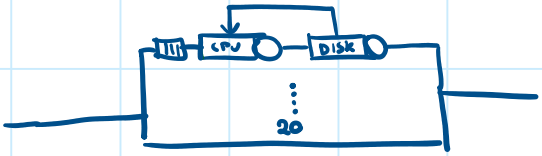
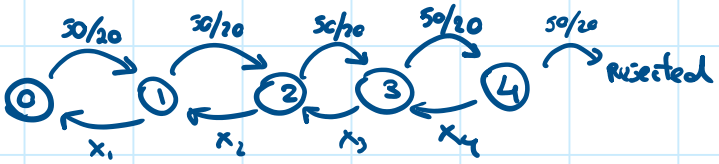
Esame 19/7/2012

martedì 14 maggio 2019 13:19

Esercizio n.3

Web service 50 requests per second
Workload is equally distributed across
Max concurrent requests is 4
Requests require 8 CPU msec and 5 disks read (10 msec)
Average request service time? Throughput? Percentage of rejected requests?
Performance improvement with cache (access time of 100 μsec) hit 70%?





$S_{CPU} = 8$ msec

$D_{DISK} = 50$ msec $= \overbrace{V_i}^{5} \cdot S_{DISK}$

Caso 1: (n=1)

$R_{CPU1} = D_{CPU} = 8$ msec

$R_{DISK1} = D_{DISK} = 50$ msec

$R_{TOT_1} = 58$ msec

$X(1) = \frac{1}{R_{TOT_1}}$

$N_{CPU_1} = R_{CPU_1} \cdot X_0(1) = 0.14$

$N_{DISK} = R_{DISK_1} \cdot X_0(1) = 0.86$

Caso 2 (n=2):

$R_{CPU_2} = D_{CPU_2} = 16$ msec

$R_{DISK_2} = 93$

$R_{TOT_2} = 102$

$X(2) = 2/R_{TOT}$

$N_{CPU_2} = R_{CPU_2} \cdot X(2) = 0,18$

$N_{DISK} = R_{DISK_2} \cdot X(2) = 1,82$

$D_{CPU}(1 + N_{CPU;i-1})$

$50\ (1 + N_{CPU;i-1})$

Caso n.3

$R_{CPU_3} = 9,44$

$R_{DISK_3} = 141$

$R_{TOT_3} = 150.44$

$X(3) = 19.94$

$N_{CPU_2} = 0,188$

$N_{DISK_2} = 2,81$

Caso n.4

$R_{CPU_4} = 0,504$ msec

$R_{DISK_4} = 190$ msec

$R_{TOT_4} = 200,004$ msec

$X(4) = 19,99$ msec

$N_{CPU_4} = 0,19$

$N_{DISK} = 3,81$

$$\begin{cases} P_0 \cdot \frac{5}{2} = P_1 \cdot X_{01} \\ P_1 \cdot \frac{5}{2} = P_2 \cdot X_{02} \end{cases}$$

$$P_1 = \frac{P_0 \cdot \frac{5}{2}}{X_0(1)}$$

$$P_0 \left[1 + \frac{2.5}{17,24} \dots\right]$$

$$\begin{cases} P_1 \cdot \frac{5}{2} = P_2 \cdot X_{02} \\ P_3 \cdot \frac{5}{2} = P_3 \cdot X_{03} \\ P_4 \cdot \frac{5}{2} = P_4 \cdot X_{04} \\ P_1 + P_2 + P_3 + P_4 + P_0 = 1 \end{cases}$$

$$P_2 = \frac{P_1 \cdot 5/2}{X_0(2)}$$

$$P_3 = \frac{P_2 \cdot 5/2}{X_0(3)}$$

$$P_4 = \frac{P_3 \cdot 5/2}{X_0(4)}$$

$$P_0 \left[1 + \frac{2.5}{17,24} \dots\right]$$

$P_2 = 0.85$

$P_1 = 0,12$

$P_2 = 0,015$

$P_3 = 1,9 \cdot 10^{-3}$

$P_4 = 2,4 \cdot 10^{-4}$

Probabilità Loss = $1 - (P_0 + P_1 + P_2 + P_3 + P_4)$

Throughput media = $X(1) \cdot P_1 + X(2) \cdot P_2 + X(3) P_3 + X(4) P_4$

Average response time $\frac{N}{X} = \frac{P_1 \cdot 1 + P_2 \cdot 2 + P_3 \cdot 3 + P_4 \cdot 4}{P_1 \cdot X(1) + P_2 \cdot X(2) + P_3 \cdot X(3) + P_4 \cdot X(4)} = \frac{\bar{N}}{2.4}$

Considering cache

$R_{DISK_i} = P_{miss} (D_{DISK} + D_{cache}) + (1 - P_{miss}) (D_{cache})] (1 + u_{i-1})$

Esercizio 11.1

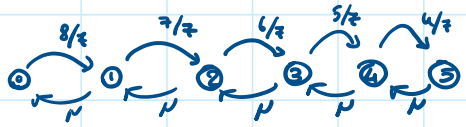
Esercizi 20/6/2012

mercoledì 15 maggio 2019 13:03

Server composed of a single with max 5 users in queue, finited 8 users

$\frac{1}{\lambda} = 30$ sec

$S = 20$ sec



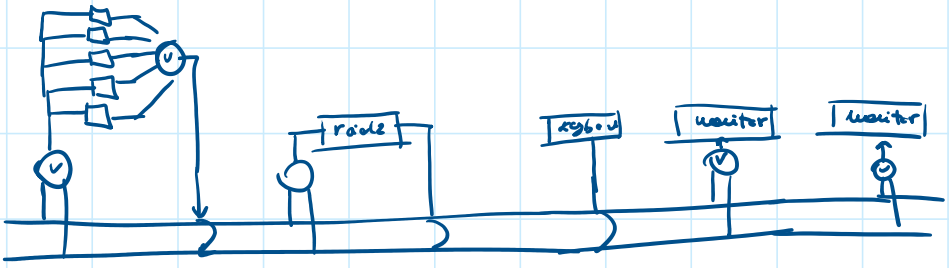
$\mu = \frac{1}{S} = \frac{1}{20} = 0.05$

$$\begin{cases} P_0 \frac{8}{\lambda} = P_1 \mu \\ P_1 \frac{7}{\lambda} = P_2 \mu \\ P_2 \frac{6}{\lambda} = P_3 \mu \\ P_3 \frac{5}{\lambda} = P_4 \mu \\ P_4 \frac{4}{\lambda} = P_5 \mu \\ P_1 + P_2 + P_3 + P_4 + P_5 = 1 \end{cases} \Rightarrow \begin{cases} P_1 = 3{,}95 \cdot 10 \\ P_2 = 18{,}43 \cdot 10^{-} \\ P_3 = 73{,}73 \\ P_4 = 245{,}77 \cdot 10^{-} \\ P_5 = 655{,}40 \cdot 10^{-} \end{cases} \qquad P_0 = 0{,}000742$$

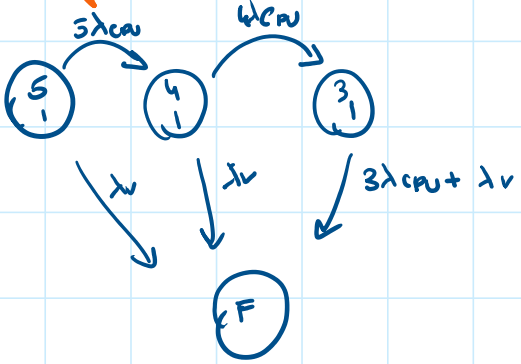
$\bar{X} = \sum P_i \cdot \mu_i = P_1 \cdot \mu + P_2 \cdot \mu + P_3 \cdot \mu + P_4 \cdot \mu + P_5 \cdot \mu = 49{,}85$ richieste/sec

$\bar{N} = \sum_{i=1}^{5} i P_i \qquad R = \bar{N} / \bar{X}$

Esercizio 1



Reliability



$\dot{P}_{5,1}(t) = P_{5,1}(t) \cdot (-5\lambda_{CPU} - \lambda_V)$

$\dot{P}_{4,1}(t) = P_{4,1}(t) \cdot (-4\lambda_{CPU} - \lambda_V) + P_{5,1}(t) \cdot 5\lambda_{CPU}$

$\dot{P}_{3,1}(t) = P_{3,1}(t) \cdot (-3\lambda_{CPU} - \lambda_V) + P_{4,1}(t) \cdot 4\lambda_{CPU}$

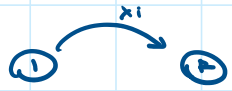
$\dot{P}_F(t) = -\lambda_V (P_{5,1}(t) + P_{4,1}(t) + P_{3,1}(t)) - 3\lambda_{CPU} P_{3,1}(t)$

$P_{5,1}(t) + P_{4,1}(t) + P_{3,1}(t) + P_F(t) = 1$

$P_{5,1}(0) = 1$

$R_{CPU} = 1 - P_F(t) = P_{5,1}(t) + P_{4,1}(t) + P_{3,1}(t)$

Keyboard - Printer - Monitor



$\dot{P}_1(t) = P_1(t) \cdot (-\lambda_i)$

$\dot{P}_F(t) = P_1(t) \cdot \lambda_i$

$P_1(t) + P_F(t) = 1$

$P_1(0) = 1$

$R_{KPM} = 1 - P_F(t) = P_1(t)$

Bus + voters

$R_{BV} = 1 - P_F(t) = P_{BV}(t)$

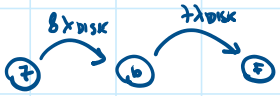
$\dot{P}_{BV}(t) = P_{2\,bus\,v}(t) (-2\lambda_V - 4\lambda_V)$

$R(0) = 1$

$R_{KFT} = 1 - P_F(t) = R(t)$

Raid

Availability: ΠR_i

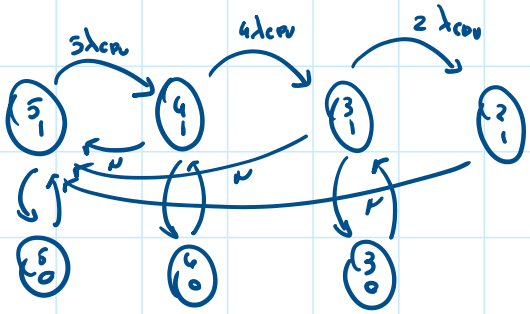


$\dot{P}_7(t) = -7\lambda_{DISK} \cdot P_7(t)$

$P_6'(t) = +7\lambda_{DISK} P_7(t) - 6\lambda_{DISK} P_6$

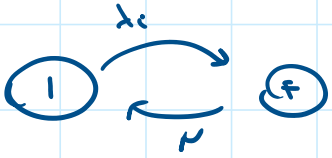
$P_F'(t) = 6\lambda_{DISK} P_6(t)$

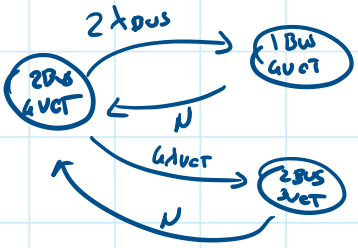
Availability

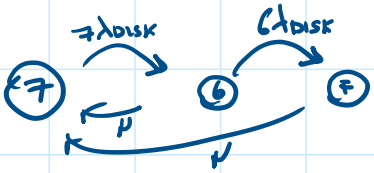


$\dot{P}_{5,1}(t) = -P_{5,1}(t)(5\lambda_{CPU} + \lambda_U) + \mu(P_{5,0}(t) + P_{4,1}(t) + P_{3,1}(t) + P_{2,1}(t)$

$\vdots$







Availability totale:

$\Pi_i A_i$

Safety:

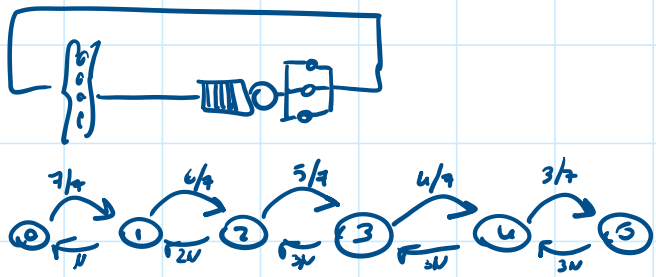
Sempre uguale ma con meno

Esercizi 15/04/2013

mercoledì 15 maggio 2019 15:15

Esercizio 4.3

Response time, throughput, probability of loss?



$$\begin{cases} P_0 \tfrac{7}{2} = P_1 4\mu \\ P_1 \tfrac{6}{7} = P_2 2\mu \\ P_2 \tfrac{5}{7} = P_3 3\mu \\ P_3 \tfrac{4}{7} = P_4 3\mu \\ P_4 \tfrac{3}{7} = P_5 3\mu \\ P_0 + P_1 + P_2 + P_3 + P_4 = 1 \end{cases} \Rightarrow \begin{aligned} P_0 &= 0,054 \\ P_1 &= 0,189 \\ P_2 &= 0,2835 \\ P_3 &= 0,23625 \\ P_4 &= 0,1575 \\ P_5 &= 0,07875 \end{aligned}$$

$\bar{X} = \sum_{i=1} P_i \mu_i$ // throughput medio

$\bar{N} = \sum i \cdot P_i$ // numero di utenti medi

Esercizio 4.3

100 requests x second

4 identical servers (CPU + RAM)

File server: CPU + 8 disks // connected with Ethernet 8 Gb/s

connected with Router (no delay)

File dimension: 100 kb/s

Request: 500 bytes

$D_{CPU}^{HIT} = 5$ min (hit)

$D_{CPU}^{miss} = 10$ msec HTTF = 1000 hours

$D_{CPU+FS}^{miss} = 10$ msec HTTR = 1 hour

$D_{DISK}^{miss} = 10$ msec

average service time, throughput, final bottleneck

$F_{ETH}^{req} = \frac{500}{65515} = 1$ fragments ETH

$F_{ETH}^{res} = \frac{100.000}{65515} = 2$ fragments ETH

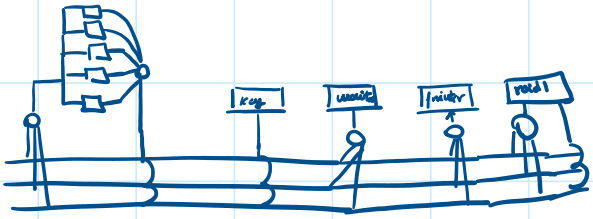
Frame = datagrammi = $\frac{100000}{1460} = 69+3$

Overhead = $(69+3)(20+20+18) = 4176$

$D_{ETH}^{req} = \frac{100.000 + 4176}{2 \cdot 10^9} = 5208 \cdot 10^{-5}$

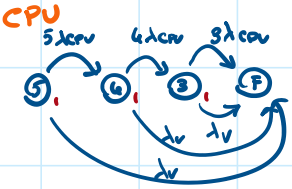
R,S

Esercizio n.1



Reliability

CPU



$$\begin{cases} \dot{P}_5(t) = P_5(t)\cdot -5\lambda_{CPU} + P_5(t)\cdot -\lambda_V \\ \dot{P}_4(t) = P_5(t)\cdot 5\lambda_{CPU} - P_4(t)\cdot 4\lambda_{CPU} - P_4(t)\cdot \lambda_{voter} \\ \dot{P}_3(t) = -P_4(t)\cdot 4\lambda_{CPU} - P_3(t)\cdot \lambda_V + P_4(t)\cdot 4\lambda_{CPU} \\ \dot{P}_F(t) = P_5\lambda_V + P_4\lambda_V + P_3\lambda_V + P_3(t)\cdot 3\lambda_{CPU} \\ P_5(t) = 1 \end{cases}$$

