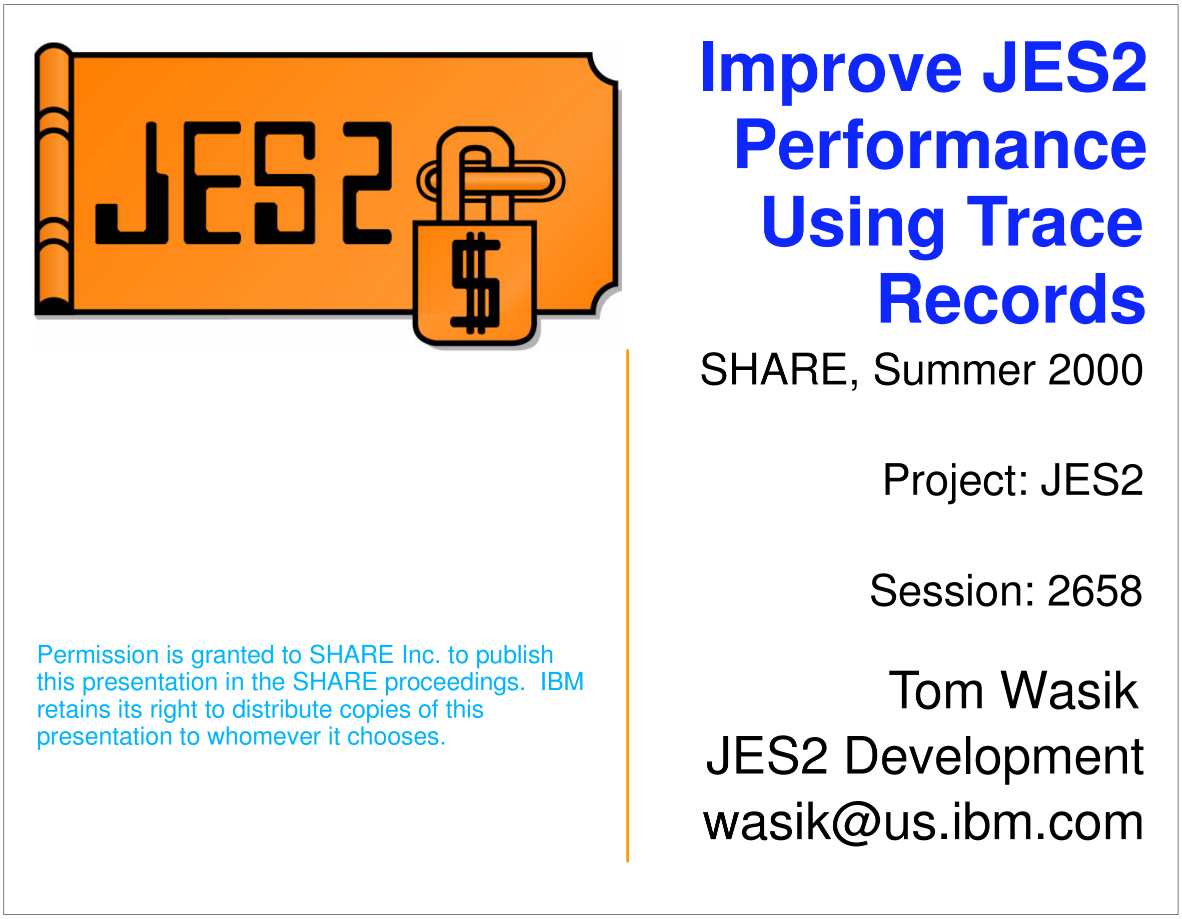

Improve JES2 Performance Using Trace Records

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Project: JES2

Session: 2658

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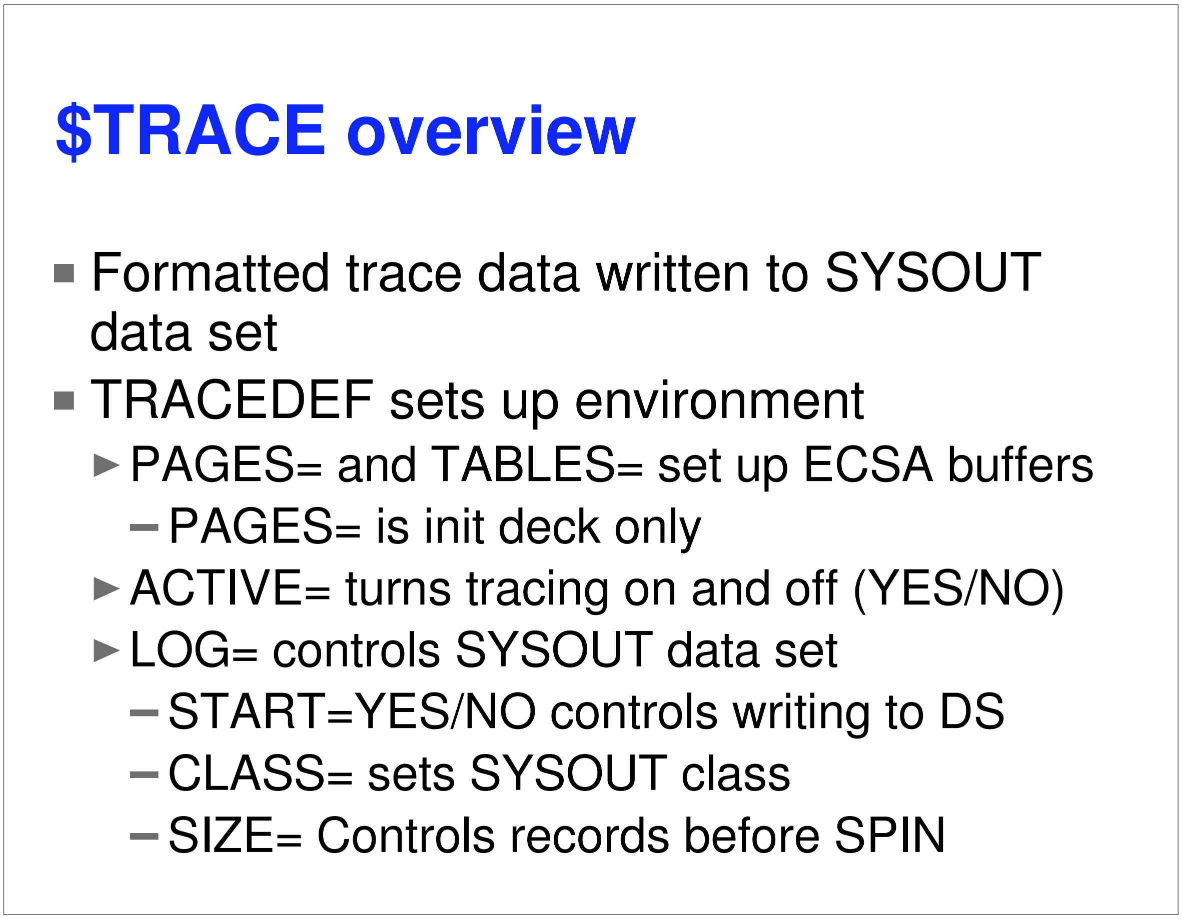
- This presentation describes various JES2 trace records and how to use them to improve overall JES2 performance. It is assumed that you are familiar with JES2 and have a knowledge of the JES2 $TRACE facility.
- This presentation was created using examples from the OS/390 release 10 level of JES2. Some differences may exist in older levels of JES2.

