

Page Fault Timing ANALYSIS -- MULTICS Initialization Run

Run Made: 3/8/68; timing done during page-fault processing only.

Traces: 166, 122, 123, 131, 141

Total number of page faults taken: 2654.

Total time spent processing page faults: 254,669,627 ms.

Mean page fault processing time: 95.95 ms./page fault

Segment Usage in Order of Time Used

<u>Segment Name</u>	<u>Number of Interrupts *</u>	<u>Mean Time per Page Fault (ms)</u>	<u>Cumulative Percentage</u>
1 dev_ctl	8625	32.45	34.0
2 pwn	3880	14.61	49.3
3 bug	1008	3.80	53.3
4 ilock	984	3.70	57.1
5 swap_sdw	919	3.46	60.7
6 io done	870	3.28	64.2
7 dim_command	868	3.27	67.7
8 assign	807	3.04	70.8
9 dims	655	2.47	
10 dim	651	2.45	
11 entry	616	2.32	
12 get page	579	2.18	
13 page_fault	546	2.06	
14 movstr_	545	2.05	
15 master_mode_ut	539	2.03	
16 wired_sup_linkage	537	2.02	89.1
17 ptr	495	1.86	
18 page out	409	1.54	
19 checkentry	340	1.28	
20 service_done_list	322	1.21	95.4

(continued)

Segment Usage (continued)

Segment Name	Number of Interrupts	Mean Time Per Page Fault (ms)	Cumulative Percentage
21 remove page	244	.92	
22 segment_meter	157	.59	
23 base	126	.47	
24 pwn_validate	116	.44	
25 dimcmd	84	.32	
26 set faults	83	.31	
27 forcemove	59	.22	
28 zero	56	.21	
+ 29 get usc	43	.16	
30 set ptw	43	.16	
31 remove pt	37	.14	
32 switch_stack	35	.13	
33 updates	35	.13	
34 clock_	20	.08	
35 cam_	18	.07	
36 stgop_	12	.05	
37 free_store	11	.04	
38 cioc	8	.03	
39 free_	6	.02	
+ 40 contiguatc	1	.00	
		<u>95.57</u>	100.0
		ms/pf (total)	

* Interrupts occur at 10 ms. intervals
 + dummy

Case Control:

bug	3.80		
assign	3.04		
entry	<u>2.32</u>		
	9.16	ms./page fault	or 9.6% of total time

Calls:

- Time spent in linkage sections (wired_sup_linkage) = 2.02 ms/page-fault
- Time spent executing instructions in a linkage section for a single call (i.e., the time during which the pbr is in a linkage section) is:

- change lps: 2.4 us
 - gos (3.7us, but $\leq 1/2$ linkage sections have gos): 1.9 us
 - tra to target procedure: tra and fetch "its" pair -- assume sdw and ptw's in assoc. mem -- (2us); compute target address -- 1 ptw + 1 sdw + 1 ptw-fetch -- (3us)
- total 5.3

- All interrupts recorded in linkage sections are caused by inter-procedure calls. Therefore the total number of calls required to service the average page fault is

$$\frac{2020 \text{ us/page-fault}}{9.3 \text{ us/call}} = 217 \text{ calls/page-fault. (conservative)}$$

- Assuming an average of 84 us to execute the call-save-return sequence for a normal call, but ignoring time spent in argument preparation, the time spent during a page fault to transfer control among procedures is

$$(217 \text{ calls/page-fault}) \cdot (84 \text{ us/call-save-return}) = 18.2 \text{ ms/page-fault}$$

Therefore the proportion of time spent in interprocedure transfers of control, exclusive of argument preparation, is :

$$\frac{18.2}{96} \approx 19\% .$$