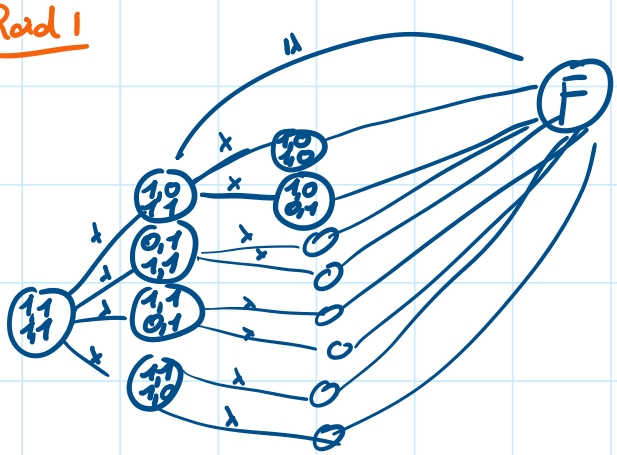
$$\text{Reliability}(t) = 1 - P_F(1)$$

Keyboard / Monitor / Printer

$$\begin{cases} \dot{P}_1(t) = -P_1(t)\cdot \lambda_{Fi} \\ \dot{P}_F(t) = P_1(t)\cdot \lambda_{Fi} \\ P_1(t) = 1 \end{cases}$$

$$\text{Reliability}(t) = 1 - P_F(t)$$

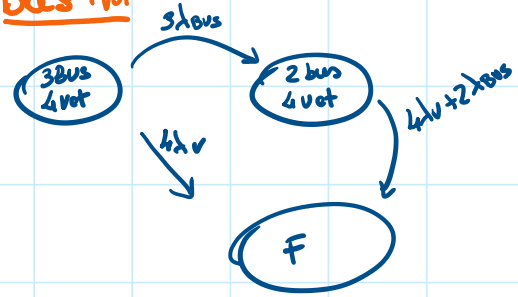
Raid 1



2-5 1 failure

raid 0 0 failure

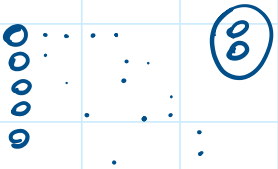
Bus + Vot



$$\begin{cases} \dot{P}\left(\frac{3}{4}\right)(t) = -P\left(\frac{3}{4}\right)(3\lambda_{bus} + 4\lambda_V) \\ \dot{P}\left(\frac{2}{4}\right)(t) = P\left(\frac{3}{4}\right)t\cdot(3\lambda_{bus}) + -P\left(\frac{2}{4}\right)t\cdot(4\lambda_V + 2\lambda_{bus}) \\ \dot{P}(F)t = (4\lambda_V)\cdot P\left(\frac{3}{4}\right)t + (4\lambda_V + 2\lambda_{bus})P\left(\frac{2}{4}\right)t \\ P\left(\frac{3}{4}\right)(t) = 1 \end{cases}$$

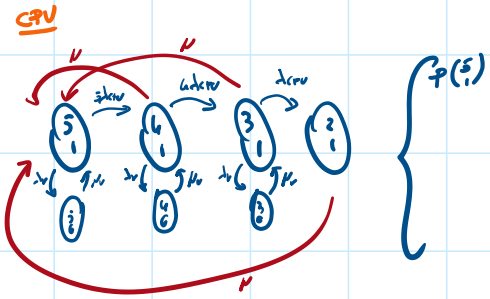
Availability

N ripara tutto il componente

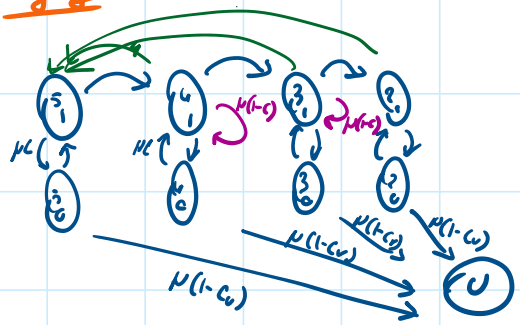


CPU

CPU



Safety



$\mu(1-C)^2$ * coverage factor * cov

Esame 13-09-2013

mercoledì 15 maggio 2019 16:49

Esercizio 2

Sempre uguale per quanto riguarda calcolo di $\bar{x}$ e $\bar{N}$

Se tengo conto delle rotture come indipendenti

$$A = \frac{MTTR}{MTTF+MTTR} = 0.98$$

$$q_3 = 1 \cdot A^3 \qquad q_2 = A^2(1-A) \qquad q_1 = 3A(1-A)^2$$

$$q_0 = (1-A)^3$$

$$\bar{R} = q_1 \cdot R_1 + q_2 \cdot R_2 + q_3 \cdot R_3$$

$$\bar{x} = q_1 \bar{x}_1 + q_2 \bar{x}_2 + q_3 \bar{x}_3$$

Esercizio 6/15

giovedì 16 maggio 2019 10:44

1 Gbps FDDI

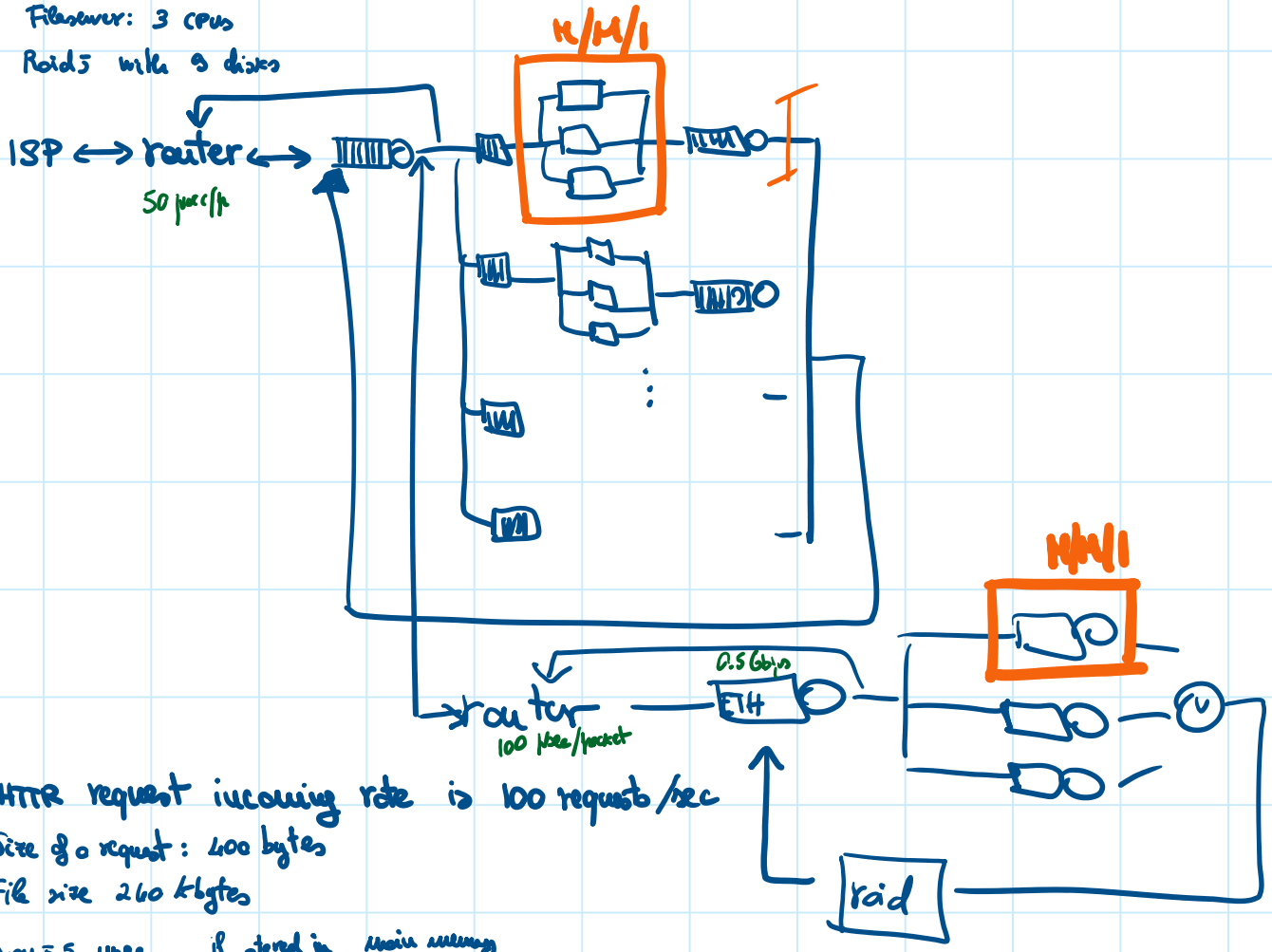
50 msec/packet latency

FDDI - Router 1,46 Gbps

Web site: 4 cores, local mem, local disk

Fileserver: 3 CPUs

Raid5 with 9 disks



HTTP request incoming rate is 100 requests/sec

Size of a request: 400 bytes

File size 260 kbytes

D_{CPU} = 5 msec if stored in main memory

$D_{CPU-DISK}$ = 10 msec if local disk

$D_{CPU-NOFILE}$ = 30 msec

D_{DISCO} = 10 msec

$S_{single\ disk\ or\ RAID5}$ = 10 msec × 20 kbytes

$D_{RAID5} = \frac{200}{20} \cdot 10 = 120$

NETWORKing Course MTU

packets = $\frac{260.000}{1460} = 165$ (1460 = 1500 − 20 − 20)

packet/request = $\frac{400}{1460} = 1$

$D_{FDDI} = \frac{1+3(20+20+28)+400 + (165+3)(20+20+28)+260\,000}{1,46 \cdot 10^{9}} = 2$ msec

rete sovraccaricata

HP: assumo 3 pacchetti aggiuntivi

$D_{router} = 172 \cdot 50$ µ/sec = 8,6 µ/sec

Dcontr = 172.50 M/sec = 8,6 M/sec

Ddisk = uguale a quella prima ma con 1 Gbyte = 2,01 msec

$P_{rete} = \sum_{i=1}^{5} k_i$ 20 % hit rate, 80 % miss

$P_{disk} = \sum_{i=1}^{10} k_i$ 60 % hit disk, 40 % miss

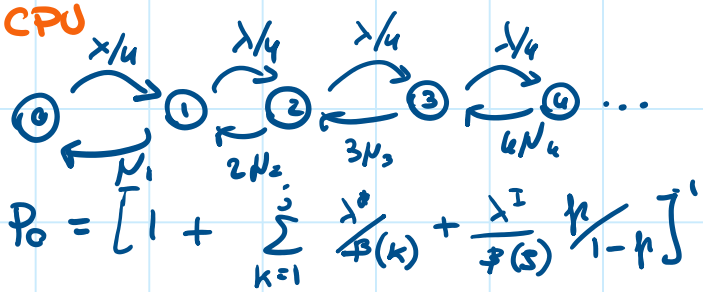
Average response time:

$\bar{R}_i = \frac{D}{1-U_i}$ $R_{TOT} = \sum_i R_i$

$U = X \cdot D$

Disk

Router:



$P_0 = \left[1 + \sum_{k=1}^{3} \frac{\lambda^*}{\mu(k)} + \frac{\lambda^I}{\mu(s)} \frac{\rho}{1-\rho}\right]^{-1}$