Overview

This presentation will cover the following:

- Quick overview of the JES2 $TRACE facility
- Relevant trace record information
  - ID 17 - Checkpoint
  - ID 20 - SYSOUT work selection
  - ID 30 - Posting for new work
  - ID 31 - JOB work selection
  - Others
- Putting it all together



$TRACE overview

- Formatted trace data written to SYSOUT data set
- TRACEDEF sets up environment
  - PAGES= and TABLES= set up ECSA buffers
    - PAGES= is init deck only
  - ACTIVE= turns tracing on and off (YES/NO)
  - LOG= controls SYSOUT data set
    - START=YES/NO controls writing to DS
    - CLASS= sets SYSOUT class
    - SIZE= Controls records before SPIN

$TRACE overview *(continued)*

- TRACE(n) controls individual IDs
  - START=YES/NO turns an ID on or off
- PCEs/Devices can have selective tracing
  - TR or TRACE=YES/NO controls device
- Trace data sets can be spun at any time
  - $TTRACEDEF,SPIN

Turning on a trace and create SYSOUT

- $T TRACEDEF,ACTIVE=YES, LOG=(START=YES)
- $STRACE(17)

run test

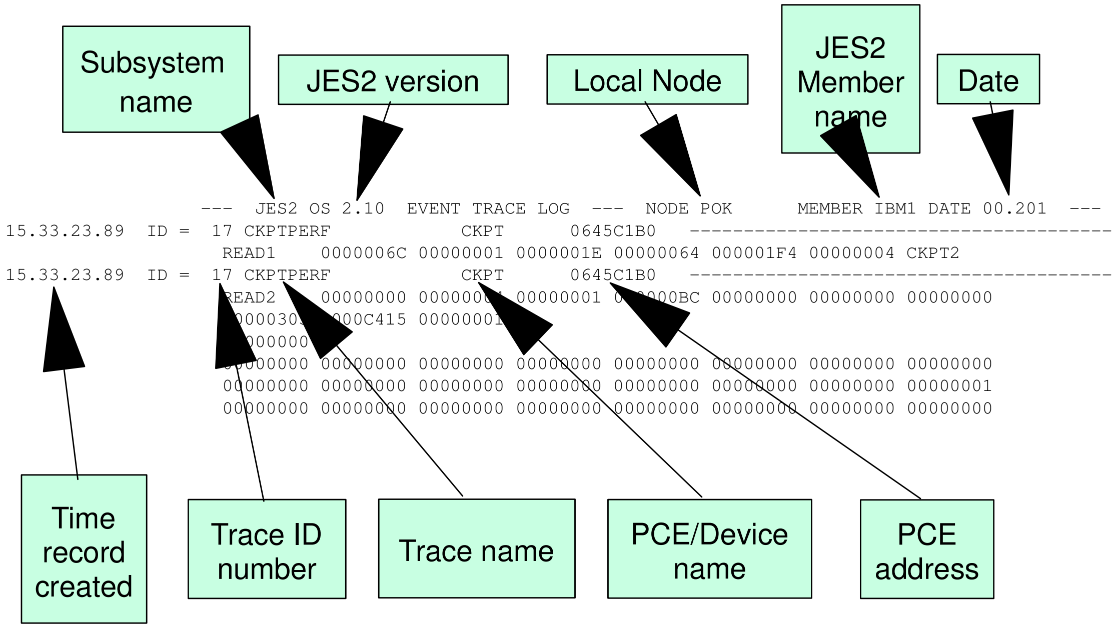
- $PTRACE(17)
- $T TRACEDEF,SPIN
- $T TRACEDEF,ACTIVE=NO

$TRACE output

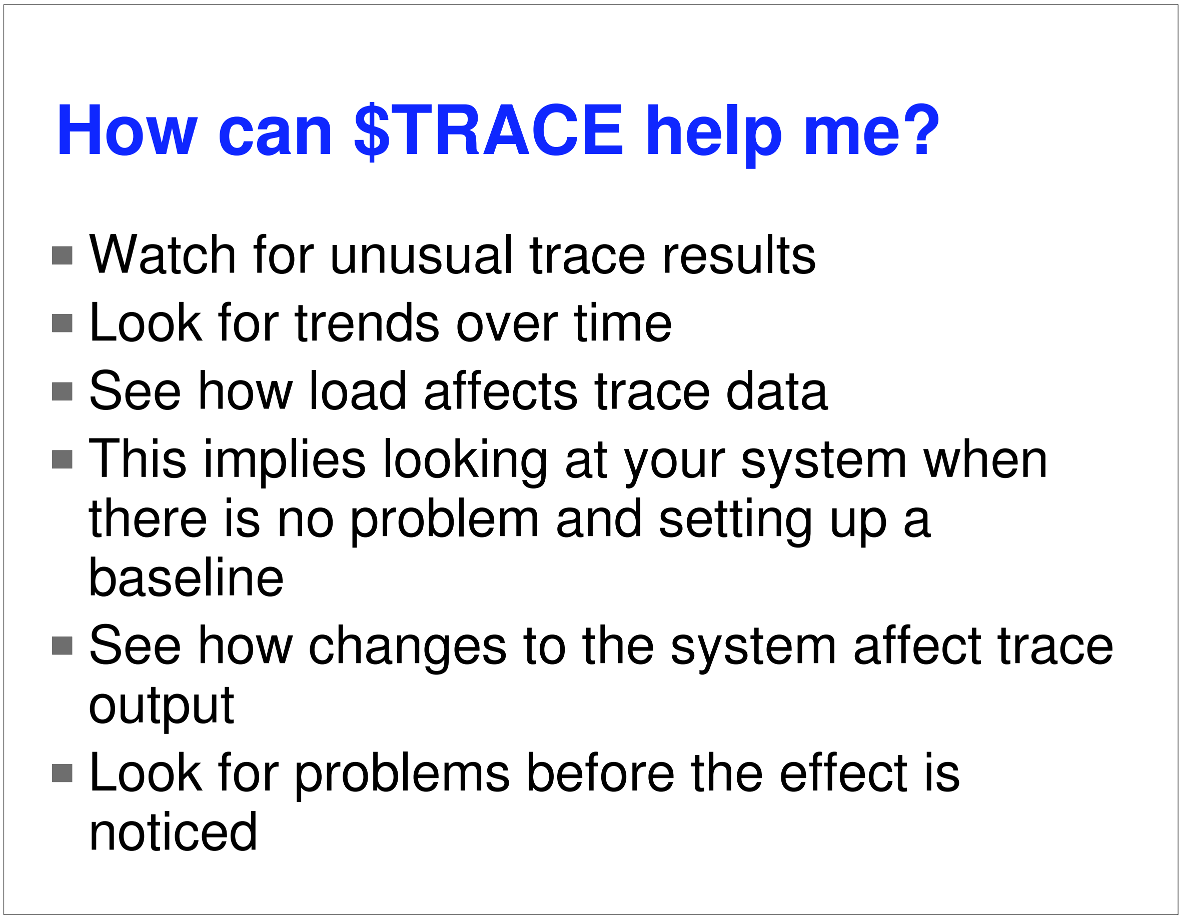
- SPIN SYSOUT data set created
  - JOBNAME is $TRCLOG
  - This is an STC
  - SYSOUT class is as specified on TRACEDEF

```
$HASP686 OUTPUT($TRCLOG)   OUTGRP=1.1.1,BURST=NO,FCB=****,
$HASP686                   FLASH=****,FORMS=STD,HOLD=(NONE),
$HASP686                   OUTDISP=WRITE,PRIORITY=144,
$HASP686                   PRMODE=LINE,QUEUE=A,
$HASP686                   RECORDS=(91 OF 91),ROUTECDE=LOCAL,
$HASP686                   SECLABEL=,TSOAVAIL=NO,UCS=****,
$HASP686                   USERID=IBMUSER,WRITER=
```

$TRACE Output *(continued)*



```
                  ---  JES2 OS 2.10  EVENT TRACE LOG  ---  NODE POK      MEMBER IBM1 DATE 00.201  ---
15.33.23.89  ID =  17 CKPTPERF            CKPT      0645C1B0   --------------------------------------
                    READ1    0000006C 00000001 0000001E 00000064 000001F4 00000004 CKPT2
15.33.23.89  ID =  17 CKPTPERF            CKPT      0645C1B0   --------------------------------------
                    READ2    00000000 00000001 00000001 000000BC 00000000 00000000 00000000
                    00000300 0000C415 00000001
                    00000000
                    00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
                    00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000001
                    00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
```



