Nets and Ops - Part 1

1. EAT = a + p S a = base access time p = page fault rate s = service a page fault

a = 150 nano = 150 X 10^-9

p = 1.0 X 10^-5 = 0.00001

S = S\_min=150 micro + 5milli

**Conversion**

a = 150 nano

p= 0.00001

S= Smin=150 micro + 5milli = 5 X 10^-3 = 5000 X 10^-6 = 150 + 5000 = 5150 X 10^-6 = 5150000 nano

**Calculation**

p X S = 0.00001 X 5150000 = 51.5

a + p = 150 + 51.5 = 201.5

**Answer to 3 significant figures**

202

1. Degradation = 100 \* (EAT - a)/a

**Calculation**

EAT – a = 202 – 150 = 52 nano

100\*(EAT - a) = 100\* 52 = 5200

100 \* (EAT - a)/a = 5200 / 150 = 34.7%

**Answer to 3 significant figures**

34.7%



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Memory size | Cost | Page-fault rate (p) | Degradation w/ HDD | Cost w/ SSD | Degradation w/ SSD |
| 2x 0.5 GiB | $0 (current state of machine) | 1.0E^-5 | 34.7% | $34 | 9.33% |
| 2x 1 GiB | $10 | 0.5E^-5 | 17.3% | $44 | 4.77% |
| 2x 2 GiB | $20 | 0.25E^-5 | 8.67% | $54 |  |
| 2x 4 GiB | $40 | 0.125E^-5 |  | $74 |  |
| 2x 8 GiB | $80 | 0.0625E^-5 |  | $114 |  |
| 2x 16 GiB | $160 | 0.03125E^-5 |  | $194 |  |

S = S\_min + K / D

a = 150 nanoseconds  
S\_min = 150,000 nanoseconds  
k = 500,000,000 nanoseconds

Standard Configuration:

D = 100MiB  
S = 5,150,000 nanoseconds  
  
5,150,000 – S\_min = 5,150,000 – 150,000 nanoseconds = 5,000,000 nanoseconds

5,000,000 = k/ D = 5,000,000 = k / 100MiB/s (D is known because the default configuration of the machine includes a HDD rather than SSD)

k = 5,000,000 x D = 5,000,000 x 100 + 150,000 = 5,150,000

k = 500,000,000 nanoseconds  
  
S\_min = 150,000 nanoseconds  
k = 500,000,000 nanoseconds  
D = Hard Drive = 100 MiB

1GB Ram + SSD

D = 400MiB/s

S=150,000 + 500,000,000 / 400 = 1,400,000

EAT = 150 + (0.00001 x 1,400,000) = 164

Degradation = 100 x (164 – 150) / 150 = 9.33%

2GB RAM + HDD

D = 100MiB/s

S = 150,000 nanoseconds + 500,000,000 nanoseconds / 100 = 5,150,000

EAT = 150 + (0.000005 x 5,150,000) = 176

Degradation = 100 x (176 – 150) / 150 = 17.3%

2GB RAM + SSD

D = 400 MiB/s

S = 150,000 + (500,000,000 / 400) = 1,400,000

EAT = 150 + (0. 000005 x 1,400,000) = 157

Degradation = 100 x (157 – 150) / 150 = 4.67%

4GB RAM + HDD

D = 100MiB/s

S = 150,000 nanoseconds + 500,000,000 nanoseconds / 100 = 5,150,000

EAT = 150 + (0.0000025 x 5,150,000) = 163

Degradation = 100 x (163 – 150) / 150 = 8.67%

Final Conclusion

We have found that the cheapest configuration which brings the degradation to below 10% to be 4GB of RAM and a standard hard drive (HDD). There are two reasons we know that this is the cheapest solution:

1. The only other solution that we found to bring the degradation to below 10% used 1GB of RAM and a solid state drive (SSD) with a decrease in degradation down to 9.33%. This configuration comes to a total cost of $34 and the reduction in degradation was inferior to our chosen solution, where increasing the RAM to 4GB and leaving the HDD in leads to a cost of $20 with a decrease in degradation down to 8.67%
2. All other untested configurations cost more than our chosen configuration. This means that we do not need to do any further testing because, even if the degradation is below 10%, the cost of the configuration will still be higher than the cost of our chosen configuration.