$X_1 = P_1$

$X_2 = P_2$ $\Rightarrow \bar{X}$

$X_3 = P_3$

$X_4 = P_4$

Esame 11/02/2016

sabato 18 maggio 2019 15:56

Esercizio n 1

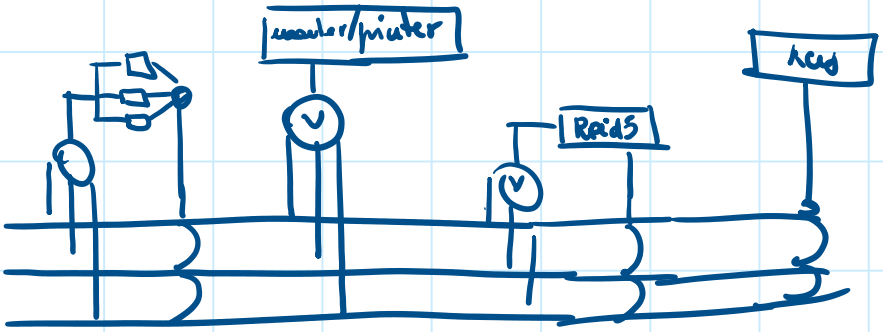
3 CPU in parallelo with voter

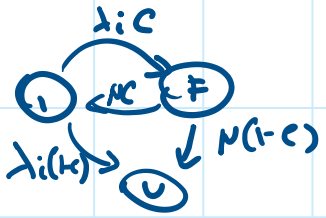
Raid 5 with 8 disks

3 bus

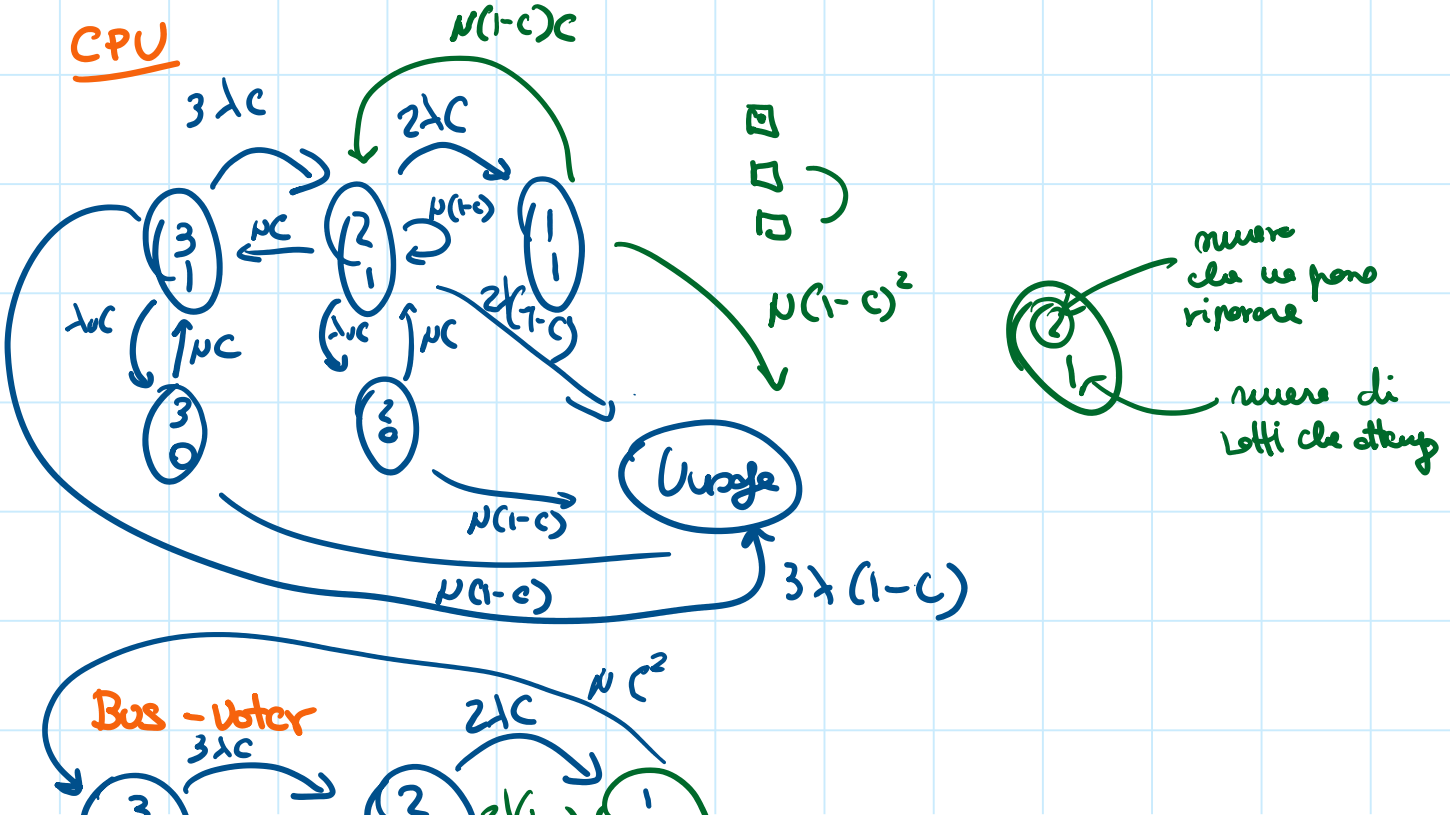
1 keyboard

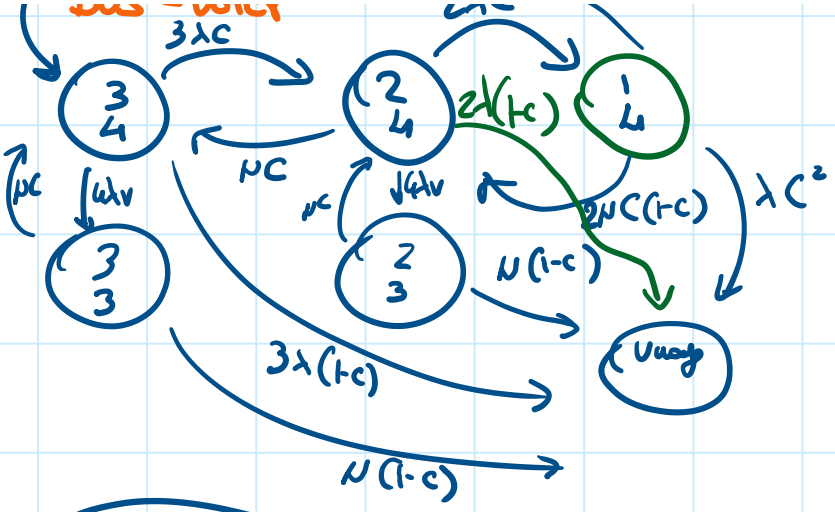
1 monitor

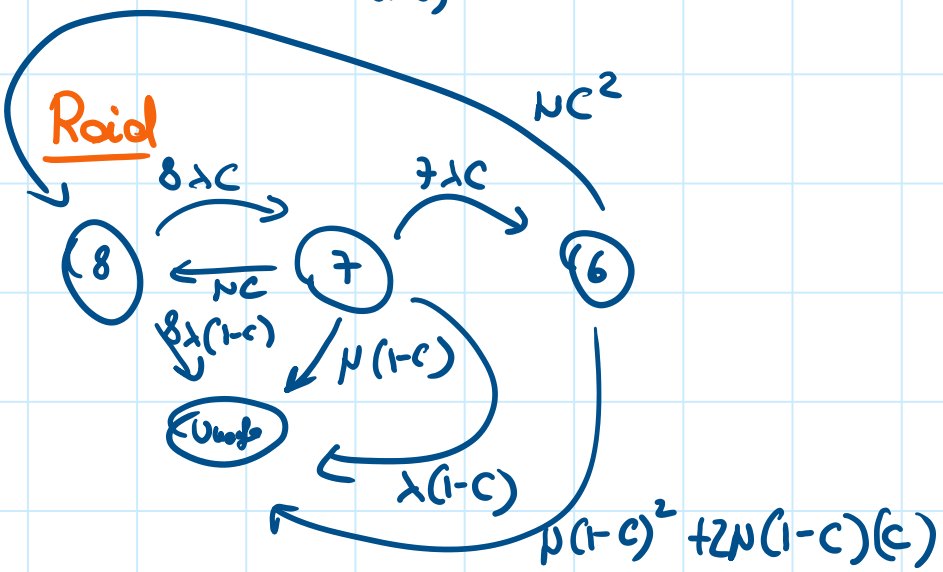




$$\begin{cases} \dot{P}_1(t) = P_1(t)\cdot(-\lambda_i C) + P_F(\mu C) \\ \dot{P}_F(t) = P_F(t)\cdot(-\mu C - N(1-C)) + P_1(t)\lambda_i C \\ U(t) = 1 P_F(t) N(1-C) + P_1(t)\cdot\lambda_i(1-C) \end{cases}$$



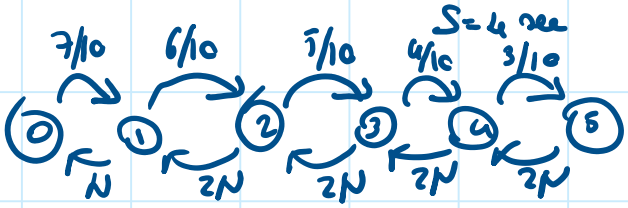


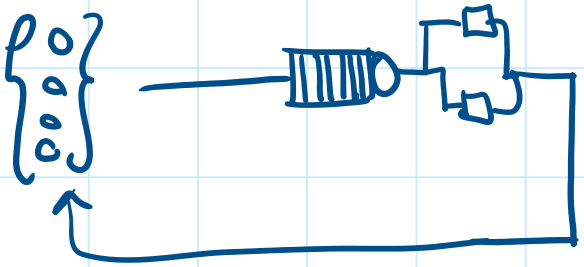


Esercizio 4.2

$\bar{R}$ $\bar{X}$?

1a sec first time





2 funzionanti

$P_0\ 7/10 = P_1\ \mu$

$P_1\ 6/10 = P_2\ 2\mu$

$P_2\ 5/10 = P_3\ 2\mu$

$P_3\ 4/10 = P_4\ 2\mu$

$P_4\ 3/10 = P_5\ 2\mu$

$P_0+P_1+P_2+P_3+P_4+P_5=1$

$\Rightarrow$

$P_0 = x_{1,2}$

$P_1 = a_{1,2}$

$P_2 = a_{2,2}$

$P_3 = a_{3,2}$

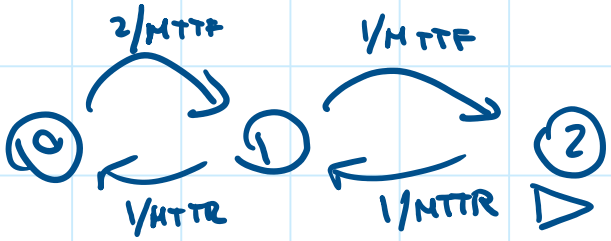
$P_4 = a_{4,2}$

X

1 funzionante

1 Esercizio

$$\begin{cases} P_0 \cdot 7/10 = P_1 \mu \\ P_1 \cdot 6/10 = P_2 \mu \\ P_2 \cdot 5/10 = P_3 \mu \\ P_3 \cdot 4/10 = P_4 \mu \\ P_4 \cdot 3/10 = P_5 \mu \\ P_0 + P_1 + P_2 + P_3 + P_4 + P_5 = 1 \end{cases} \Rightarrow \begin{aligned} P_0 &= x_{1,1} \\ P_1 &= a_{1,1} \\ P_2 &= a_{2,1} \\ P_3 &= a_{3,1} \\ P_4 &= a_{4,1} \\ P_5 &= a_{5,1} \end{aligned}$$



Ip: 1 riparatore x entrambi

$$\begin{cases} P_0 \cdot 2/MTTF = P_1 \cdot 1/MTTR \\ P_1 \cdot 1/MTTF = P_2 \cdot 1/MTTR \\ P_0 + P_1 + P_2 = 1 \end{cases} \Rightarrow P_0^*, P_1^F, P_2^F$$

$$X_0^2 = \sum w_i P_i = \mu R + 2\mu P_2 \dots$$

$$X_0^1 = \sum \mu_i P_i = \mu R_1 + 2\mu P_2 \dots$$

$$N^2 = \sum_i P_i = P_1^2 + 2P_2^2 + 3P_3^2$$

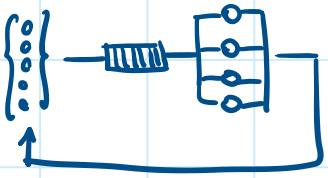
$$\bar{R}^2 = \frac{N^2}{X_0}$$

$$\bar{R}^1 = \frac{N^1}{X_0}$$

$$\bar{R} = P_0 \cdot \bar{R}^2 + P_1 \cdot \bar{R}^1$$

Esercizi 19/02/15

lunedì 20 maggio 2019 14:47



$\tau = 10$ sec

$S = 2$ sec $\quad \mu = \frac{1}{S} = 0.5$

MTTF = 10 settimane = $10 \cdot 7 \cdot 24 = 1680$

MTTR = 2 ore

Caso 4/4

$$\begin{cases} P_0\ 8/10 = P_1 \cdot 0.5 \\ P_1\ 7/10 = P_2 \\ P_2\ 6/10 = P_3 \cdot 1,5 \\ P_3\ 5/10 = P_4 \cdot 2 \\ P_4\ 4/10 = P_5 \cdot 2 \\ P_5\ 3/10 = P_6 \cdot 2 \\ P_0 + P_1 + P_2 + P_3 + P_4 + P_5 + P_6 = 1 \end{cases}$$

$P_0 = 0.232$

$P_1 = 0.391$

$P_2 = 0,259$

$P_3 = 0,103$

$P_4 = 0,025$

$P_5 = 5 \cdot 10^{-3}$

$P_6 = 7,5 \cdot 10^{-4}$

$\bar{N}_4 = \sum i P_i = 1,327$

$\bar{X}_4 = \sum \mu P_i = 0,66$

$$\bar{P} = \frac{\bar{N}_4}{\bar{X}_4} = 2,01$$

Caso 3/4

Caso 3/4

$$\begin{cases} P_0\ 8/10 = P_1 \cdot 0.5 \\ P_1\ 7/10 = P_2 \\ P_2\ 6/10 = P_3 \cdot 1,5 \\ P_3\ 5/10 = P_4 \cdot 1.5 \\ P_4\ 4/10 = P_5 \cdot 1.5 \\ P_5\ 3/10 = P_6 \cdot 1.5 \\ P_0 + P_1 + P_2 + P_3 + P_4 + P_5 + P_6 = 1 \end{cases}$$

Availability

Ipotesi: Riparazioni e guasti dipendenti

Ipotesi: Spengo dopo 2

$P_{B\ 1/MTTR} = P_{4\ 1/MTTF}$

$$P_4 = P_3 \cdot \frac{MTTF}{4\,MTTR} \qquad P_3 = \frac{4\,MTTR}{4\,MTTF} \cdot P_4$$

$$\begin{cases} P_3 \frac{1}{\mu_{TTR}} = P_4 \frac{1}{\mu_{TTF}} \\ P_2 \frac{1}{\mu_{TTR}} = P_3 \frac{1}{\mu_{TTF}} \\ P_3 + P_2 + P_4 = 1 \end{cases}$$

$$P_4 = P_3 \cdot \frac{\mu_{TTF}}{4\,\mu_{TTR}}$$

$$P_3 = P_2 \cdot \frac{\mu_{TTF}}{3\,\mu_{TTR}}$$

$$P_3 + P_2 + P_4 = 1$$

$$P_3 = \frac{4\,\mu_{TTR}}{\mu_{TTF}} \cdot P_4$$

$$P_2 = \frac{3\,\mu_{TTR}}{\mu_{TTF}} \cdot \frac{4\,\mu_{TTR}}{\mu_{TTF}} \cdot P_4$$

$$\left(\frac{4\,\mu_{TTR}}{\mu_{TTF}} + \frac{3\,\mu_{TTR}}{\mu_{TTF}} \cdot \frac{4\,\mu_{TTR}}{\mu_{TTF}} + 1 \right) P_4 = 1$$

$$\frac{8}{1680} + \frac{6}{1680} \cdot \frac{8}{1680} + 1$$

$$P_4 = 0.995$$

$$P_3 = 4{,}76 \cdot 10^{-3}$$

$$P_2 = 2{,}256 \cdot 10^{-5}$$

$$\bar{R} = P_4^5 \bar{R}_4 + B^4 \bar{R}_B$$

Esercizio 06/06/13

lunedì 20 maggio 2019 15:25

Request 5 workstations (users)

$Z = 5000$ msec

$D_{CPU} = 20$ ms

$D_{DISK} = 10 \cdot 5 = 50$ ms

At most 3 users

R ? $\bar{X}$ = ? percentage_of_refused_requests = ?

Caso N = 1

$R_{CPU} = 20$ msec

$R_{DISK} = 50$ msec

$R_{TOT} = 70$ msec

$\bar{X}_0 = 1/R_{TOT} = 0,014$

$N_{CPU} = R_{CPU} \cdot X_0(1) = 0,28$

$N_{DISK} = R_{DISK} \cdot X_0(1) = 0,72$

Caso N = 2

$R_{CPU} = D_{CPU}(1 + M_{CPU,1}) = 26,6$ msec

$R_{DISK} = D_{DISK}(1 + M_{DISK,1}) = 86$ msec

$\bar{X}_2 = 2/R_{TOT} = 2/116,6 = 0,018$

$M_{CPU,2} = 25,6 \cdot 0,018 = 0.46$

$M_{disk,2} = 86 \cdot 0,018 = 1.54$

Caso N = 3

$R_{CPU} = D_{CPU}(1 + M_{CPU,2}) = 29,2$

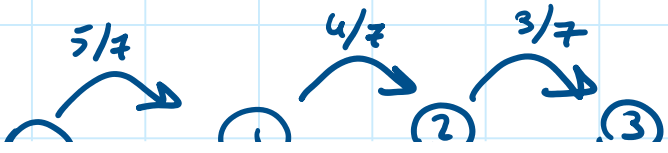
$R_{DISK} = D_{DISK}(1 + M_{DISK,2}) = 127$

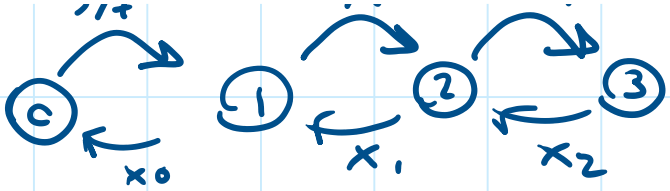
$R_{TOT} = 156,2$

$N_{CPU,3} = 0,554$

$N_{DISK,3} = 2,413$

$X_3 = 3/R_{TOT} = 0,0192$





$$\begin{cases} P_0 \cdot 3/7 = P_1 \cdot x_0 \\ P_1 \cdot 4/7 = P_2 \cdot x_1 \\ P_2 \cdot 3/7 = P_3 \cdot x_2 \\ P_0 + P_1 + P_2 + P_3 = 1 \end{cases}$$

$P_0 = 0{,}930$

$P_1 = 0.066$

$P_2 = 2{,}353 \cdot 10^{-3}$

$P_3 = 9{,}828 \cdot 10^{-5}$

$\bar{x} = x_i \cdot P_i = 9{,}79 \cdot 10^{-4} = 0.$

$\bar{R} = \frac{N}{X} = \frac{0.072}{9{,}79 \cdot 10^{-4}} = 73{,}55$ Controllo unità di misura

$0{,}013902 +$

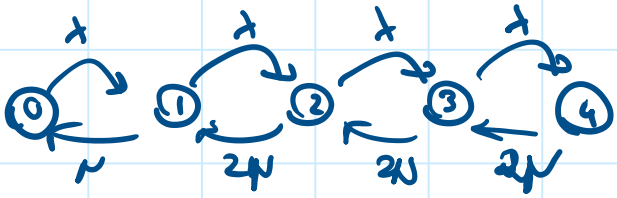
Esame 7/7/2015

lunedì 20 maggio 2019 16:29

2 server, max 4 users

$\lambda = 0.5$ (service rate)

$X = ?$ $U = ?$



flussi in = flussi out

$\Rightarrow$ p_0, p_1, p_2, p_3, p_4 ← poiché loss probability

$$X = \sum_1^4 \mu_i p_i =$$

$$N = \sum_1^4 i p_i =$$

$$p_0 = \frac{\lambda}{N}$$

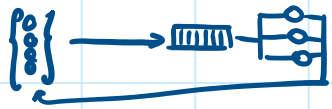
$$U = 1 - p_0 = 0.24$$

Esame 20/2/2013

martedì 21 maggio 2019 09:21

Esercizio 2

$\bar{R} = ?$,



$\mu = 10$

$1/\text{MTTF} = 1/12 \text{ months} = \frac{1}{365 \cdot 24}$

$1/\text{MTTR} = 1/12 \text{ hours} =$

$$\begin{cases} P_0 \cdot 8/20 = P_1 \cdot 0.1 \\ P_1 \cdot 7/20 = P_2 \cdot 0.2 \\ P_2 \cdot 6/20 = P_3 \cdot 0.3 \\ P_3 \cdot 5/20 = P_4 \cdot 0.3 \\ P_4 \cdot 4/20 = P_5 \cdot 0.3 \end{cases}$$