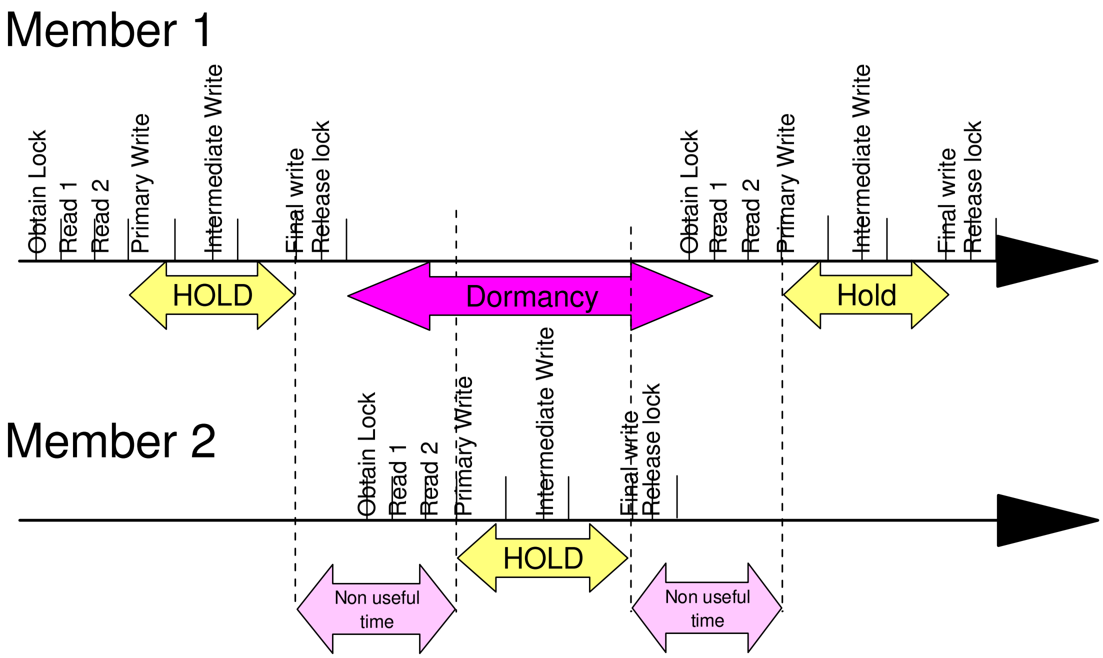
How can $TRACE help me?

- Watch for unusual trace results
- Look for trends over time
- See how load affects trace data
- This implies looking at your system when there is no problem and setting up a baseline
- See how changes to the system affect trace output
- Look for problems before the effect is noticed

Trace 17 - Checkpoint

- This traces all CKPT I/O and reports various data
- Reduction program JES2T17A in SHASSAMP
- Most useful in an MAS
- Tuning knobs that this can help with
  - MASDEF HOLD= and DORMANCY=

The Checkpoint Cycle

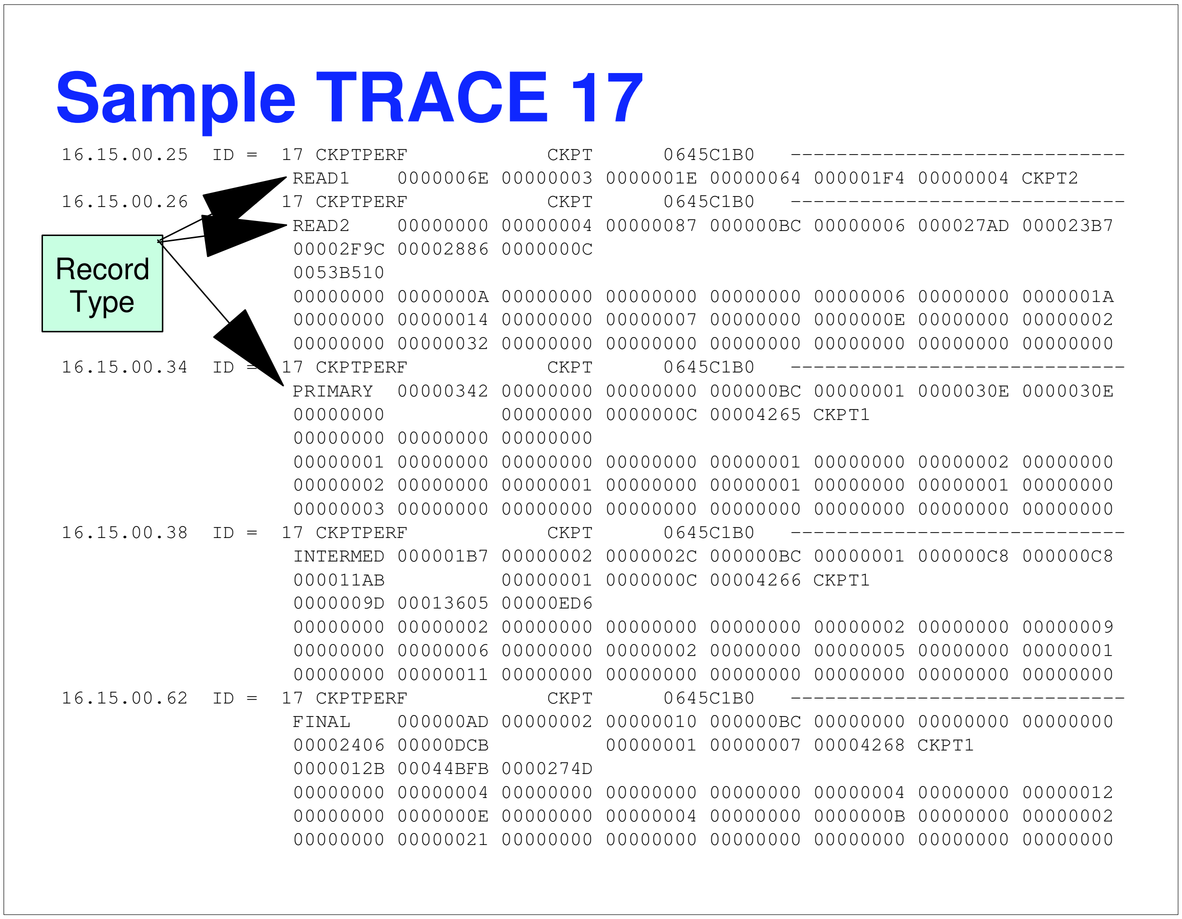


Trace 17 - Checkpoint *(continued)*

- Goal in tuning
  - Reduce MAS performance penalty
  - Functions in MAS are delayed waiting for checkpoint
  - Impact of delay can be reduced by parallel processing
    - Parallel processing example - use multiple internal readers to submit jobs instead of a single internal reader
  - CKPT tuning can also reduce delays

Trace 17 - Checkpoint *(continued)*

- Goals in tuning (continued)
  - Balancing act between
    - Reduce time to reacquire checkpoint
    - Hold long enough to not create additional delays
    - Keep non-useful time in CKPT cycle short
  - Trace 17 and its reduction program helps adjust the balance

