20181210 유창호

1.7 +20

1.7.1) clock cycle = CPI × IC

P1 time = $(1\times10^5 + 2\times2\times10^5 + 3\times5\times10^5 + 3\times2\times10^5)\times\frac{1}{2.5\times10^9 s}$

$= \frac{26\times10^8}{2.5\times10^{94}} = \frac{26}{25\times10^3} = 104\times10^{-5} s$

P2 time = $(2\times10^5 + 2\times2\times10^5 + 2\times5\times10^5 + 2\times2\times10^5)\times\frac{1}{3\times10^9 s}$

$= \frac{20\times10^5}{3\times10^9} = \frac{20}{3}\times10^{-4} s$

$\frac{200}{3} < 104$ P2 is faster

1.7.2) CPI (P1) — $\frac{26\times10^5}{10^6} = 2.6$

CPI (P2) — $\frac{20\times10^5}{10^6} = 2$

1.7.3) Clock cycle (P1) — 2.6×10^6

Clock cycle (P2) — 2×10^6

1.9

+10

(1.9.1) power $= \frac{1}{2} Cp\,load \times V^2 \times F$

Pentium 4

$90(\text{dynamic power}) = \frac{1}{2} cp\,load \times 1.25^2 \times 3.6 \times 10^9$

$180 = cp\,load \times 1.5625 \times 3.6 \times 10^9$

$cp\,load = \frac{180}{1.5625 \times 3.6 \times 10^9} = 3.2 \times 10^{-8} F$

Core i5

$40(\text{dynamic power}) = \frac{1}{2} cp\,load \times 0.9^2 \times 3.4 \times 10^9$

$cp\,load = \frac{80}{0.81 \cdot 3.4 \cdot 10^9}$

$= 2.904 \times 10^{-8} F$

(1.9.2) Pentium 4 Static : dynamic = 1 : 9

Core i5 Static : dynamic = 3 : 4

% of total dissipated power by static power

$10/100 = 10\%$

$30/70 = 42.857\%$

1.11

1.10

1.11.1) Find the yield for both wafers

$$\text{die area} = \frac{\text{wafer area}}{\text{dies per wafer}}$$

$$\text{yield} = \frac{1}{\left(1+\left(\text{defects} \times \frac{\text{die area}}{2}\right)\right)^2}$$

75
75
375
525
5625

49

$$15\text{cm wafer die area} = \frac{7.5^2\pi}{64} = \frac{5625}{64}\pi$$

$$15\text{cm wafer yield} = \frac{1}{\left(1+\left(\frac{2}{100} \times \frac{5625}{\cancel{100}\ 64}\pi\right)\right)^2}$$

$$= \frac{1}{\left(1+\frac{0.5625\pi}{64}\right)^2}$$

$$\approx 0.9593$$

$$30 \text{ wafer die area} = \frac{10^2\pi}{100} = 10\pi$$

$$30 \text{ wafer yield} = \frac{1}{\left(1+\left(\frac{31}{1000} \times 10\pi\right)\right)^2}$$

$$\approx 0.9093$$

1.11.2) Find the cost per die for both wafers

$$\text{Cost per die} = \frac{\text{Cost per wafer}}{\text{dies per wafer} \times \text{yield}}$$

$$15\text{cm cost per die} = \frac{12}{64 \times 0.9593}$$

$$= 0.1469$$

$$30\text{cm cost per die} = \frac{15}{100 \times 0.9093}$$

$$= 0.1649$$

1.12 +35

1.12.1 $\frac{\text{exe clock cycles}}{\text{exe time}} = \frac{\text{ref clock cycles}}{\text{ref time}}$

$$\text{CPU time} = IC \times CPI \times \underbrace{\text{clock cycle time}}_{=\frac{1}{\text{clock rate}}}$$

$$CPI = \text{clock cycles} \times \frac{1}{IC}$$

$$\text{exe clock cycles} = \frac{9650s}{0.333ns} \times 750$$

$$= \frac{9650 \times 10^9 ns}{0.333 ns} \times 750$$

$$\approx 2.24 \times 10^{12}$$

$$CPI = \frac{2.24 \times 10^{12}}{2.389 \times 10^{12}}$$

$$= 0.9376$$

1.12.2 $\text{SPEC ratio} = \frac{\text{ref time}}{\text{exe time}}$

$$= \frac{965\cancel{0}}{75\cancel{0}}$$

$$= 12.8666$$

1.12.3 $\text{CPU time} = IC \times CPI \times \frac{1}{\text{clock rate}}$

$$= 1.1 IC \times CPI \times \frac{1}{\text{clock rate}}$$

+ 10% in CPU time

1.12.4

$$1.1 \cdot IC \cdot 1.05 \, CPI \cdot \frac{1}{\text{clock rate}}$$

$$= 1.155 \, IC \cdot CPI \cdot \frac{1}{\text{clock rate}}$$

+ 15.5% in CPU time

1.12.5

new SPEC ratio $= \dfrac{\text{ref cpu time (old)}}{\text{exe time (new)}}$

$= \dfrac{1}{1.155}$

$= 0.8658$

SPEC ratio has decreased about 14 %

1.12.6

$700s = \frac{85}{100} IC \cdot CPI \cdot \frac{1}{4 \cdot 10^9 hz}$

$700 \cdot 100 \cdot 4 \cdot 10^9 \cdot \frac{1}{85} = IC \cdot CPI$

2.389×10^{12}

$13.7 \text{ (SPEC ratio)} = \dfrac{\text{ref cpu time (old)}}{700s \text{ (new)}}$

ref cpu time (old) $= 9590s$

$70 \cdot 4 \cdot \frac{1}{85} = 2.389 \cdot CPI$

$CPI = 1.3788$

1.14 +15

1.14.1

$\text{cpu time}_{fp} = 70 \times \frac{8}{10} = 56\text{s}$

$\underset{(\text{before})}{\text{total cpu time}} = 70 + 85 + 55 + 40 = 250$

$\underset{(\text{after})}{\text{total cpu time}} = 56 + 85 + 55 + 40 = 236$

14 s is reduced, $\frac{236}{250} = \frac{944}{1000}$ 5.6% reduced

1.14.2

$\text{cpu time}_{total} = 250 \times \frac{8}{10} = 200\text{s}$

$\underset{(\text{before})}{\text{total cpu time}} = 250$

INT (old) $= 250 - 70 - 85 - 40 = 55$

INT (new) $= 200 - 70 - 85 - 40 = 5$

$\frac{5}{55}$ 50s is reduced, 91% reduced,

1.14.3

goal : 200 s

70 (FP) + 85 (L/S) + 55 (INT) + 0 (branch reduced to max) = 210 s

No