$P_0 + P_1 + P_2 + P_3 + P_4 + P_5 = 1$

$P_0 = 0.03$

$P_1 = \frac{P_0 \cdot 8/20}{0.1} = 0,12$

$P_2 = \frac{P_1 \cdot 7/20}{0.2} = 0,21$

$P_3 = \frac{P_2 \cdot 6/20}{0.3} = 0,21$

$P_4 = \frac{P_3 \cdot 5/20}{0.3} = 0,175$

$P_5 = 0,116$

$N_3 = \sum i \cdot P_i = 2,45$

$\bar{X}_3 = \sum \mu_i \cdot P_i = 0,20$

$\bar{R}_3 = N_3 / X_3 = 12$

Caso 2 server

$$\begin{cases} P_0 \cdot 8/20 = P_1 \cdot 0.1 \\ P_1 \cdot 7/20 = P_2 \cdot 0.2 \\ P_2 \cdot 6/20 = P_3 \cdot 0.2 \\ P_3 \cdot 5/20 = P_4 \cdot 0.2 \\ P_4 \cdot 4/20 = P_5 \cdot 0.2 \end{cases} \Rightarrow$$

$P_0 + P_1 + P_2 + P_3 + P_4 + P_5 = 1$

$P_0 = \frac{1}{[P_1 + P_2 + P_3 \ldots]}$ (sommiamo fino a 1) $= 0,02$

$P_{1T} = 4$

$P_{2T} = \frac{4 \cdot 7/20}{0.2} = 7$

$P_{3T} = 10.\bar{5}$

$P_{4T} = 13,12$

$P_{5T} = 13,12$

$P_1 = 0,08$

$P_2 = 0,14$

$P_3 = 0,21$

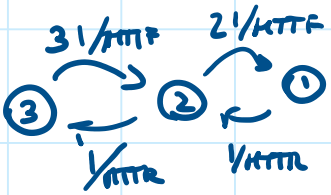
$P_4 = 0,26$

$P_5 = 0,26$

$P_{SF} = 13,12$

$\overline{N_2} = 3,33$ $\quad X_2 = 0,18$ $\quad R_2 = 18.29$

Availability



$$\begin{cases} P_3 \frac{1}{MTTF} = P_2 \cdot \frac{1}{MTTR} \\ P_2 \frac{1}{MTTF} = P_1 \cdot \frac{1}{MTTR} \\ P_3 + P_2 + P_1 = 1 \end{cases}$$

$P_3 = 0,995$

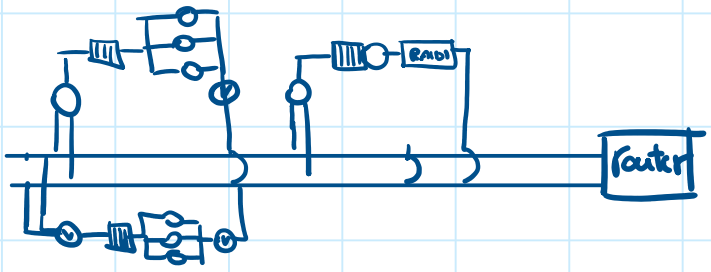
$P_2 = 4,08 \cdot 10^{-3}$

$P_1 = 9.2 \cdot 10^{-6}$

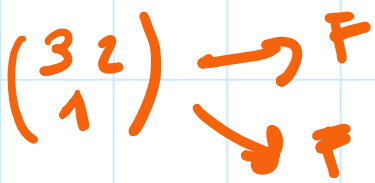
$$\overline{X} = P_3 \cdot \overline{X_3} + P_2 \cdot \overline{X_2} = 0,203$$

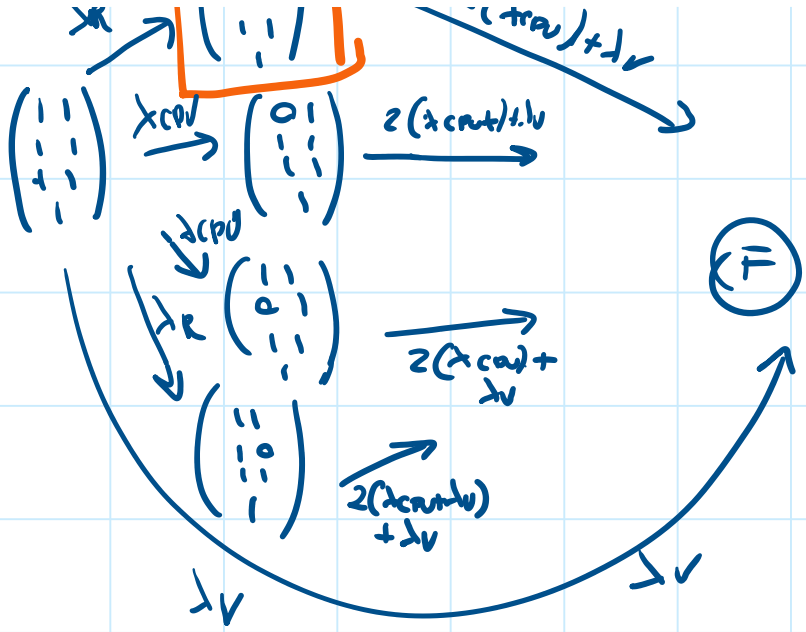
$$\overline{R} = P_3 \cdot \overline{R_3} + P_2 \cdot \overline{R_2} = 12,01$$

Esercizio 1



Reliability



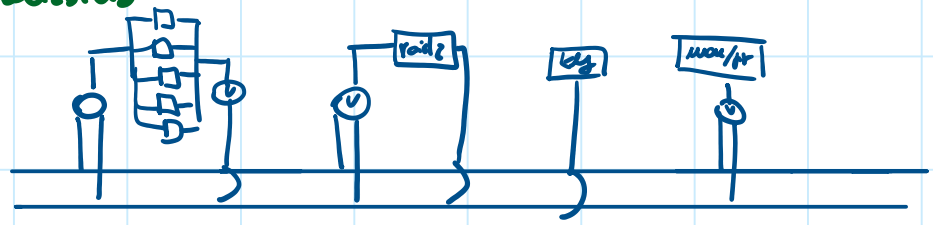


Esame 13/9/13

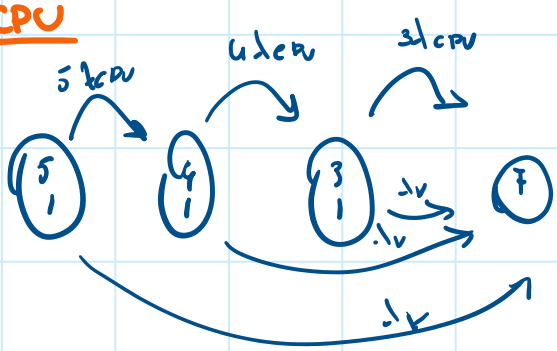
martedì 21 maggio 2019 11:04

Esercizio 1

Reliability

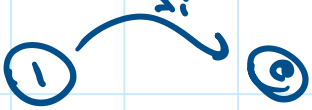


CPU



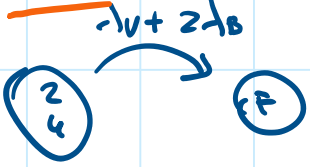
$$\begin{cases} \dot{P}_{3,1}(t) = P_{5,1}(t) \cdot (-5\lambda_{CPU}) \\ \vdots \\ P_{5,1}(0) = 1 \end{cases}$$

MONITOR PRINTER Kyboard

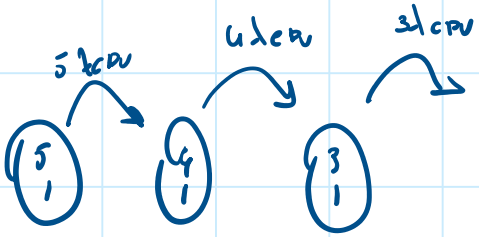


RAID

BUS



Availability



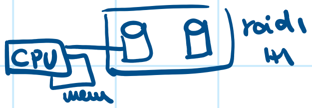
Esercizio casa

martedì 21 maggio 2019 16:08

SLA: $\lambda = 100$ requests/sec

$\bar{R} = 1$ sec

Disp = 95 % loss = 2%



S_{CPU} = 10 msec max 4 utenti

S_{DISK} = 20 msec

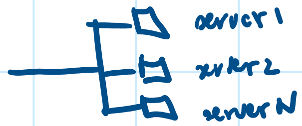
4 utenti max

$MTTF_{CPU}$ = 1 year = 52

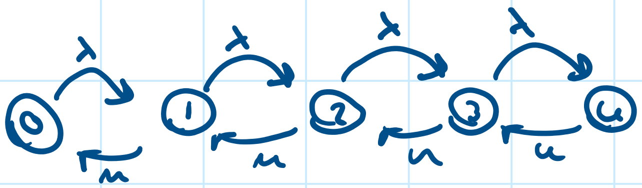
$MTTF_{disk}$ = 6 months = 26 sett

$MTTR_{CPU}$ = 1 week

$MTTR_{DISK}$ = 1 week



manutenzioni indipendenti



$$A_{CPU} = \frac{MTTR}{MTTR_{CPU} + MTTF_{CPU}} = \frac{52}{1+52} = 0.98$$

$$A_{DISK\ single} = \frac{MTTR}{MTTR_{DISK} + MTTF_{DISK}} = \frac{26}{1+26} = 0.96$$

$$A_{1/2\ disk} = 2 A_{sing} (1 - A_{singdisk}) = 0.076$$

$$A_{2/2\ disk} = 0.96 \cdot 0.96 = 0.92$$

$A_s = A_{CPU} \cdot A_{1/2} = 0.074\ \%$ || single disk, ignoro

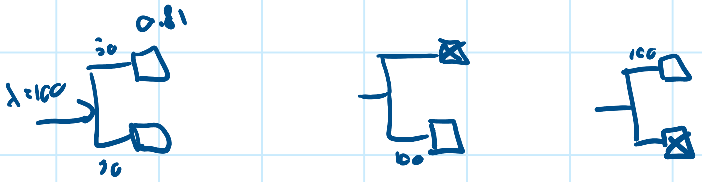
$A_s = A_{CPU} \cdot A_{2/2} = 0.90\ \%$ | caso conservativo, assumo che il raid ci metta del tempo a ricostruire

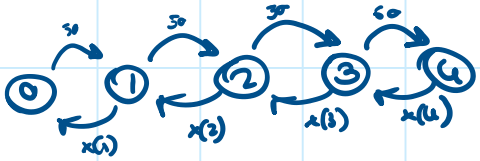
$A_{TOT\ 1/2+2/2} = 1 - (1 - 0.90)^2 = 0.99\ \%$ ||

$A_{tutti\ e\ 2} = 0.81$ ↔ P_2

$A_{solo\ 1} = 2(1 - 0.90)(0.90) = 0.18$ P_1

server



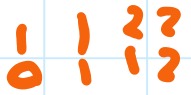


Caso u1

$R_{CPU} = 10$
$R_{DISK} = 20$
$R_{TOT} = 30$
$X_1 = 1/3 \cdot 10^{-2}$
$N_{CPU} = D_{CPU} X_1 = 0{,}33$
$N_{DISK} = D_{DISK} X_1 = 0{,}66$

Caso u2

$R_{CPU} = 10(1 + N_{CPU_1}) = 13{,}3$
$R_{DISK} = 20$
$R_{TOT} = 33{,}3$
$X_2 = 1/33{,}3 = 3$
$N_{CPU_2} = D_{CPU} X_1 =$
$N_{DISK} = D_{DISK} \cdot X_1 =$



Caso u3

$R_{CPU} = 10(1 + N_{CPU_2})$
$R_{DISK} = 20(1 + N_{DISK_2})$
$X_3 =$
N_{CPU_3}

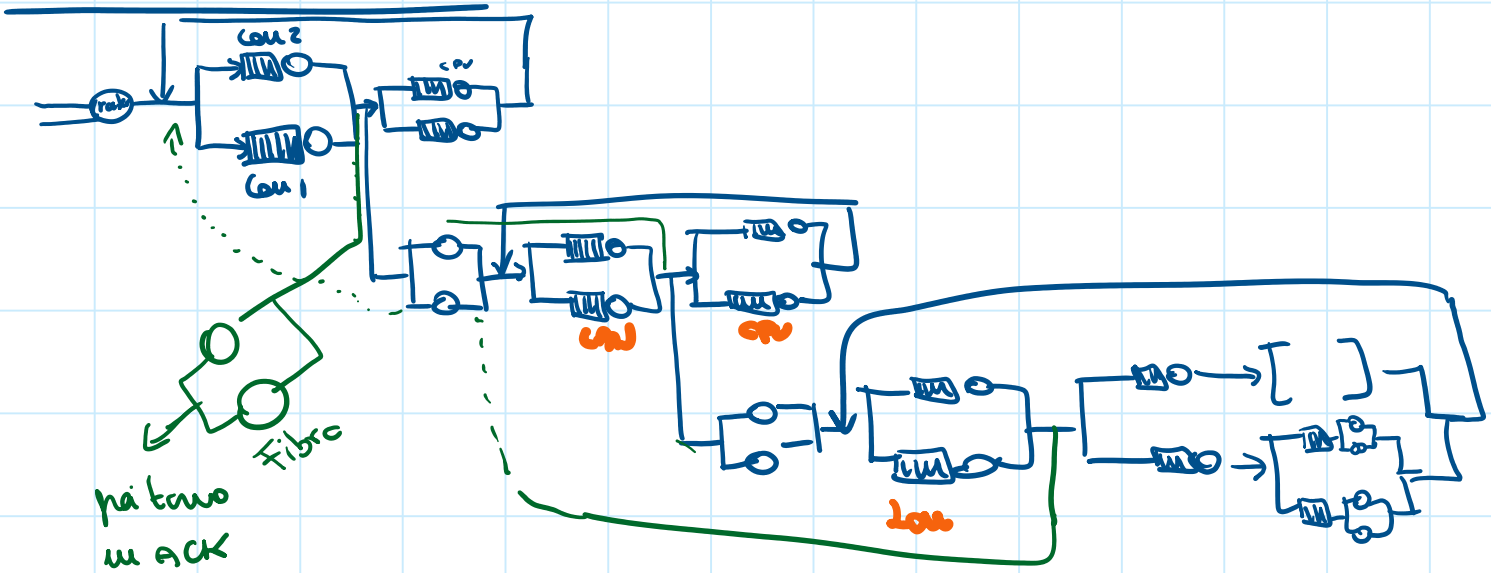
Caso u4

$R_{CPU} =$
$R_{DISK} = R_{DISK_3}$
X_4

$\bar{R}_2 = \sum P_i \cdot R_i$

Fibre con i dati funzionante ($\lambda = 100$)

→ Normalizzo con $(1 - P_0)$ se richiede che nel periodo funzionante
→ Non normalizzo altrimenti



ha trovo un ACK

Esercizio performability Alex

sabato 25 maggio 2019 17:29

$\bar{R} = ?$ $\bar{X} = ?$

4 server → 1 CPU, RAM, RAID 1 (4+4)

$MTTF_D = 500$ ore $MTTF_C = 1000$ ore

$MTTR_D = 50$ ore $MTTR_C = 10$ ore

6 utenti con $Z = 10$ sec

$A_{CPU} = \frac{1000}{1010} = 0.99$ $\mu = 1/5$

$A_{DISK} = \frac{500}{550} = 0.90$

$A_{raid} = (1-(1-A_{DISK})^2)^4 = 0.96$

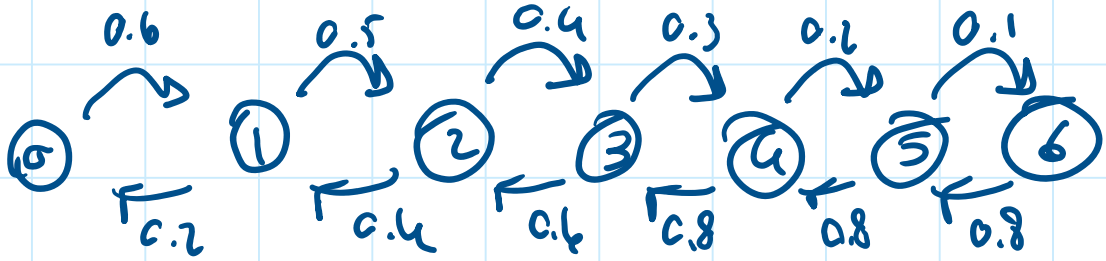
$A_{server} = A_{CPU} \cdot A_{raid}$

$q_4 = 0.95^4 = 0.81$

$q_3 = 4 \cdot 0.95^3(1-0.95) = 0.17$

$q_2 = 6 \cdot 0.95^2(1-0.95)^2 = 0.013$

$\binom{4}{1} = \frac{4!}{1(3!)} = \frac{4 \cdot 3!}{6} = 4$ n oggetti presi k a k