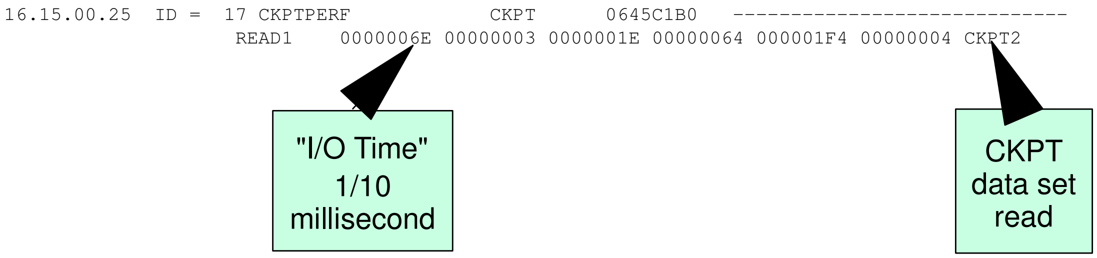


Sample TRACE 17

Record Type

```
16.15.00.25  ID =  17 CKPTPERF            CKPT      0645C1B0   -----------------------------
                    READ1    0000006E 00000003 0000001E 00000064 000001F4 00000004 CKPT2
16.15.00.26        17 CKPTPERF            CKPT      0645C1B0   -----------------------------
                    READ2    00000000 00000004 00000087 000000BC 00000006 000027AD 000023B7
                    00002F9C 00002886 0000000C
                    0053B510
                    00000000 0000000A 00000000 00000000 00000000 00000006 00000000 0000001A
                    00000000 00000014 00000000 00000007 00000000 0000000E 00000000 00000002
                    00000000 00000032 00000000 00000000 00000000 00000000 00000000 00000000
16.15.00.34  ID =  17 CKPTPERF            CKPT      0645C1B0   -----------------------------
                    PRIMARY  00000342 00000000 00000000 000000BC 00000001 0000030E 0000030E
                    00000000          00000000 0000000C 00004265 CKPT1
                    00000000 00000000 00000000
                    00000001 00000000 00000000 00000000 00000001 00000000 00000002 00000000
                    00000002 00000000 00000001 00000000 00000001 00000000 00000001 00000000
                    00000003 00000000 00000000 00000000 00000000 00000000 00000000 00000000
16.15.00.38  ID =  17 CKPTPERF            CKPT      0645C1B0   -----------------------------
                    INTERMED 000001B7 00000002 0000002C 000000BC 00000001 000000C8 000000C8
                    000011AB          00000001 0000000C 00004266 CKPT1
                    0000009D 00013605 00000ED6
                    00000000 00000002 00000000 00000000 00000000 00000002 00000000 00000009
                    00000000 00000006 00000000 00000002 00000000 00000005 00000000 00000001
                    00000000 00000011 00000000 00000000 00000000 00000000 00000000 00000000
16.15.00.62  ID =  17 CKPTPERF            CKPT      0645C1B0   -----------------------------
                    FINAL    000000AD 00000002 00000010 000000BC 00000000 00000000 00000000
                    00002406 00000DCB          00000001 00000007 00004268 CKPT1
                    0000012B 00044BFB 0000274D
                    00000000 00000004 00000000 00000000 00000000 00000004 00000000 00000012
                    00000000 0000000E 00000000 00000004 00000000 0000000B 00000000 00000002
                    00000000 00000021 00000000 00000000 00000000 00000000 00000000 00000000
```

Sample TRACE 17 - READ1

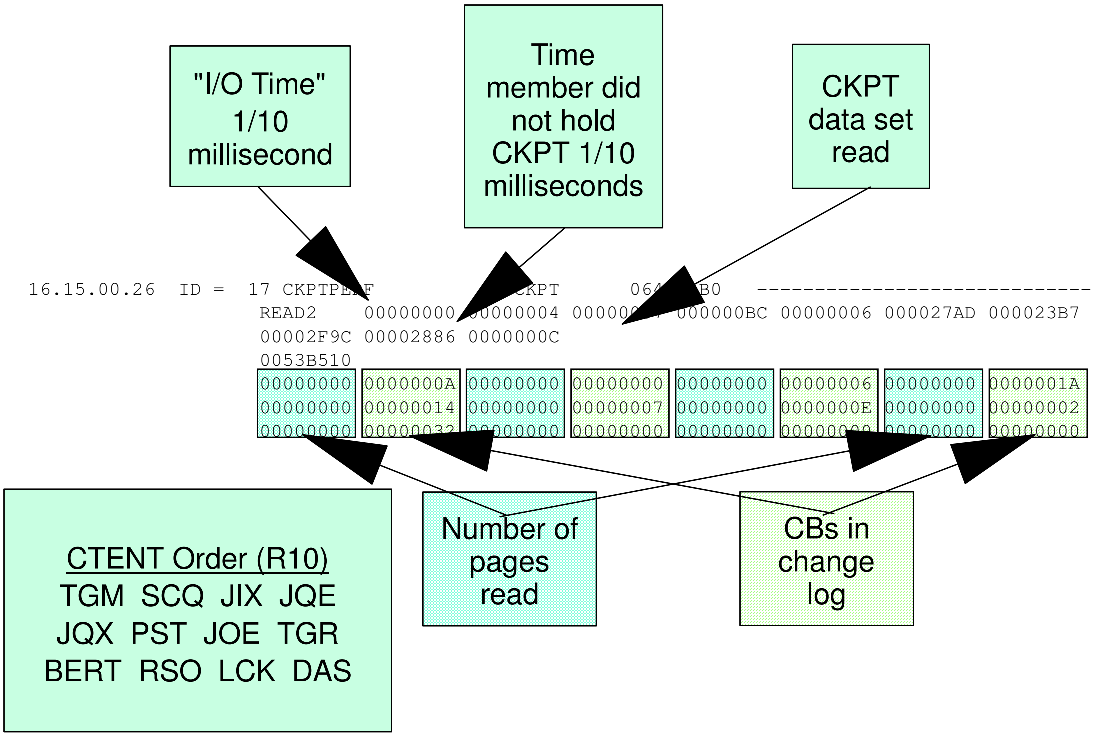


```
16.15.00.25  ID =  17 CKPTPERF            CKPT      0645C1B0   -----------------------------
                    READ1     0000006E 00000003 0000001E 00000064 000001F4 00000004 CKPT2
```

"I/O Time"
1/10
millisecond

CKPT
data set
read

Sample TRACE 17 - READ2



```
16.15.00.26  ID =  17 CKPTPERF          CKPT       064[illegible]B0   -----------------------------
                      READ2     00000000 00000004 000000[illegible]7 000000BC 00000006 000027AD 000023B7
                      00002F9C 00002886 0000000C
                      0053B510
                      00000000 0000000A 00000000 00000000 00000000 00000006 00000000 0000001A
                      00000000 00000014 00000000 00000007 00000000 0000000E 00000000 00000002
                      00000000 00000032 00000000 00000000 00000000 00000000 00000000 00000000
```

"I/O Time" 1/10 millisecond

Time member did not hold CKPT 1/10 milliseconds

CKPT data set read

Number of pages read

CBs in change log

CTENT Order (R10)
TGM SCQ JIX JQE
JQX PST JOE TGR
BERT RSO LCK DAS

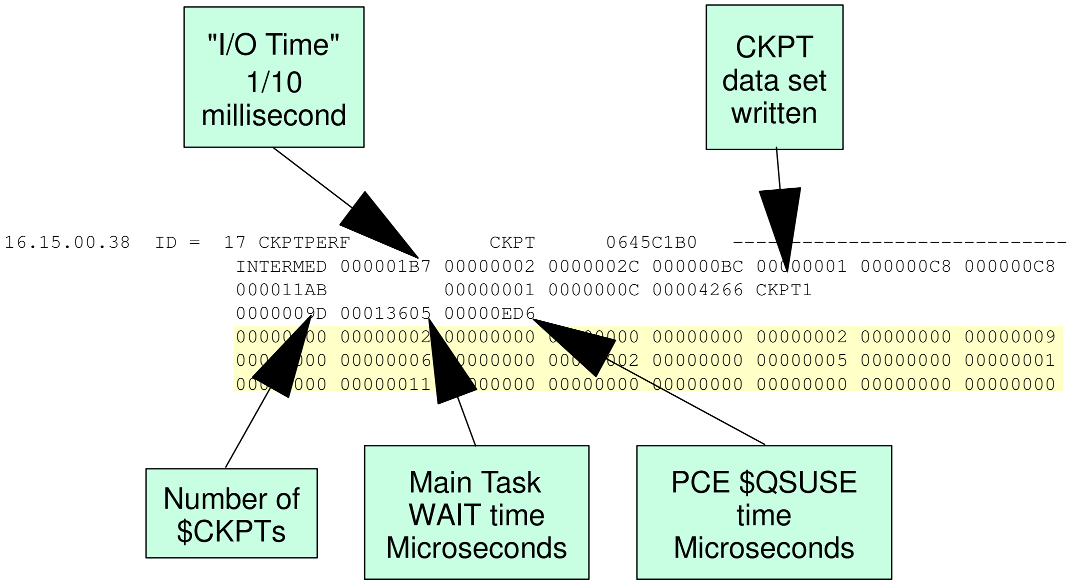
Sample TRACE 17 - PRIMARY

"I/O Time"
1/10
millisecond

CKPT
data set
written

```
16.15.00.34  ID =  17 CKPTPERF            CKPT      0645C1B0   -----------------------------
                    PRIMARY  00000342 00000000 00000000 000000BC 00000001 0000030E 0000030E
                    00000000          00000000 0000000C 00004265 CKPT1
                    00000000 00000000 00000000
                    00000001 00000000 00000000 00000000 00000001 00000000 00000002 00000000
                    00000002 00000000 00000001 00000000 00000001 00000000 00000001 00000000
                    00000003 00000000 00000000 00000000 00000000 00000000 00000000 00000000
```

