CS 506 homework 3

Problem 1

Assume a color display using 8 bits for each of the primary colors

(red, green, blue) per pixel and a frame size of 1280 × 1024.

**a.** What is the minimum size in bytes of the frame buff er to store a frame?

**b.** How long would it take, at a minimum, for the frame to be sent over a 100

Mbit/s network?

Ans.

1. The minimum size of the frame is equal to

=Frame(pixels) X bytes

=3 X 1280 X 1024 = **3932160 Bytes**

1. Time= size/speed

Size= 3932160 X 8 = 31457280bit

Speed= 10^8bit/s

**Therefore, Time will be 0.3145728s**

Problem 2

Consider three different processors P1, P2, and P3 executing

the same instruction set. P1 has a 3 GHz clock rate and a CPI of 1.5. P2 has a

2.5 GHz clock rate and a CPI of 1.0. P3 has a 4.0 GHz clock rate and has a CPI

of 2.2.

**a.** Which processor has the highest performance expressed in instructions per second?

**b.** If the processors each execute a program in 10 seconds, find the number of

cycles and the number of instructions.

**c.** We are trying to reduce the execution time by 30% but this leads to an increase

of 20% in the CPI. What clock rate should we have to get this time reduction?

Ans. a) CPU time=(instructions X CPI )/clock rate

So IPS= instructions/cpu time

IPS= clock rate/CPI

So,

**IPS(P1) =2 X 109**

**IPS(P2) = 2.5 X 109**

**IPS (P3) = 1.82 X 109**

Processor 2 has the highest performance in IPS.

1. Clock cycles = IPS X CPU time

**So,**

* **Clock cycle1=3 X 1010**
* **Clock cycle2=2.5 X 1010**
* **Clock cycle3=4 X 1010**

1. Execution time= clock cycles/ clock rates

=(instructions\*CPI )/clock rates….(i)

We want to find new clock rate

So,

New Execution time= 0.7 X old Execution time

On Substituting equation (i) we get,

1.2/ new clock rate=0.7/old clock rate

New clock rate= 1.71 X old clock rate

**Clock rate is increase by 71 percent.**

Problem 3

If the total dissipated power is to be reduced by 10%, how much

should the voltage be reduced to maintain the same leakage current? Note: power

is defined as the product of voltage and current.

Ans we know that P = V x I,

a 10% reduction of power would cause 10% reduction in the product of voltage and current.

So that gives us = 9P = 9(V x I).

Assuming that flow of current is same, we get

9P = (9V) x I

**Therefore, the voltage is reduced by 10 percent.**

Problem 4

Suppose that we are developing a new version of the AMD

Barcelona processor with a 4 GHz clock rate. We have added some additional

instructions to the instruction set in such a way that the number of instructions

has been reduced by 15%. Th e execution time is reduced to 700 s and the new

SPEC ratio is 13.7. Find the new CPI.

Answer: Cycle time = 1/clock rate= 1/4GHz=0.25 X 10-9 s

Now 1 GHz= 10^9 s

Execution time= clock cycles X cycle time

Clock cycles= Execution time/cycle time= 700/0.25 X 10-9=2.8 X 1012

CPI= clock cycles x no. of instructions=2.8 X 1012 / (2.389x1012)

**CPI=1.38**

Problem 5

Assume a 15 cm diameter wafer has a cost of 12, contains 84 dies, and has

0.020 defects/cm2. Assume a 20 cm diameter wafer has a cost of 15, contains 100

dies, and has 0.031 defects/cm2.

5. 1 Find the yield for both wafers.

5.2 Find the cost per die for both wafers.

5.3 If the number of dies per wafer is increased by 10% and the

defects per area unit increases by 15%, find the die area and yield.

5.4 Assume a fabrication process improves the yield from 0.92 to

0.95. Find the defects per area unit for each version of the technology given a die

area of 200 mm2.

Answer: Die area = area of wafer /dies per wafer

D.A1= (3.142x7.5x7.5)/ 84= 2.1037 cm2

D.A2= )3.14x6x6)/100= 3.142 cm2

1. Yield =

Yield1= 1/ ( 1+ ( 0.02 \* 2.103/2))2

=1/(1.021)2

=1/1.0425

**Yield1=0.9592**

Yield2 = 1 / (1.04867)2

= 1/1.0997

**Yield2=0.9093**

1. cost per die = cost per wafer / (dies per wafer x yield)

cost per die (1) = 12/ (84\*.959)

**=0.1489**

cost per die (2) = 15/ (100\*0.909)

**=0.1649**

1. For first wafer die area will be:

DA1new=2.1037/1.1=1.9124 cm2

Using same yield formula, we get

**Yieldnew=0.9574cm2**

For first wafer die area will be:

DA1new=3,142/1.1=2.8559 cm2

Using same yield formula, we get

**Yieldnew=0.9055cm2**

1. Yield = 1/ (1+defect rate)2

As the area is in square centimeters, we use the above formula

Defect rate= (1/(Yield)1/2)-1

Now we calculate old defect rate,

**Old Defect rate= (1/(Yield)1/2)-1=0.0425 defects/cm2**

New defect rate is,

**New Defect rate= (1/(Yield)1/2)-1=0.0259 defects/cm2**