$N_4 = \sum i P_i = 1,57$

$\bar{x}_u = \sum_N p_i = 0,39$

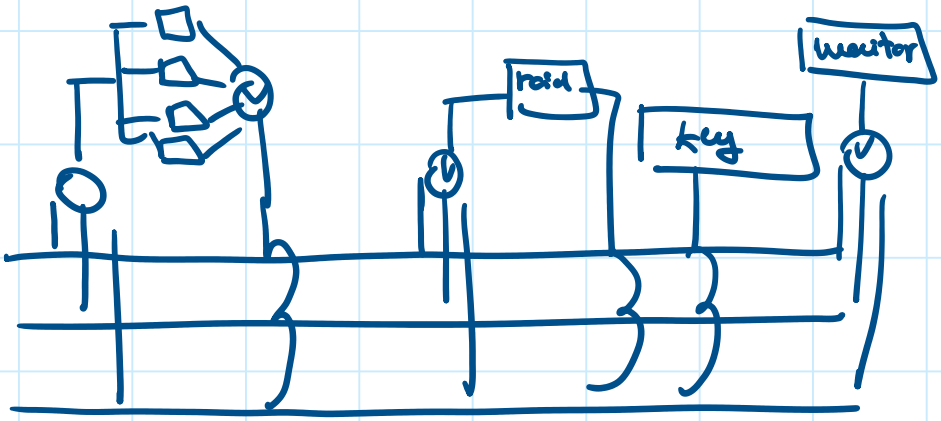
$\bar{R}_u = 5,05$

Facile: 3 gemme, 2 gemme, 1 gemma

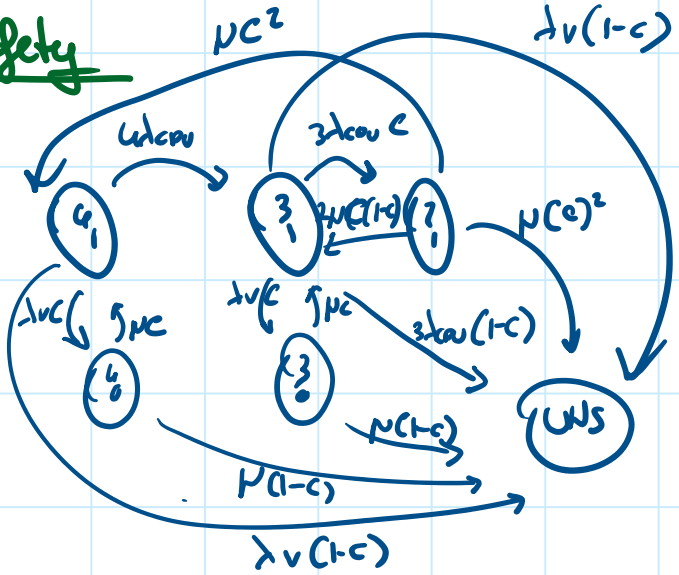
$R_{TOT} = q_4 \cdot R_4 + q_3 \cdot R_3 + q_2 \cdot R_2 + q_1 \cdot R_1$

Esame 21/12/04

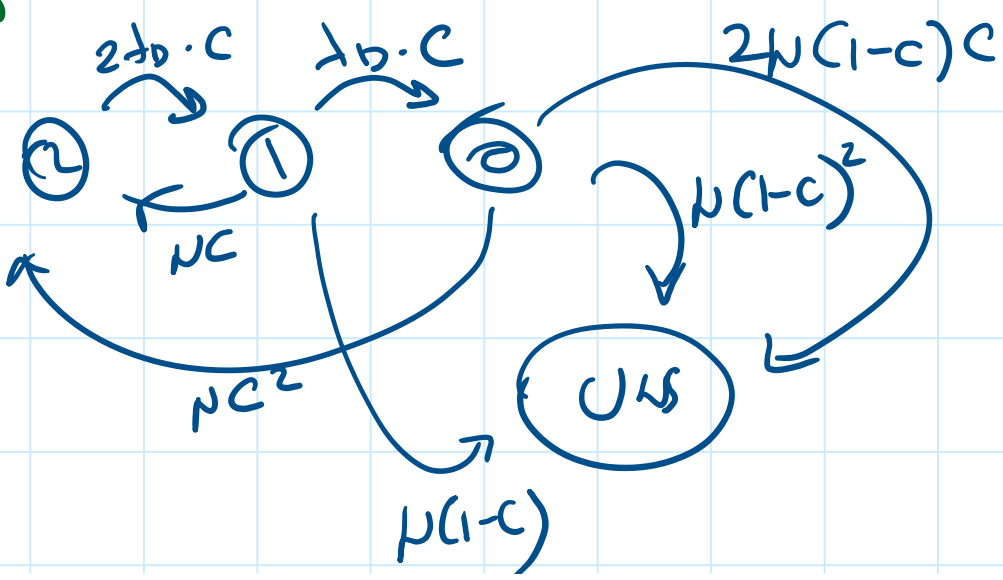
sabato 25 maggio 2019 17:40



Safety

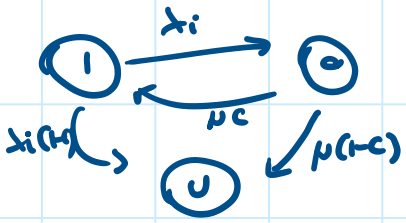


Safety RAID



$\mu(1-c)$

Safety Monitor/Printer



Esame 20/02/2013

sabato 25 maggio 2019 18:45

$\bar{R} = ?$ $\bar{X} = ?$

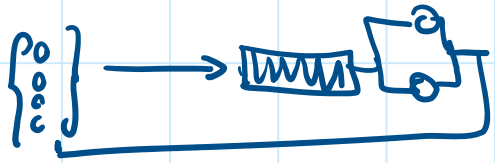
2 paralleli systems

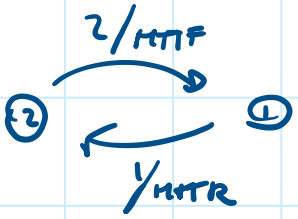
at most 4 users

$\tau = 100$ sec

HTTF = 3 week

HTTR = 1 hour





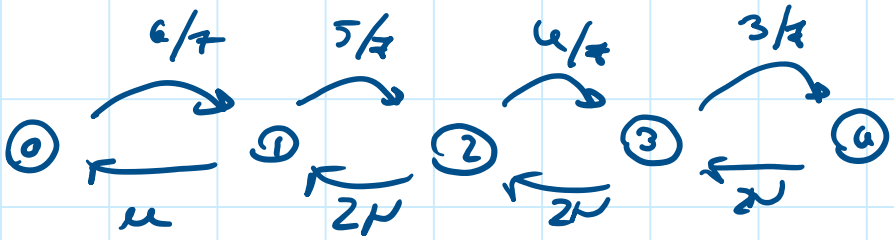
$$\begin{cases} P_2 \, 2/50\mu = P_1 \, 1/1 \\ P_1 \, 1/50\mu = P_0 \, 1/1 \\ P_2 + P_1 + P_0 = 1 \end{cases}$$

$$P_2 = 1/\left[1 + 2/50\mu + 2/50\mu \cdot 1/50\mu\right] = 0{,}996$$

$$P_1 = 3{,}98 \cdot 10^{-3}$$

$$P_0 = 7{,}8 \cdot 10^{-6}$$

μ: sistema funziona solo se entrambi funzionano



P_0
P_1
P_2
P_3
P_4

$N = \sum_i i \cdot P_i$

$X = \sum \mu_i \cdot P_i$

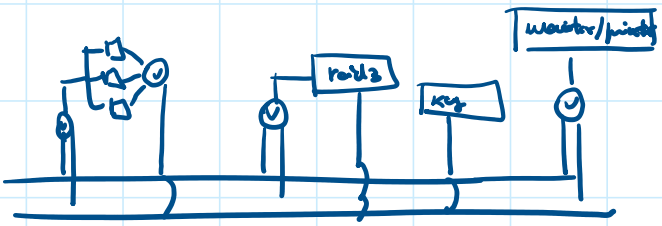
$R = N/X$

Esame 13/1/2012

domenica 26 maggio 2019 12:05

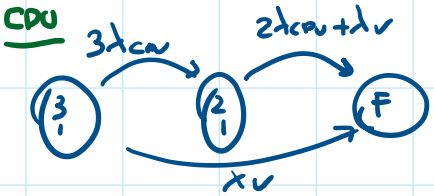
Esercizio n.1

3 cpu
Raid 3 4 disk
1 keyboard
1 Printer
1 monitor
2 bus



Reliability

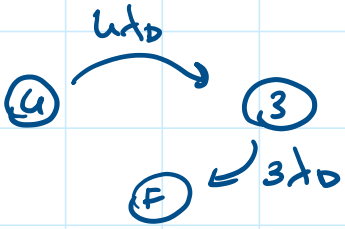
CPU



$$\begin{cases} \dot{P}_{3,1}(t) = -P(3,1)(3\lambda_{CPU}+\lambda_V) \\ \dot{P}_{2,1}(t) = -P(2,1)(2\lambda_{CPU}+\lambda_V) + P(3,1)\,3\lambda_{CPU} \\ \dot{P}_F(t) = +P(2,1)(t)(2\lambda_{CPU}+\lambda_V) + P(3,1)(t)(\lambda_V) \\ \dot{P}(3,1)(0) = 1 \end{cases}$$

$$R_{CPU} = 1 - P_F(t)$$

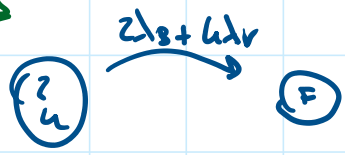
DISK



$$\begin{cases} \dot{P}_4(t) = -P(4)(t)\,4\lambda_D \\ \dot{P}_3(t) = +P(4)(t)\,4\lambda_D - 3\lambda_D P_F(t) \\ \dot{P}_F(t) = P(F)\,3\lambda_D \\ P(4)(0) = 1 \quad 0 \text{ otherwise} \end{cases}$$

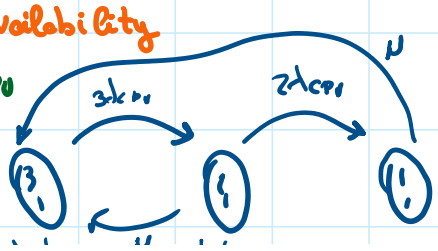
MON / PRINTER / key

BUS

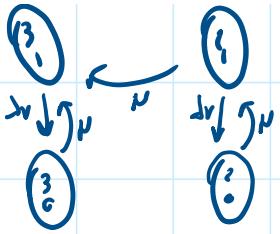


Availability

CPU



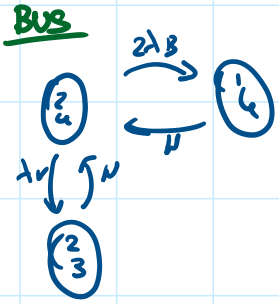
$$\begin{cases} P_{3,1}(3\lambda_C+\lambda_V) = P(2,1)N + P(1,1)N + P(3,0)N \\ P_{2,1}(2\lambda_{CPU}+N+\lambda_V) = P(2,0)N + P(3,1)\,3\lambda_C \\ P_{1,1}(N) = P(2,1)\,2\lambda_{CPU} \end{cases}$$



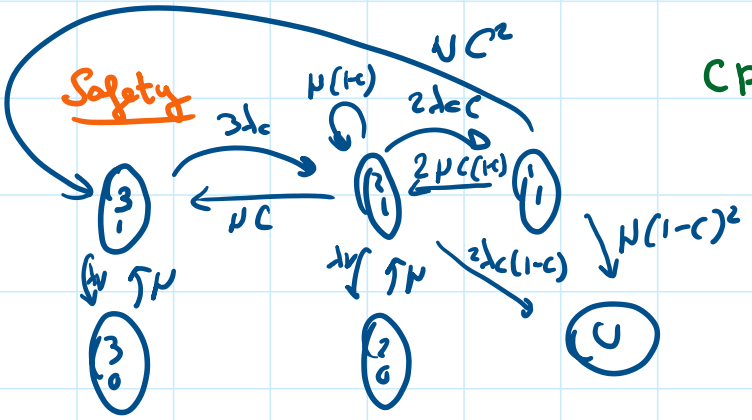
$$\begin{cases} P_{1,1}(N) = P(1_1)\,2\lambda_{CPU} \\ P_{3,0}(N) = P(3_1)\,\lambda_V \\ P_{2,0}(N) = P(1_1)\,\lambda_V \\ \sum_i P_i = 1 \end{cases}$$

$Ac \rightarrow P(3_1) + P(1_1)$

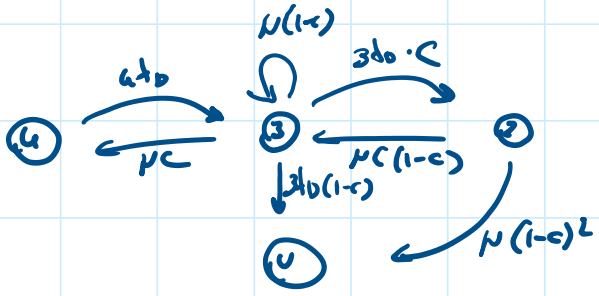
BUS



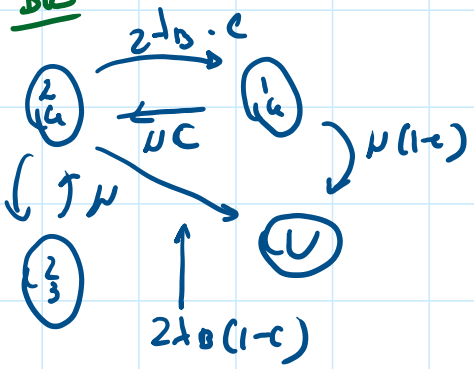
$$\begin{cases} P(2_4)\,(2\lambda_B + \lambda_V) = P(1_4)\,(N) + P(3_3)\,N \\ P(1_4)\,N = P(2_4)\,2\lambda_B \\ P(3_3)\,N = P(1_4)\,\lambda_V \\ \sum_i P_i = 1 \end{cases}$$



DISK



BUS



Esercizio 11.3

$\bar{R}$, $\bar{x}$ M/M/1/4/6

$t = 30$ sec $S = 20$ sec

$N = 1/S = 0{,}05$ rq/s

$$\begin{cases} 6/7\, P_0 = \mu P_1 \\ 5/7\, P_1 = \mu P_2 \\ 4/7\, P_2 = \mu P_3 \\ 3/7\, P_3 = \mu P_4 \\ \sum_i P_i = 1 \end{cases}$$

$$P_0 = 1/\left[1 + \frac{6}{7\mu} + \frac{6}{7\mu}\cdot\frac{5}{7\mu} + \frac{6}{7\mu}\cdot\frac{5}{7\mu}\cdot\frac{4}{7\mu} + \frac{6}{7\mu}\cdot\frac{5}{7\mu}\cdot\frac{4}{7\mu}\cdot\frac{3}{7\mu}\right]$$