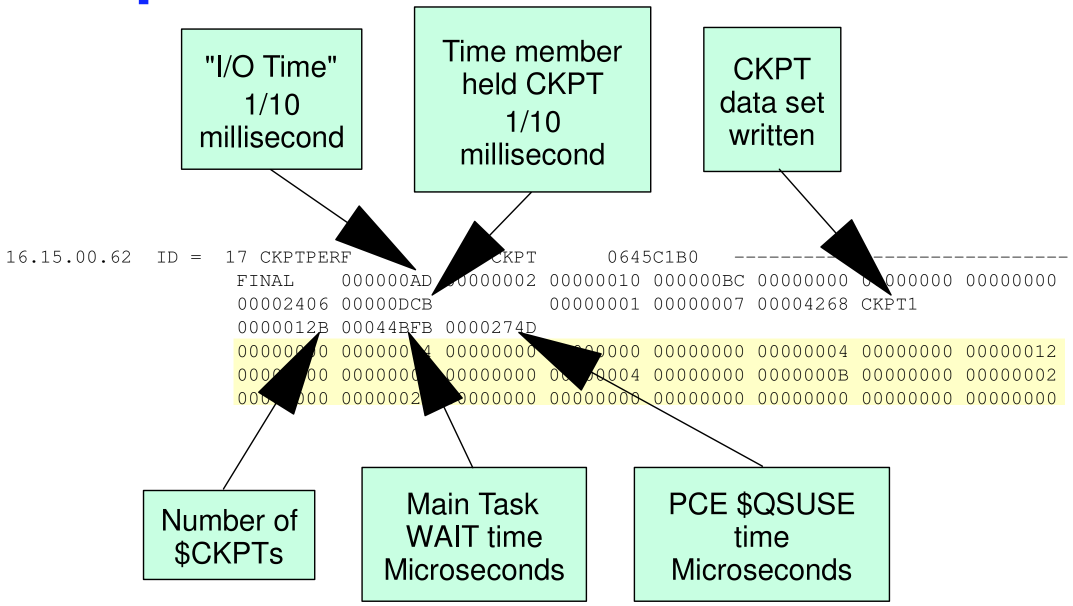
Sample TRACE 17 - INTERMED



```
16.15.00.38  ID =  17 CKPTPERF            CKPT      0645C1B0   -----------------------------
                    INTERMED 000001B7 00000002 0000002C 000000BC 00000001 000000C8 000000C8
                    000011AB          00000001 0000000C 00004266 CKPT1
                    0000009D 00013605 00000ED6
                    00000000 00000002 00000000 00000000 00000000 00000002 00000000 00000009
                    00000000 00000006 00000000 00000002 00000000 00000005 00000000 00000001
                    00000000 00000011 00000000 00000000 00000000 00000000 00000000 00000000
```

"I/O Time" 1/10 millisecond
CKPT data set written
Number of $CKPTs
Main Task WAIT time Microseconds
PCE $QSUSE time Microseconds

Sample TRACE 17 - Final



```
16.15.00.62  ID =  17 CKPTPERF           CKPT      0645C1B0   -----------------------------
                     FINAL    000000AD 00000002 00000010 000000BC 00000000 00000000 00000000
                     00002406 00000DCB          00000001 00000007 00004268 CKPT1
                     0000012B 00044BFB 0000274D
                     00000000 00000004 00000000 00000000 00000000 00000004 00000000 00000012
                     00000000 00000000 00000000 00000004 00000000 0000000B 00000000 00000002
                     00000000 00000002 00000000 00000000 00000000 00000000 00000000 00000000
```

"I/O Time"
1/10
millisecond

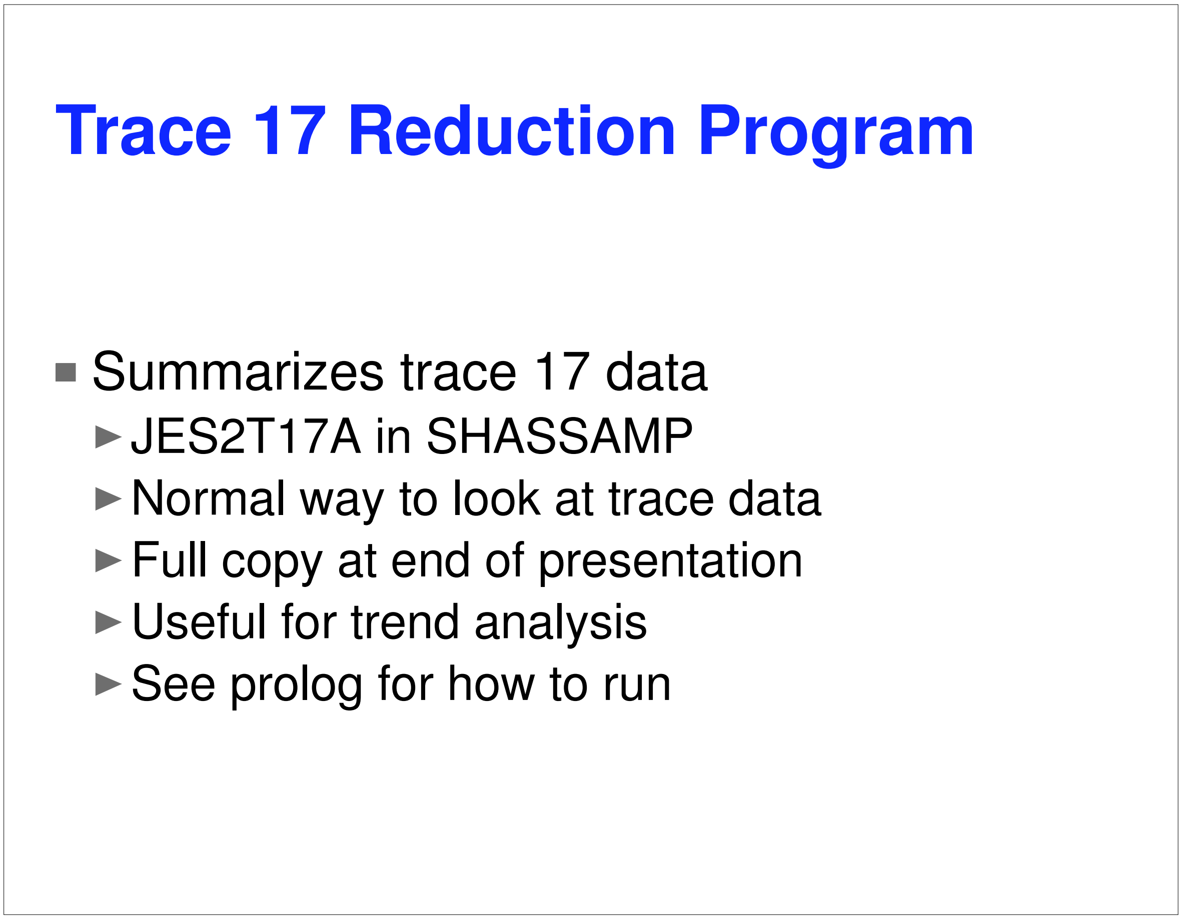
Time member
held CKPT
1/10
millisecond

CKPT
data set
written

Number of
$CKPTs

Main Task
WAIT time
Microseconds

PCE $QSUSE
time
Microseconds



Trace 17 Reduction Program

- Summarizes trace 17 data
  - ► JES2T17A in SHASSAMP
  - ► Normal way to look at trace data
  - ► Full copy at end of presentation
  - ► Useful for trend analysis
  - ► See prolog for how to run

