look to see where I/O increases. This is often indicative of either a problem or an opportunity for improvement.

4. Look for Cartesian Product nodes (Cart-Prod). These are almost always bad.

5. Look for indexes / storage structures that are not used (NU). Unless there is an action on a related index prior to that node this indicates a table scan.

6. Remember that Ingres will only use a single access method per table. Because of this it is important to provide as much additional data as makes sense (e.g., for the 77 byte account table adding 22 bytes to an index would make sense, but adding 30+ bytes to and index would not make sense). This will maximize the probability of having good performing queries every time.

Recommendations:

1. Change the storage structure for the index x_acct_num from 'isam' to 'btree'.

2. Add the columns curr_pay, quarter, rev_acct_num, uw_year, polno, layer to the index x_acct_num.

3. Add statistics to the database using the optimizedb command (use the flags "-zk –zu200 –zr200").

4. After optimization run the "sysmod" command on the database.

5. If these four changes are made I would expect to see a decrease in Disk I/O of an order of magnitude (provided the estimates are reasonably correct). This should result in the query running significantly faster.

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