P_0 P_1 P_2 P_3 P_4

$$\bar{X} = \sum \mu \cdot P_i$$

$$N = \sum i \cdot P_i$$

$$\bar{R} = N/\bar{X}$$

Esercizio 4

$\lambda = 10$ req/s

$S_{CPU} = 10$ ms

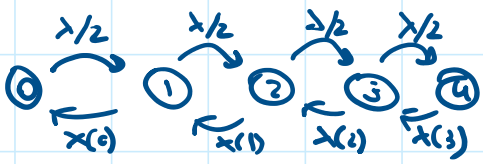
$V = 2$

$S_{IO} = 10$ ms

max 4 users

HTTP = 100000 B

HTTR = 10 B



Caso $u = 1$

Esercizio 20/02/2013

lunedì 27 maggio 2019 10:21

Esercizio 2

Hp: guasti e riparazioni indipendenti

2 postili server

$Z = 100$ sec

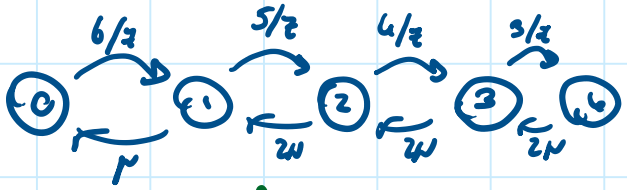
HTTP = 3 weeks

HTTR = 1 hour

$A = \frac{72}{73} = 0.98$

$A_2 = 0.98^2 = 0.96$

$A_1 = (0.98)(1-0.98) = 0.03$



Due server online

$$\begin{cases} P_0\, 6/7 = P_1 \mu \\ P_1\, 5/7 = P_2\, 2\mu \\ P_2\, 4/7 = P_3\, 2\mu \\ P_3\, 3/7 = P_4\, 2\mu \end{cases}$$

$P_0 = 1/[1 + 0.86 + 1.5 \cdot 10^{-3} + 3 \cdot 10^{-5} + 4{,}5 \cdot 10^{-7}]$

$P_1 = 0.05$

$P_2 = 1.41 \cdot 10^{-3}$

$P_3 = 2{,}88 \cdot 10^{-5}$

$P_4 = 4{,}23 \cdot 10^{-7}$

$N = \sum i P_i = 0.07$

$X = \sum \mu \cdot P_i = 0.05$

$R = 1$

Un server online

$$\begin{cases} P_0\, 1/7 = P_1 \mu \\ P_1\, 5/7 = P_2 \mu \\ P_2\, 4/7 = P_3 \mu \\ P_3\, 3/7 = P_4 \mu \end{cases}$$

$P_0 = 1/[1 + 0.06 + 3 \cdot 10^{-3} + 1{,}2 \cdot 10^{-4} + 3{,}6 \cdot 10^{-6}] = 0.94$

$P_1 = 0.05$

$P_2 = 2{,}5 \cdot 10^{-3}$

$P_3 = 1 \cdot 10^{-4}$

$P_4 = 3 \cdot 10^{-6}$

$P_{3\frac{1}{2}} = P_{4\frac{1}{2}}$ $P_3 = 1.10^{-4}$

$P_4 = 3.10^{-6}$

$N = \sum i \cdot P_i = 0.05$

$X = \sum N \cdot P_i = 0.05$

$R_i = 1$

$R = (A_2)(R_2) + (A_{single})(R_1) = 1$

Esercizio 4/11/2014

lunedì 27 maggio 2019 10:47

SLA:

0.2 seconds Response time

2% request loss

- 10 rps 0:00 - 12:00
- 20 rps 12:00 - 24:00

Prima provider

$D_{CPU} = 10$ ms

$D_{DISK} = 30$ ms di I/O disk

3 client max

1 euro x day

Seconda provider

$D_{CPU} = 20$ ms

$D_{DISK} = 20$ ms

4 client max

0.5 euro

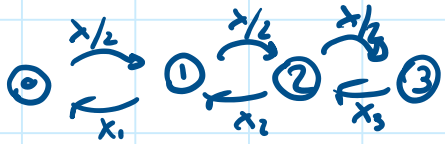
Availability:

$A = \frac{24}{25} = 0.96$

$A_{1/2} = 0.92$

$A_{1/3} = 0.0768$ } 96%

Prima provider



Caso u=1

$D_{CPU} = 10$

$D_{DISK} = 30 \cdot 10^{-3}$

$R_{TOT} = 40 \cdot 10^{-3}$

$X_1 = 1/40 = 25$

$N_{CPU,1} = X \cdot R_{CPU} = 0.25$

$N_{DISK,1} = X \cdot R_{DISK} = 0.75$

Caso u=2

$D_{CPU} = R_{CPU}(1+0.25) = 12,5 \cdot 10^{-3}$

$D_{DISK} = 30(1+0.25) = 52,5$

$X_2 = 30,7$

$N_{CPU,2} = 30,7 \cdot 12,5 \cdot 10^{-3} = 0.38$

$N_{DISK} = 30,7 \cdot 52,5 \cdot 10^{-3} = 1,61$

Caso u=3

$D_{CPU} = R_{CPU}(1+0.38) = 13,8 \cdot 10^{-3}$

$D_{DISK} = R_{DISK}(1+1,61) = 78,3 \cdot 10^{-3}$

$X_3 = 32,4$ ⇒ 95

$N_{CPU_3} = 32,4 \cdot 13,8 \cdot 10^{-3} = 0,45$

$N_{DISK_3} = 32,4 \cdot 78,3 \cdot 10^{-3} = 2,55$

$$\begin{cases} P_0 \lambda/2 = P_1 \cdot X_1 \\ P_1 \lambda/2 = P_2 \cdot X_2 \\ P_2 \lambda/2 = P_3 \cdot X_3 \\ \sum_i P_i = 1 \end{cases}$$

$P_0 = 1/[1 + 0.4 + 0,13 + 0,03] = 0,64$

$P_1 = 0.25$

$P_2 = 0,08$

$P_3 = 0.02$

$N = \sum_i i \cdot P_i = 0,47$

$X = \sum \mu \cdot P_i = 9,35$

$R = N/X = 0.05$

$$\begin{cases} P_0 \lambda = P_1 X_1 \\ P_1 \lambda = P_2 X_2 \\ P_2 \lambda = P_3 X_3 \end{cases}$$

$P_0 = 1/[1 + 0.8 + 0,53 + 0,30] = 0,39$

$P_1 = 0.304$

$P_2 = 0.2$

$P_3 = 0.11$

$$\begin{cases} P_1 x = P_2 x_2 \\ P_2 x = P_3 x_3 \end{cases}$$

$P_1 = 0.500$

$P_2 = 0.2$

$P_3 = 0,11$

$N = 1,01$

$X = 17,11$

$R = 0,96$

$$\overline{R} = A_2(R_2) + A_{1/2}(R_1) = 0,05\ \text{Rc}$$

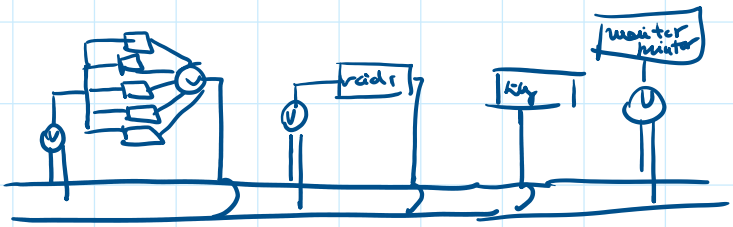
$$b_{00} = A_{2/2}\ 0.02 + A_{1/2} \cdot 0.11 = 0,026$$

Costo 24 euro

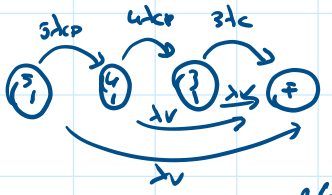
Esame 15/4/2013

lunedì 27 maggio 2019 15:17

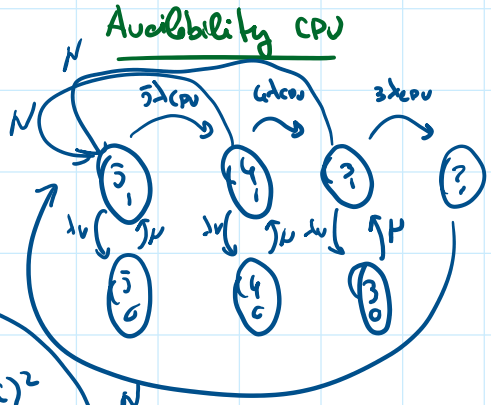
Esercizio 1



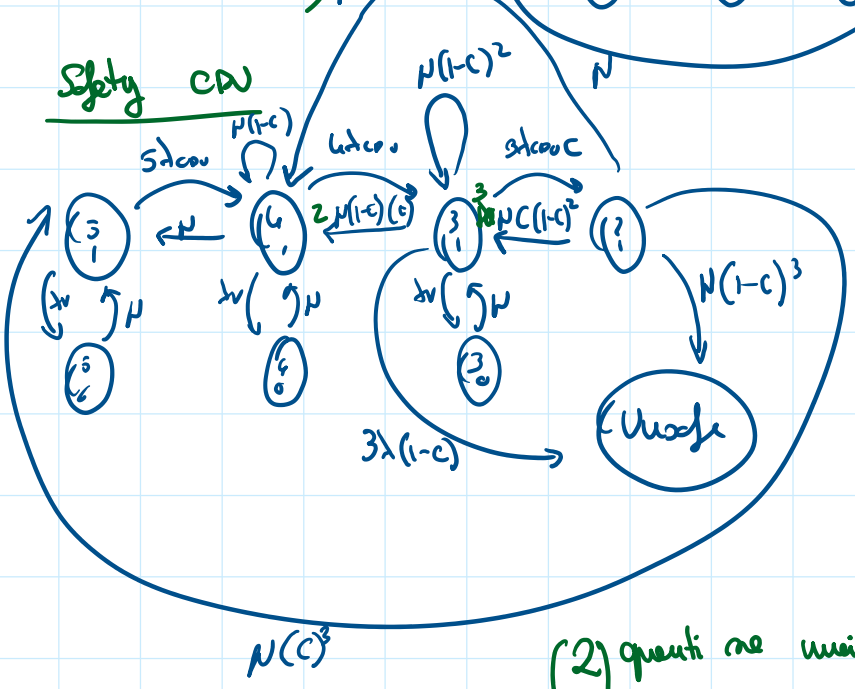
Reliability CPU



Availability CPU



Safety CPU



$$\binom{5}{2} \qquad 5\cdot 4\cdot 3\cdot 2$$

$$\frac{5!}{(5-2)!\,2!} = \frac{120}{12} = 10$$

$$\frac{5!}{(5-3)!\,3!} = \frac{120}{2\cdot 6} = 10$$

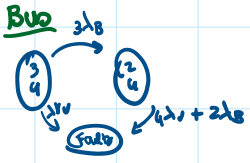
$\binom{2}{1}$ quanti ne usci rirorso

quanti te de ne rompono

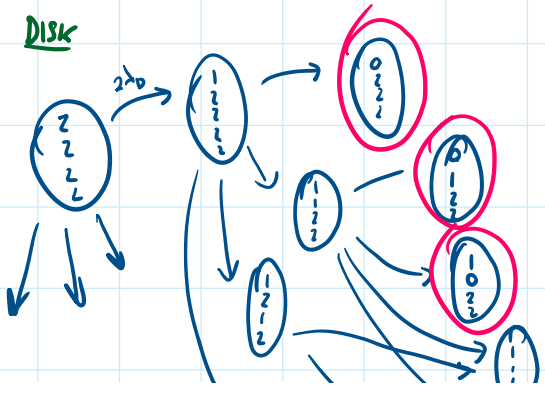
$$\binom{3}{2} = \frac{6}{2}$$

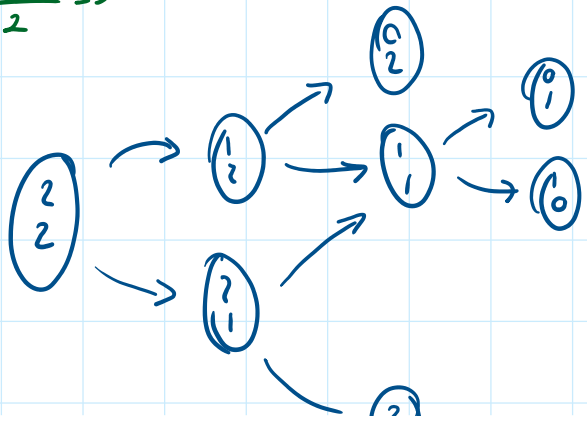
$$\binom{3}{1} = \frac{6}{2} = 3$$

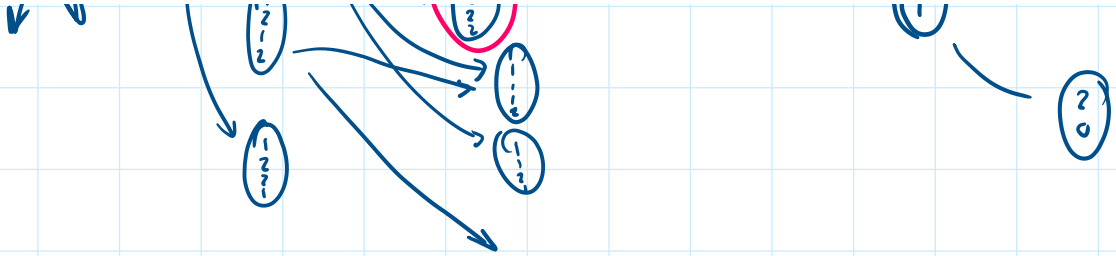
Bus



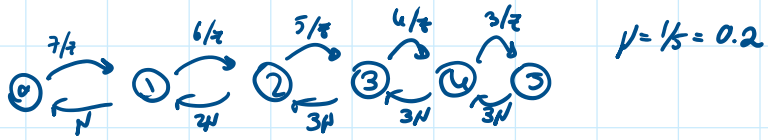
Disk







Esercizio 2



$\mu = 1/5 = 0.2$

$$\begin{cases} P_0 \, 7/4 = P_1 \mu \\ P_1 \, 6/4 = P_2 2\mu \\ P_2 \, 5/4 = P_3 3\mu \\ P_3 \, 4/4 = P_4 3\mu \\ P_4 \, 3/4 = P_5 3\mu \end{cases}$$

$$P_0 = \frac{1}{[1 + 3.5 + 3.25 + 4.37 + 2.18 + 1.46]} = 0.05$$

$P_1 = 0{,}175$

$P_2 = 0{,}24$

$P_3 = 0{,}21$

$P_4 = 0{,}14$

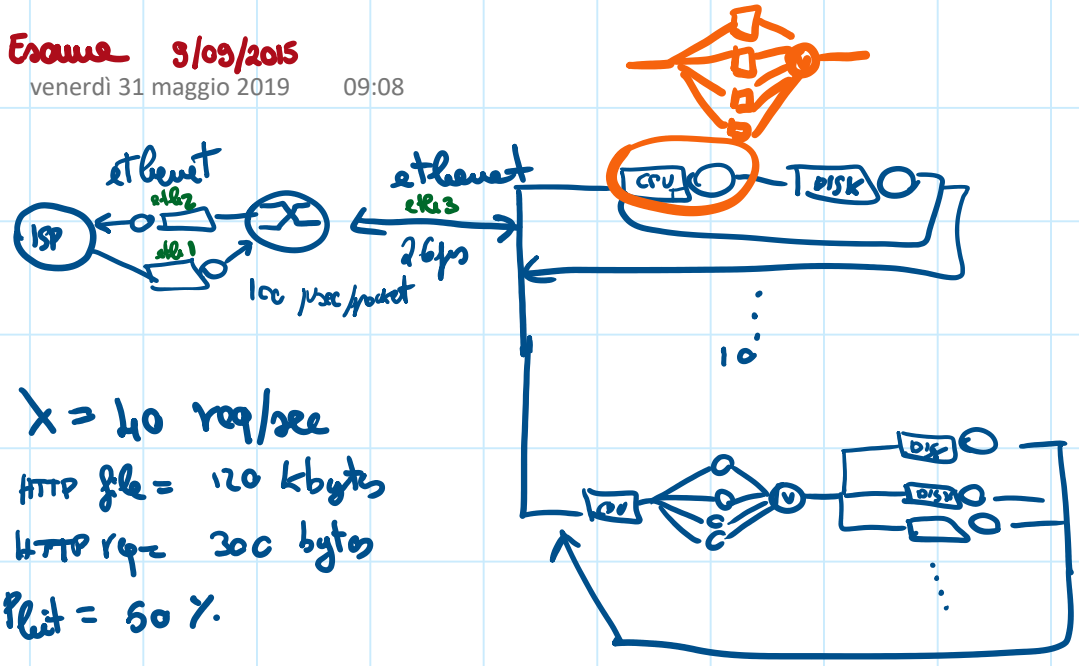
$P_5 = 0{,}07$

$$N = \sum_i i \cdot P_i$$

$$X = \sum_i \mu \cdot P_i$$

Esame 9/09/2015

venerdì 31 maggio 2019 09:08



$\lambda = 40$ req/sec

HTTP file = 120 kbytes

HTTP req = 300 bytes

$p_{hit} = 50\%$

$D_{core,hit} = 20$ msec $\quad D_{core,miss} = 40$ msec

$D_{DS} = 25$ msec

Service time for 10kbytes = 10 msec

$$D_{DISK} = \frac{100K}{10K} \cdot 1 \text{ msec} + 10 \text{ msec} = 20 \text{ msec}$$