Trace 17 Reduction Program

Non-zero counts means data was read and processed

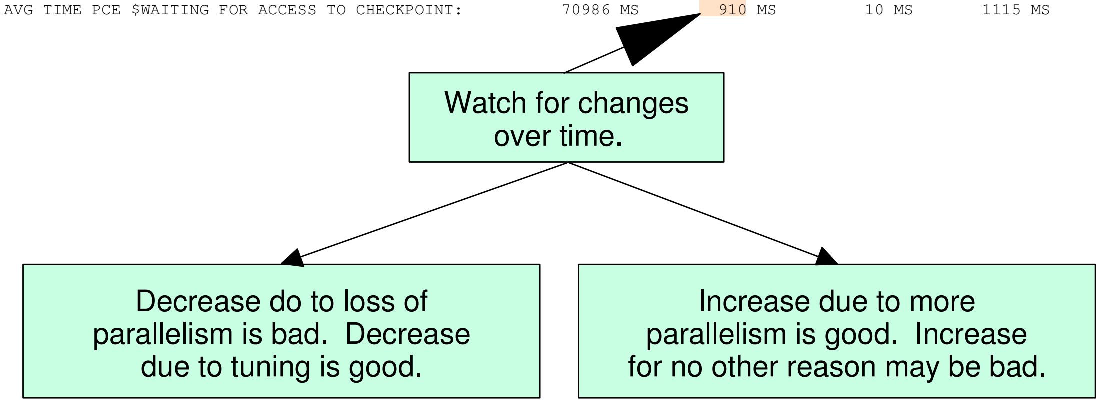
```
TRACE DATASET STATISTICS
========================
 TOTAL NUMBER OF TRACE RECORDS READ:                                            431
 TOTAL NUMBER OF CHECKPOINT (TYPE 17) TRACE RECORDS READ:                       431
 TOTAL NUMBER OF CHECKPOINT (TYPE 17) TRACE RECORDS READ - READ1:                78
 TOTAL NUMBER OF CHECKPOINT (TYPE 17) TRACE RECORDS READ - READ2:                78
 TOTAL NUMBER OF CHECKPOINT (TYPE 17) TRACE RECORDS READ - PRIMARY:              78
 TOTAL NUMBER OF CHECKPOINT (TYPE 17) TRACE RECORDS READ - INTERMEDIATE:        119
 TOTAL NUMBER OF CHECKPOINT (TYPE 17) TRACE RECORDS READ - FINAL:                78
 TOTAL NUMBER OF TRACE FILE ERRORS:                                               0
 JES2 NODE NAME:                                                           NNNNNNNN
 JES2 MEMBER NAME:                                                             MMMM
 START DATE OF TRACE:                                                        YY.DDD
 TIME STAMP - FIRST TRACE RECORD (START OF TRACE):                         16.14.30
 TIME STAMP - LAST  TRACE RECORD (END   OF TRACE):                         16.16.18
CHECKPOINT CYCLE STATISTICS                               TOTAL      AVERAGE       MINIMUM       MAXIMUM
===========================                            ========     ========      ========      ========
CYCLE TIME - (READ2 TO READ2):                           107640 MS     1416 MS       1330 MS       1710 MS
```

Cycle time good first place to look
Under 2000 is very good

High MAX could indicate a problem

Trace 17 Reduction Program

```
READ2 STATISTICS                                         TOTAL       AVERAGE       MINIMUM       MAXIMUM
================                                      ========      ========      ========      ========
NUMBER OF PCES $WAITING FOR ACCESS TO CHECKPOINT:          405             5             2             9
MAX TIME PCE $WAITING FOR ACCESS TO CHECKPOINT:          78226 MS       1003 MS         12 MS       1221 MS
AVG TIME PCE $WAITING FOR ACCESS TO CHECKPOINT:          70986 MS        910 MS         10 MS       1115 MS
```

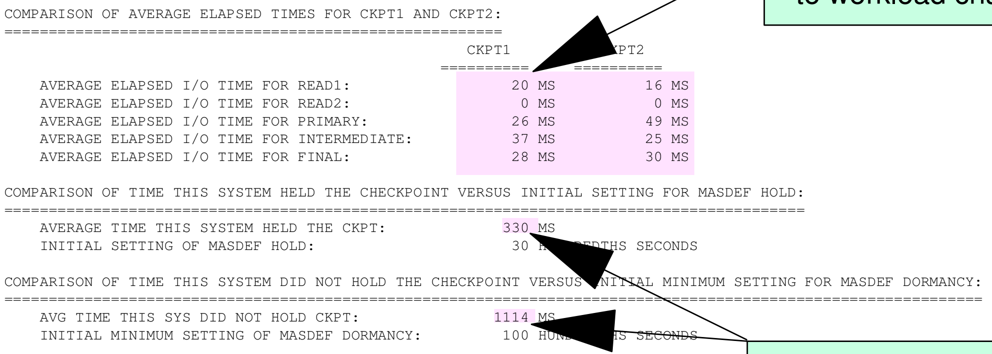


Watch for changes over time.

Decrease do to loss of parallelism is bad. Decrease due to tuning is good.

Increase due to more parallelism is good. Increase for no other reason may be bad.

Trace 17 Reduction Program



```
COMPARISON OF AVERAGE ELAPSED TIMES FOR CKPT1 AND CKPT2:
========================================================
                                                    CKPT1         CKPT2
                                                 ==========     ==========
    AVERAGE ELAPSED I/O TIME FOR READ1:                  20 MS          16 MS
    AVERAGE ELAPSED I/O TIME FOR READ2:                   0 MS           0 MS
    AVERAGE ELAPSED I/O TIME FOR PRIMARY:                26 MS          49 MS
    AVERAGE ELAPSED I/O TIME FOR INTERMEDIATE:           37 MS          25 MS
    AVERAGE ELAPSED I/O TIME FOR FINAL:                  28 MS          30 MS

COMPARISON OF TIME THIS SYSTEM HELD THE CHECKPOINT VERSUS INITIAL SETTING FOR MASDEF HOLD:
==========================================================================================
    AVERAGE TIME THIS SYSTEM HELD THE CKPT:             330 MS
    INITIAL SETTING OF MASDEF HOLD:                      30 HUNDREDTHS SECONDS

COMPARISON OF TIME THIS SYSTEM DID NOT HOLD THE CHECKPOINT VERSUS INITIAL MINIMUM SETTING FOR MASDEF DORMANCY:
==============================================================================================================
    AVG TIME THIS SYS DID NOT HOLD CKPT:               1114 MS
    INITIAL MINIMUM SETTING OF MASDEF DORMANCY:         100 HUNDREDTHS SECONDS
```

