#1: Speed of D-cache

See also: # xx: N/A

Written by: S. Okamoto January 25, 1996
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This note describes the speed of the D-cache in relation to data reading and writing.

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o What speed is the D-cache in comparison to main RAM at reading data ?

Five times faster. It takes one CPU cycle to read from D-cache, and it takes five CPU cycles to read from main RAM.

o What speed is the D-cache in comparison to main RAM at writing data ?

It takes one CPU cycle to write to D-cache from general registers. Writing to main RAM is the moust complicated part of R3000 CPU. I should say that only GOD knows the exact number of cycles for writing data to main RAM!

R3000 CPU has "Write-buffer" between registers and main RAM. W-buffer is four step 32bit length fifo. It takes one cycle to write to W-buffer. But if there are no free register on W-buffer, CPU must flush W-buffer, write ALL the data on W-buffer to main RAM.

It takes one or four cycles to write a data on W-buffer to main RAM. If two or more write operations are done continuously, the first operation takes four cycles and the second and later operations take only one cycle.

And main RAM has 1KByte "pages". Any write operation on new page takes four cycles. And programmer cannot control or detect the W-buffer flush timing, and cannot know the status of it. R3000 has Bus-Snoop-Mechanism and I-cache. You cannot predict the start of flushing of W-buffer, even if you know the complete assembler codes.

So if you have good luck, it takes only one cycle to finish one store instruction. For the worst case, I can say nothing.

As the result, I can only say that writing to main RAM is VERY slow comparted to writing to D-cache, and probably writing to main RAM is faster than reading from main RAM.

Best Regards,

Okamoto

PS Each step of W-buffer is assigned to one store instruction. So if four
Store-Byte-Instructions are executed, W-buffer becomes full.