TCP
IP
ETH

Networking

$$Delta_1 = \frac{300 \cdot 10^3 + (3+1)(o_{TCP} + o_{IP} + o_{ETH})}{0.5 \cdot 10^6} = 1.064 \cdot 10^{-6}$$

$U_{eth1} = \lambda \cdot Delta_1 = 4.45 \cdot 10^{-5}$

$R_{eth1} = \frac{D}{1-U} = 1.064 \cdot 10^{-6}$

$$Segmenti = \frac{120K}{1460} = 83$$

$$Delta_2 = \frac{(3+83)(o_{TCP} + o_{IP} + o_{ETH}) + 120K}{0.5 \cdot 10^6} = 2.48$$

$U_{eth2} = \lambda \cdot Delta_2 = 9.96 \cdot 10^{-3}$

$R_{eth2} = \frac{D}{1-U} = 2.51 \cdot 10^{-4}$

$U_{router} = 0$

$D_{router} = ((83+3)+(4)) \cdot 100\ \mu sec = 9 \cdot 10^{-3}$

$R_{router} = D_{router}$

$$D_{LAN} = \frac{((300 \cdot 10^3) + (4)(o_{TCP} + o_{ETH} + o_{IP}) + 12K + 85(o_{ETH}))1.5}{} = 5.44 \cdot 10^{-3}$$

$$Delta_3 = \frac{\left((300 \cdot 10^{-3}) + (a)(OV_{TCP} + OV_{ETH} + OV_{IO}) + 12eK + 85(OV_{TCT}) \right)}{2 \cdot 10^{6}} \cdot 1.5 = 5,4 \cdot 10^{-5}$$

$$U = \lambda \cdot Delta_3 = 3,76 \cdot 10^{-3}$$

$$R = \frac{D}{1-U} = 9,44 \cdot 10^{-3}$$

$$D_{CPU} = 20 \cdot 0.5 + 0.5 \cdot 40 = 30 \text{ min}$$

$$U_{CPU} = \frac{40}{\frac{60}{10 \cdot 4}} \cdot 30 \cdot 10^{-3} = 0.03$$

computing node · 4 core

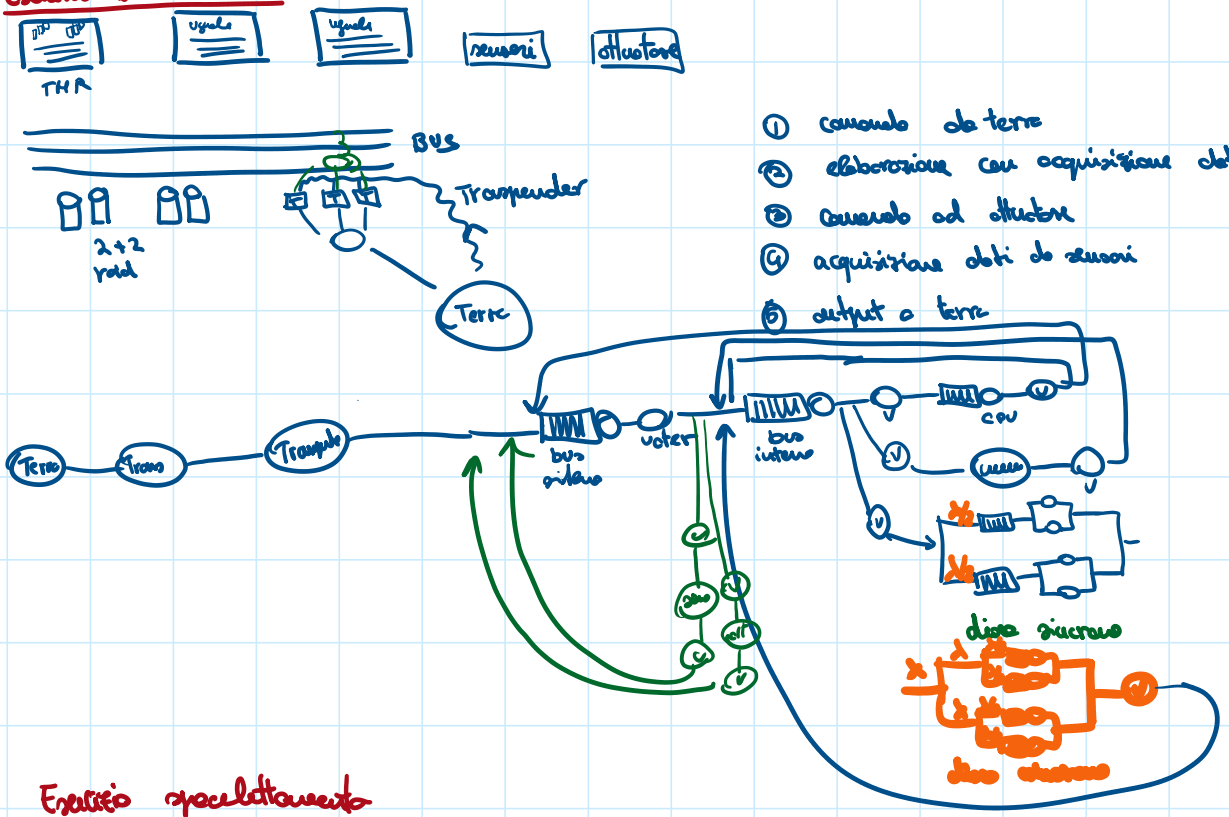
$$R_{CPU} = 0.03 \text{ sec}$$

$$D_{FS} = 0.5(25 + 20) = 22,5 \text{ ms}$$

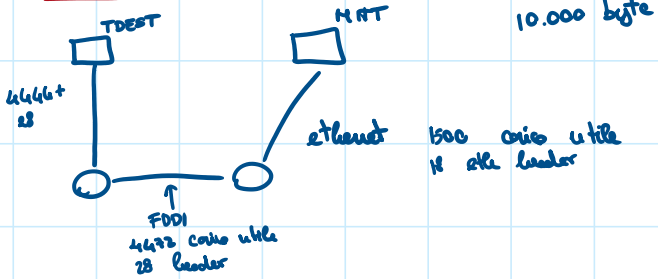
$$U_{FS} = \lambda \cdot D_{FS} = 0.9$$ bottleneck

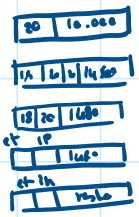
venerdì 31 maggio 2019 11:48

Esercizio modellazione



Esercizio speculativo





Esame 2006-07-03

sabato 1 giugno 2019 13:08

Segmento TCP = 10.000
header eth = 18 byte
bandwidth = 20 Kbyte/sec

Ipotizzo di non conoscere l'MTU

$\frac{10000}{65515} = 0.15 \Rightarrow 1$ segmenti TCP

$\frac{10000 + \#\text{segmenti} \cdot O_{TCP}}{65515} = 0.15 \Rightarrow 1$ datagramma

$\frac{1000 + \#\text{segmenti} \cdot O_{TCP} + \#\text{datagram} \cdot O_{IP}}{1500} = 6,69 \Rightarrow 7$ frame

Esame 20/2/2013

sabato 1 giugno 2019 13:28

$\lambda = 50$ requests/second

4 CPU working in parallel

Raid 1 disk (8+8)

ethernet = 100 Mbit/s

router delay = 100 μsec

router-ISP = 1 Gigabit/sec

file-req = 400 bytes

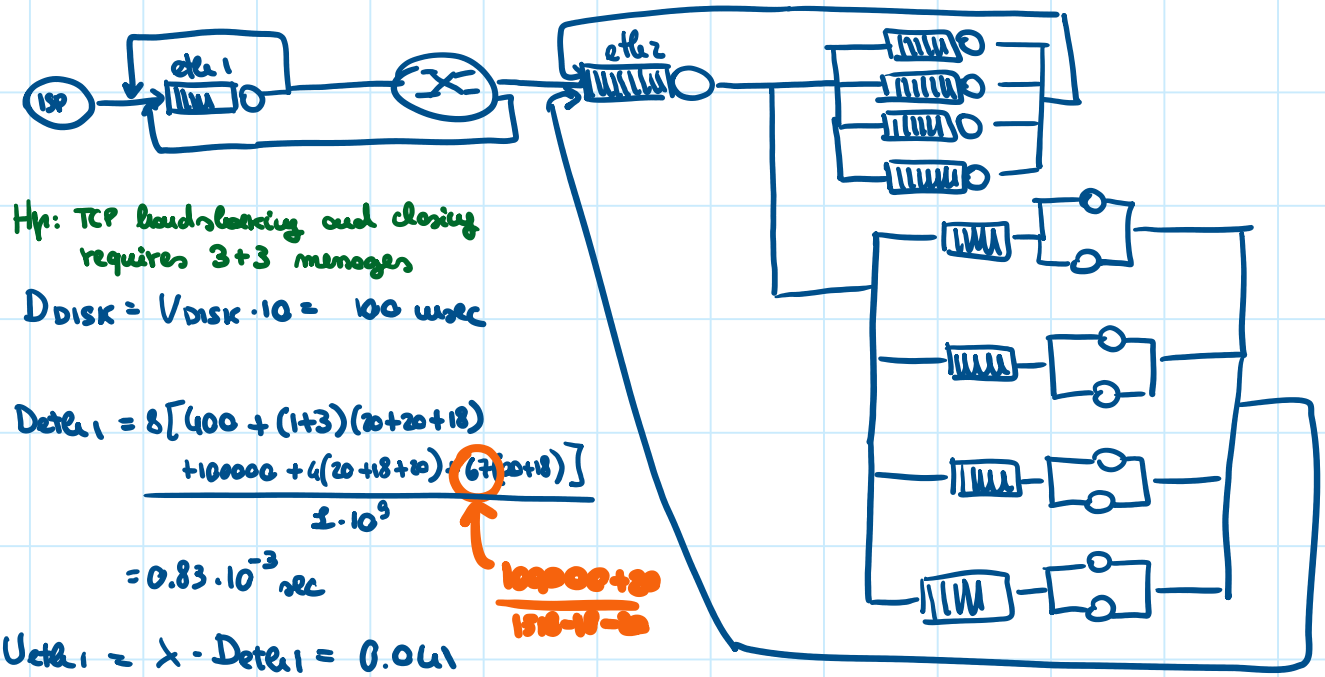
file = 100000 bytes

S_{CPU} = 20 sec × request

S_{disk} = 10000 bytes in 10 msec

R = ?

bottleneck?



Hp: TCP load balancing and closing requires 3+3 messages

$D_{DISK} = V_{DISK} \cdot 10 = 100$ msec

$$D_{eth1} = 8\left[400 + (1+3)(20+20+18) + 100000 + 4(20+18+20) + 67(20+18)\right] / 1 \cdot 10^9$$

$$= 0.83 \cdot 10^{-3} \text{ sec}$$

$$U_{eth1} = \lambda \cdot D_{eth1} = 0.041$$

$$R_{eth1} = \frac{D}{1-U} = \frac{0{,}83 \cdot 10^{-3}}{1 - 0.041} = 8{,}73 \cdot 10^{-4} \text{ sec}$$

$R_{Router} = D_{router} = \text{latency} \cdot (75) \approx 7.6 \cdot 10^{-6}$

Eth2: 2 volte la request + 1 volta il file

$$S_{ETH2,req} = \frac{8\left[(3+1)(20+20+18) + 400\right]}{100 \cdot 10^6} = 5{,}05 \cdot 10^{-5} \text{ sec}$$

$$S_{ETH,file} = \frac{8\left[(4)(20+20+18) + 67(20+18) + 100000\right]}{100 \cdot 10^6} = 8.3 \cdot 10^{-3}$$

$D_{eth2} = 2 \cdot 5{,}05 \cdot 10^{-5}$ sec $= 10{,}1 \cdot 10^{-5}$ sec

$D_{eth2,file} = 8{,}3 \cdot 10^{-3}$ sec

$D_{eth2} = 8{,}43 \cdot 10^{-5}$ sec

$U_{ETH2} = \lambda \cdot D_{ETH2} = 50 \cdot 8{,}43 \cdot 10^{-3} = 0.42$ sec

$R_{ETH2} = \frac{D}{1-U} = 0.614$ sec

$R_{ETH2} = \frac{D}{1-U} = 0.814$ sec

$U_{CPU} = \frac{\lambda}{4} \cdot D_{CPU} = \frac{30}{4} \cdot S_{CPU} = 0.25$

$R_{CPU} = \frac{0.025}{1-0.25} = 0,26$

$D_{coppia} = \frac{100}{2}$ msec $= 50$ msec

$U_{coppia} = \frac{\lambda}{4} \cdot D_{coppia} = 0,625 = U_{raid}$

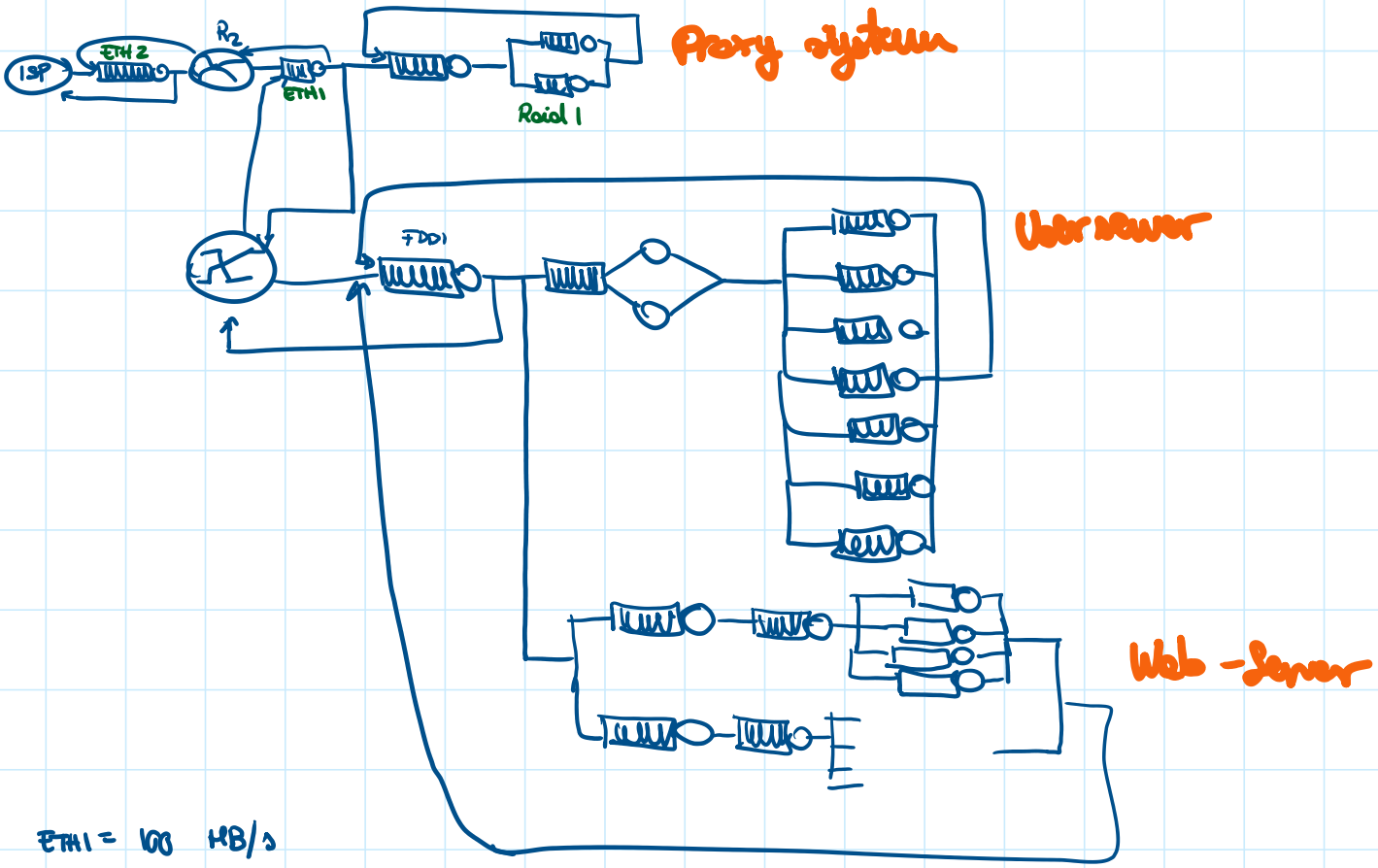
$R = \frac{D}{1-U} = 0.133$

$R_{sistema} = \sum R_i$

$Bottleneck = \underset{i \in I}{\text{argmax}}\{U_i\}$ || sottosistema con U più alto