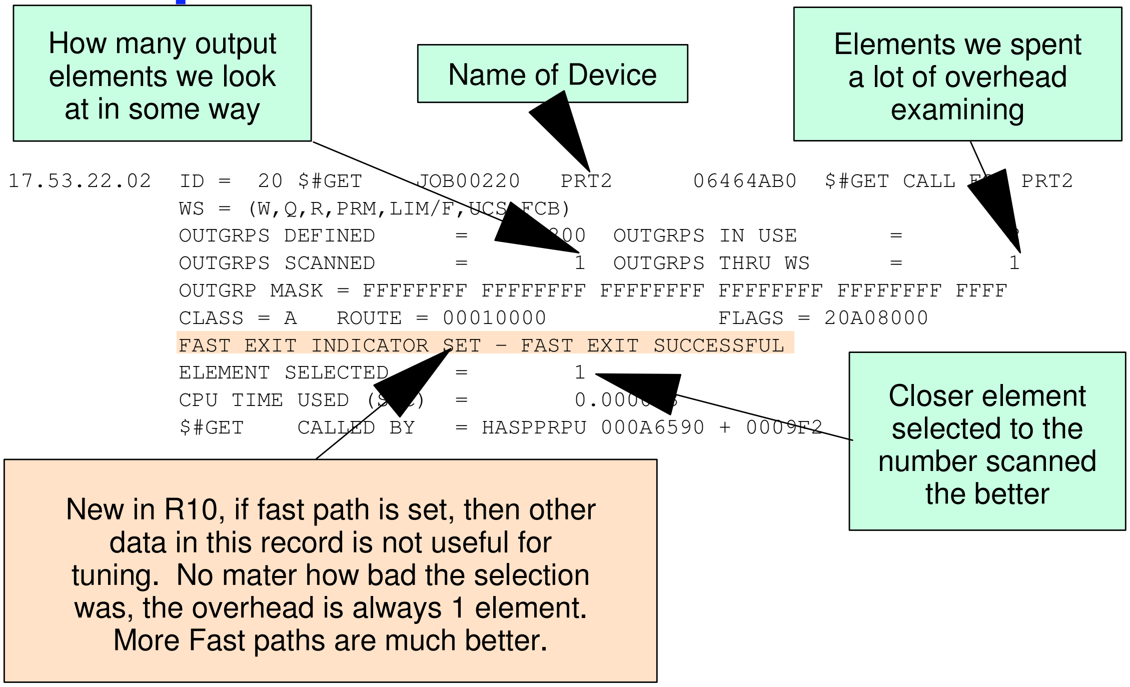
Watch for I/O time change not related to workload change

These are the actual hold and dormancy (usually larger than parameter).

Trace 20 - SYSOUT work selection

- Traces most calls to select SYSOUT for processing
  - Printer/Punch, SAPI, NJE, RJE, Offload
  - NOT PSO, External Writer
- Displays selection criteria
- Reports overhead of selection
- Used to determine efficiency of setup
- Tuning knobs that this can help with
  - WS= on devices
  - SYSOUT processing philosophy

Sample TRACE 20



How many output elements we look at in some way

Name of Device

Elements we spent a lot of overhead examining

```
17.53.22.02  ID =  20 $#GET     JOB00220   PRT2      06464AB0  $#GET CALL FOR PRT2
             WS = (W,Q,R,PRM,LIM/F,UCS,FCB)
             OUTGRPS DEFINED      =        200  OUTGRPS IN USE       =        2
             OUTGRPS SCANNED      =          1  OUTGRPS THRU WS      =        1
             OUTGRP MASK = FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF FFFF
             CLASS = A   ROUTE = 00010000              FLAGS = 20A08000
             FAST EXIT INDICATOR SET - FAST EXIT SUCCESSFUL
             ELEMENT SELECTED     =          1
             CPU TIME USED (SEC)  =          0.0000[illegible]5
             $#GET    CALLED BY   = HASPPRPU 000A6590 + 0009F2
```

Closer element selected to the number scanned the better

New in R10, if fast path is set, then other data in this record is not useful for tuning. No mater how bad the selection was, the overhead is always 1 element. More Fast paths are much better.

Sample TRACE 20

2 characters in Outgrp mask correspond to one element in WS=. Priority counts as 2 places.

```
17.55.48.42  ID =  20 $#GET    JOB00286   PRT2      06464AB0  $#GET CALL FOR PRT2
             WS = (W,Q,R,PRM,LIM/F,UCS,FCB)
             OUTGRPS DEFINED        =       200  OUTGRPS IN USE       =       77
             OUTGRPS SCANNED                  2  OUTGRPS THRU WS      =        1
             OUTGRP MASK = FFFEFFFF FFFFFFFF FFFFFFFF FFFFFFFF FFFFFFFF FFFF
             CLASS = A   ROUTE = 00010000               FLAGS = 20A00000
             ELEMENT SELECTED                 2
             CPU TIME USED (SEC)  =           0.000020
             $#GET    CALLED BY   = HASPPRPU 000A6590 + 0009F2
```

A value that is not FF indicates what WS value may have caused extra elements to be scanned. In this case, the printer was set to QUEUE=1A2B3C4D5E6F7G8 and the output selected was class A (second in the list).

Sample TRACE 20

These entries actually selected output. However, do not forget to look at entries that do NOT select any output (Element selected = 0). The cost of these are often greater than the cost to select output.

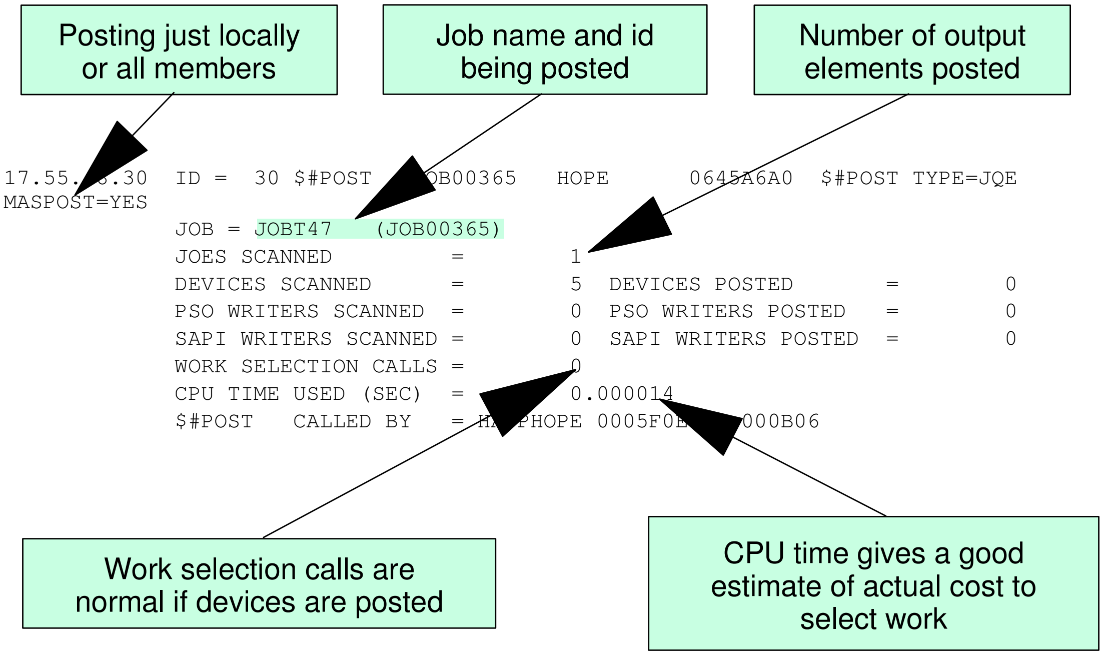
```
17.55.48.42  ID =  20 $#GET    JOB00286   PRT2      06464AB0  $#GET CALL FOR PRT2
             WS = (W,Q,R,PRM,LIM/F,UCS,FCB)
             OUTGRPS DEFINED      =      200  OUTGRPS IN USE       =       77
             OUTGRPS SCANNED      =           OUTGRPS THRU WS      =        1
             OUTGRP MASK = FFFEFFFF FFFFFF   FFFFFFFF FFFFFFFF FFFFFFFF FFFF
             CLASS = A   ROUTE = 00010000              FLAGS = 20A00000
             ELEMENT SELECTED     =          2
             CPU TIME USED (SEC)  =          0.000020
             $#GET    CALLED BY   = HASPPRPU 00 A6590 + 0009F2
```

CPU time gives a good estimate of actual cost to select work

TRACE 30 - $#POST

- Work selection is a 2 part process
  - Devices selecting work to process
  - New and changed output finding devices to wake up
- Overhead on the posting side can be as high as the selection side
- When looking at device setup, look at both trace records to see the effect
- Tuning knobs that this can help with
  - Same as Trace 20
  - Command overhead

Sample TRACE 30



Posting just locally or all members

Job name and id being posted

Number of output elements posted

```
17.55.[illegible]8.30  ID =  30 $#POST   JOB00365   HOPE      0645A6A0  $#POST TYPE=JQE
MASPOST=YES
             JOB = JOBT47    (JOB00365)
             JOES SCANNED          =        1
             DEVICES SCANNED       =        5  DEVICES POSTED       =        0
             PSO WRITERS SCANNED   =        0  PSO WRITERS POSTED   =        0
             SAPI WRITERS SCANNED =        0  SAPI WRITERS POSTED  =        0
             WORK SELECTION CALLS =        0
             CPU TIME USED (SEC)   =        0.000014
             $#POST   CALLED BY    = HASPHOPE 0005F0E[illegible]000B06
```

Work selection calls are normal if devices are posted

CPU time gives a good estimate of actual cost to select work

Sample TRACE 30

For individual output element posts, the OUTGRP name is included

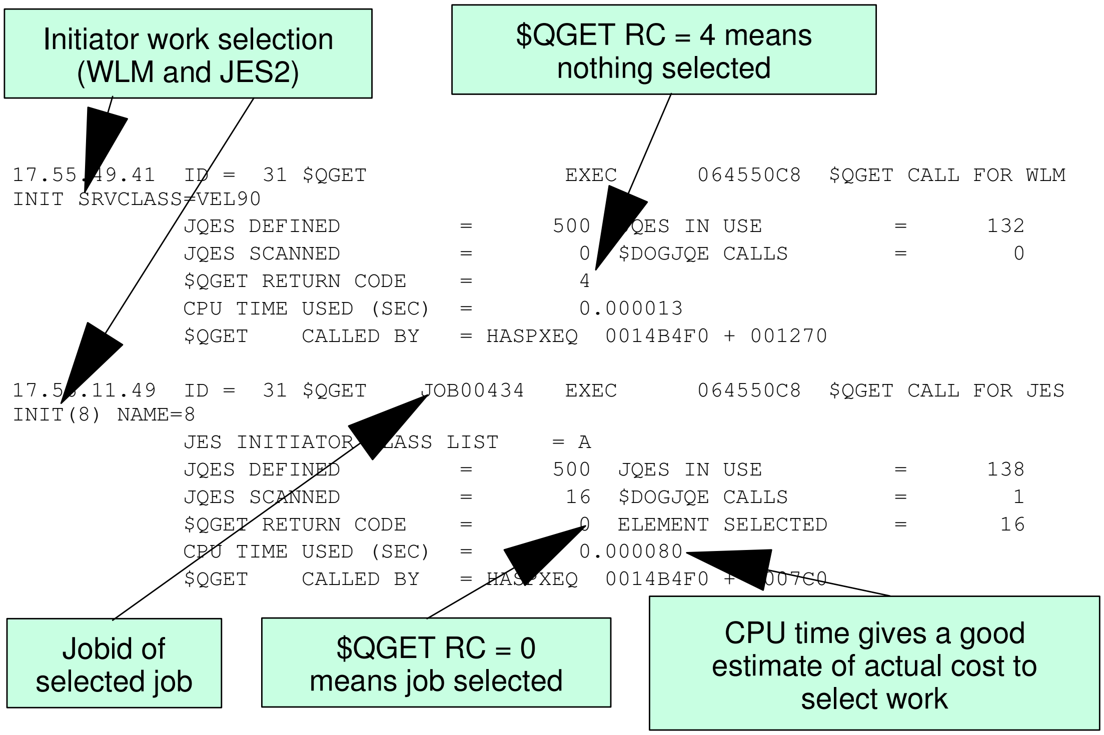
```
17.56.11.49  ID =  30 $#POST              CKPT      0645C1B0  $#POST TYPE=JOE
             JOB = JOBT77    (JOB00404)       OUTGRP =  1.00001.00001
             DEVICES SCANNED      =        5  DEVICES POSTED       =        1
             PSO WRITERS SCANNED  =        0  PSO WRITERS POSTED   =        0
             SAPI WRITERS SCANNED =        0  SAPI WRITERS POSTED  =        0
             WORK SELECTION CALLS =        1
             CPU TIME USED (SEC)  =        0.000031
             $#POST    CALLED BY  = HASPCKPT 00028160 + 00139A
```

Entries from checkpoint are for cross member posts. Entries from HOPE and SPIN are new output. Entries from COMM are commands

Trace 31 - JOB selection

- Each phase of JES2 processing (other than input) must select work to process
- Offload devices select work to process
- Tuning knobs that this can help with
  - JES2 initiator class list
  - EXIT 14/49 performance impact

Sample TRACE 31



Initiator work selection (WLM and JES2)

$QGET RC = 4 means nothing selected

```
17.55.49.41  ID =  31 $QGET               EXEC      064550C8  $QGET CALL FOR WLM
INIT SRVCLASS=VEL90
             JQES DEFINED         =       500  JQES IN USE          =      132
             JQES SCANNED         =         0  $DOGJQE CALLS        =        0
             $QGET RETURN CODE    =         4
             CPU TIME USED (SEC)  =         0.000013
             $QGET    CALLED BY   = HASPXEQ  0014B4F0 + 001270

17.56.11.49  ID =  31 $QGET    JOB00434   EXEC      064550C8  $QGET CALL FOR JES
INIT(8) NAME=8
             JES INITIATOR CLASS LIST    = A
             JQES DEFINED         =       500  JQES IN USE          =      138
             JQES SCANNED         =        16  $DOGJQE CALLS        =        1
             $QGET RETURN CODE    =         0  ELEMENT SELECTED     =       16
             CPU TIME USED (SEC)  =         0.000080
             $QGET    CALLED BY   = HASPXEQ  0014B4F0 + 0007C0
```

Jobid of selected job

$QGET RC = 0 means job selected

CPU time gives a good estimate of actual cost to select work

Sample TRACE 31

Not just for initiator selection

Overhead of extra idle processors is small (below what can be measured)

```
17.55.49.41  ID =  31 $QGET               CNVT      064557E0  $QGET CALL FOR
QUEUE=CNVT
             JQES DEFINED          =       500  JQES IN USE          =      132
             JQES SCANNED          =         1  $DOGJQE CALLS        =        0
             $QGET RETURN CODE     =         4
             CPU TIME USED (SEC)   =         0.000001
             $QGET    CALLED BY    = HASPCNVT 0003E7F0 + 000102

17.56.10.25  ID =  31 $QGET    JOB00384   PURGE     06456080  $QGET CALL FOR
QUEUE=PURGE
             JQES DEFINED          =       500  JQES IN USE          =      145
             JQES SCANNED          =         4  $DOGJQE CALLS        =        1
             $QGET RETURN CODE     =         0  ELEMENT SELECTED     =        4
             CPU TIME USED (SEC)   =         0.000067
             $QGET    CALLED BY    = HASPTRAK 0013FDA8 + 001AE6
```

Sample TRACE 31

```
19.24.19.79  ID =  31 $QGET    JOB00008   EXEC      064550C8  $QGET CALL FOR JES
INIT(1) NAME=1
             JES INITIATOR CLASS LIST    = A
             JQES DEFINED          =      500  JQES IN USE          =       18
             JQES SCANNED          =        1  $DOGJQE CALLS        =        1
             $QGET RETURN CODE     =        0  ELEMENT SELECTED     =        1
             CPU TIME USED (SEC)   =        0.000096
             CPU TIME USED (X14)   =        0.000004
             EXIT 14 RETURN CODE   =        0
             CPU TIME USED (X49)   =        0.000003
             EXIT 49 SKIPPED JQES =         0
             $QGET    CALLED BY    = HASPXEQ  0014B4F0 000007C0
```

Overhead of exits can be measured

Anything else?

- TRACE 27 - PSO/external writer
  - No specific data, but indicates frequency of use, who is making requests, and time to competes (delta in trace time stamps)
  - Can detect run away PSO applications
- TRACE 28 and 29 - SAPI
  - Similar to trace 27 but for the SAPI interface
  - Detects excessive SAPI requests

PERFDATA? CTRACE?

- $D PERFDATA can help tune systems
  - ► QSUSE info identifies impact of CKPT delays
  - ► EVENT identifies commands take more than 5 seconds to complete
  - ► PCESTAT displays all that is known about PCE performance
- CTRACE rolling traces in dumps can help
  - ► Of limited use. Mostly for performance bugs.
  - ► Can tell how long PCE was running.

Questions?