24 Maggio 2012

sabato 1 giugno 2019 14:32



ETH1 = 100 MB/s

FDDI = 300 MB/s

routers delay = 1 ms

ETH2 = 16

Probabilità FS = 30%

Prob WS = 70%

Prob HIT cache = 50 %

$F_{File-server}$ = 30 Kbytes

$F_{File\ WS}$ = 200 Kbytes

Request = 400 bytes

$S_{USER,CPU}$ = 30 msec

$S_{User,DISK}$ = 30 msec

$S_{web,CPU}$ = 50 msec

S_{web,FS_CPU} = 30 msec

$S_{web,DISK}$ = 40 msec

$S_{proxy,CPU_{HIT}}$ = 10 msec

$S_{proxy,CPU/D,miss}$ = 20 msec

$$ETH2 = \frac{\{[(3+1)\,58 + 400 + [(2+3)\cdot 58 + 30000]\,0.3 + [(27\cdot 3)\cdot 58 + 200.000]\cdot 0.7\}\cdot 0.8}{1\cdot 10^8} = 1.24\cdot 10^{-3}\ sec$$

$U_{ETH2} = \lambda \cdot D_{ETH2} = 3.72\cdot 10^{-3}$

$R_{ETH2} = \frac{D_{ETH2}}{1-U} = 1.24\cdot 10^{-3}$ sec

$R_{router2} = delay \cdot \#requests = 1\cdot 10^{-3}\cdot (4 + 24\cdot 0.3 + 140\cdot 0.7) = 0.105$ sec

ETH1

$D_{ETH1} = [4\cdot 58 + 400]\cdot 0.3 + [24\cdot 58 + 30000]\cdot 0.3$

$+ P_{HIT}\cdot (4\cdot 58 + 400 + (140\cdot 58 + 200.000)) + 2P_{miss}(4\cdot 58 + 400 + 140\cdot 58 + 200.000) / 100\cdot 10^6 = 2,28\cdot 10^{-3}$

$U_{ETH1} = \lambda \cdot D_{ETH1} = 6,84\cdot 10^{-3}$

$U_{ETH1} = \lambda \cdot D_{ETH1} = 6{,}84 \cdot 10^{-3}$

$R_{ETH1} = D_{ETH1} / (1 - U_{ETH1}) = 4.13 \cdot 10^{-3}$

FDDI

$D_{FDDI} = [4.68 + 400 + 24.68 + 30000] \cdot 0.3 + ([4.68 + 400 + 200000 + 140.68] \cdot 0.5) 0.7 = 1.65 \cdot 10^{-4}$

$U_{FDDI} = \lambda D_{FDDI} = 4.98 \cdot 10^{-4}$

$R_{FDDI} = \frac{D_{FDDI}}{1-U} = 1.66 \cdot 10^{-4}$ sec

Proxy

$D_{Proxy} = (10 \cdot P_{HIT} + 20 \cdot P_{MISS}) \cdot 0.7 \simeq 11 \cdot 10^{-3}$ sec

$U_{Proxy} = \lambda \cdot D_{Proxy} = 40 \cdot 10^{-3}$

$R_{Proxy} = 0.015$ sec

Filesystem

$D_{FS} = 60$ ms $\cdot 0.3$

$U_{FS} = \lambda \cdot D_{FS} = 0.054$

$R_{FS} = 0.063$ sec

WebServer

$D_{WebServer} = 50 + 30 + \frac{40}{4} = 80 \cdot 10^{-3}$ sec

$U_{WebServer} = 0.5 \cdot 0.7 \cdot \lambda \cdot D_{WebServer} = 0.067$

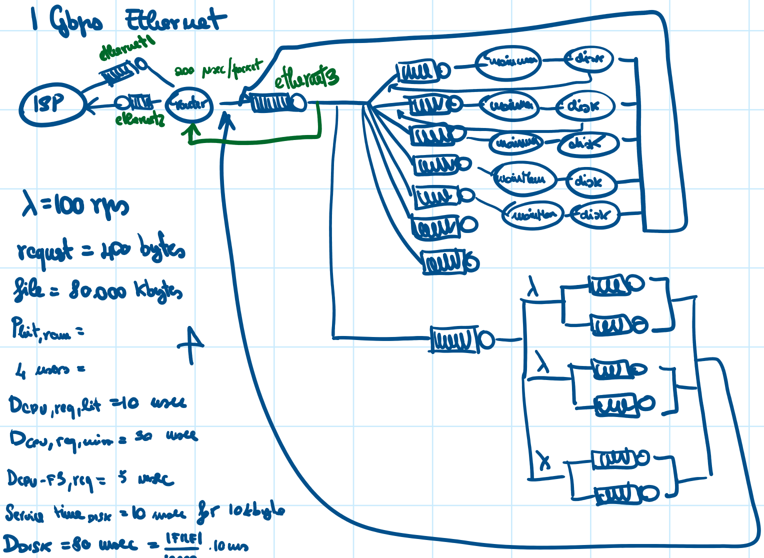
$R_{WebServer} = 0.094$ sec

$R_{TOT} = \sum_i \cdot R_i$

Esame

domenica 2 giugno 2019 16:04

1 Gbps Ethernet



$\lambda = 100$ rps

request = 400 bytes

file = 80.000 Kbytes

$P_{lit,rom} =$

4 users =

$D_{CPU,req,lit} = 10$ usec

$D_{CPU,req,win} = 30$ usec

$D_{CPU-FS,req} = 5$ usec

Service time$_{DISK}$ = 10 usec for 10kbyte

$D_{DISK} = 80$ usec $= \frac{|FILE|}{10000} \cdot 10$ us

ETH1

$D_{ETH1} = \frac{[(3+1)(20+20+18)+400]\cdot 8}{1\cdot 10^9} = 5\cdot 10^{-6}$

$U_{ETH} = \lambda \cdot D_{ETH1} =$

$R_{ETH} = \frac{D_{ETH1}}{1-U} =$

ETH2

$D_{ETH2} = \frac{[5(58)+53(38)+80.000]}{1\cdot 10^9} = 6{,}38\cdot 10^{-6}$

devi tenere conto delle prob di Lo Pe

ETH3

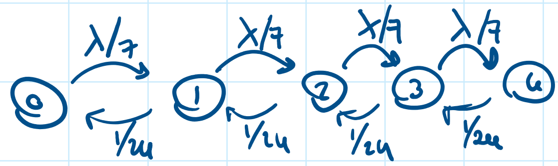
$D_{ETH3} = \frac{\overbrace{P_{lit}}^{0.3}((3+1)(58)+400+5\cdot 58+53(38)+80.000) + 2P_{win}((3+1)(38)+400+5\cdot 58+53(38)+80.000)}{1\cdot 10^9} = 6{,}73\cdot 10^{-4}$

CPU

$D_{CPU} = 10\cdot 0.3 + 30\cdot 0.7 = 24$

CPU-FS

$D_{CPU-FS} = 5$ us



Router

D_{router}

DISK

$D_{DISK} = 80$ usec$/2$

Availability

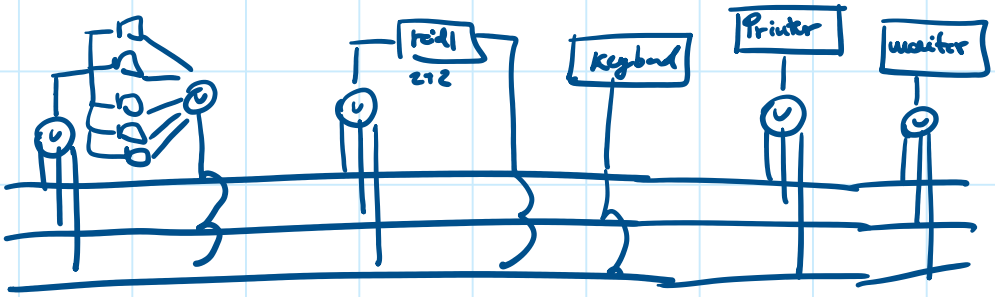
$A_{CPU} = 1-(1-A_{CPU})^2$

$A_{raid} = (1-(1-A_{DISK})^2)^4$

Esame 15-04-13

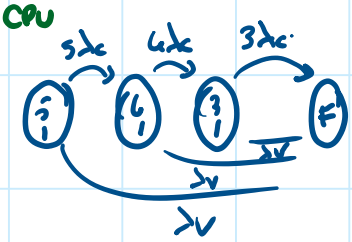
martedì 4 giugno 2019 13:59

Esercizio 1



Reliability

CPU



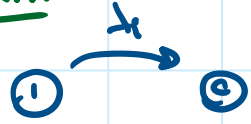
$$\dot{P}\begin{pmatrix}3\\1\end{pmatrix} = -P\begin{pmatrix}5\\1\end{pmatrix}(5\lambda c + \lambda v)$$

$$\dot{P}\begin{pmatrix}4\\1\end{pmatrix} = -P\begin{pmatrix}4\\1\end{pmatrix}(1)(4\lambda c + \lambda v) + P\begin{pmatrix}5\\1\end{pmatrix}5\lambda c$$

$$\dot{P}\begin{pmatrix}3\\1\end{pmatrix} = -P\begin{pmatrix}3\\1\end{pmatrix}(1)(3\lambda c + \lambda v) + P\begin{pmatrix}4\\1\end{pmatrix}4\lambda c$$

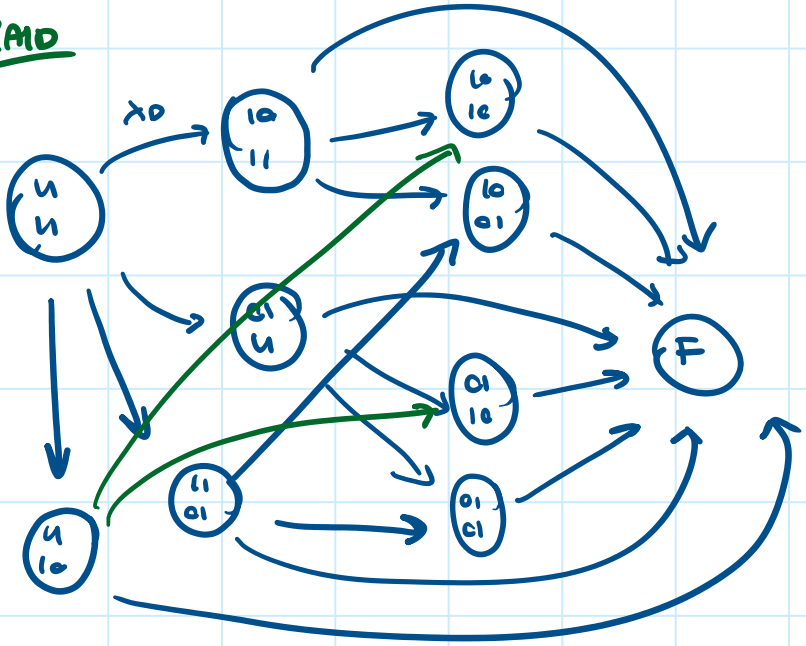
$$\dot{P}(F) = P\begin{pmatrix}3\\1\end{pmatrix}$$

KPH

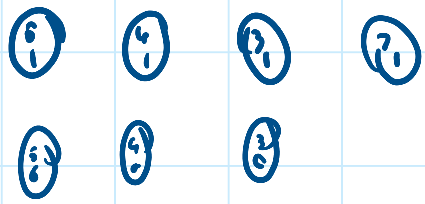


BUS+VOT

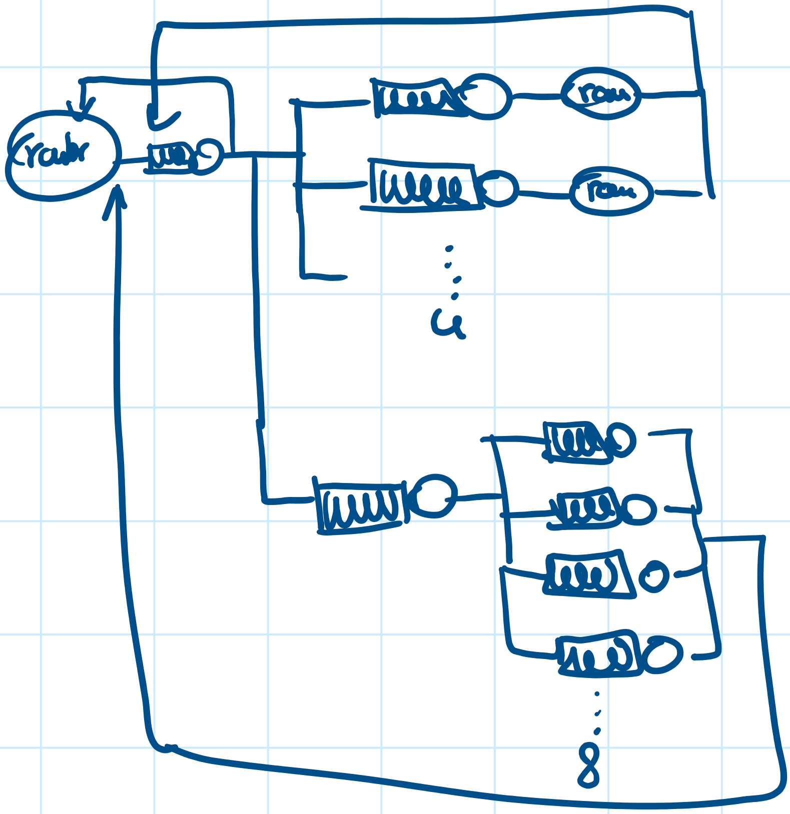
RAID



Availability



Esercizio 3



$\lambda = 100$ r/s

ETH = 2 GB/s

FILE = 100 kbytes

Request = 500 bytes

$D_{CPU, HIT} = 5$ ms

$D_{CPU, MISS} = 10$ ms

$D_{CPU\_FS} = 10$ ms

$D_{DISK} = 10$ ms

$D_{CPU} = 0.5 \cdot (5 \text{ ms}) + 0.5 (10) = 7.5$

$D_{DISK} = 0.5 \cdot 10 \text{ ms} = 5$

$D_{CPU\text{-}server} = 0.5 \cdot 10 \text{ ms} = 5$

$D_{max} = 7.5 \Rightarrow \lambda_s = 133$

$D_{ETH} = \left[(3 \overset{+3}{+1})(58) + 500 + 2(58) + 66(38) + 100.000 \right] P_{bit}$
$+ 2 P_{min} ((6) \cdot 58 + \text{quelle dentro al } P_{bit})$ $\Big/ \; 2 \cdot 10^9$

$U_{server} = \frac{\lambda}{\ldots} \cdot 7.5 \cdot 10^{-3} = 0.18$

$U_{server} = \frac{\lambda}{\mu} \cdot 7.5 \cdot 10^{-3} = 0.18$

$U_{CPUs} = \lambda \cdot 5.6^{-3} = 0.5$

$U_{DISK} = \lambda / \beta \cdot 5 \cdot 10^{-3} = 0.06$

$R_i = \frac{D_i}{1 - U_i}$ $\uparrow throughput = \lambda \Rightarrow$ resta valida

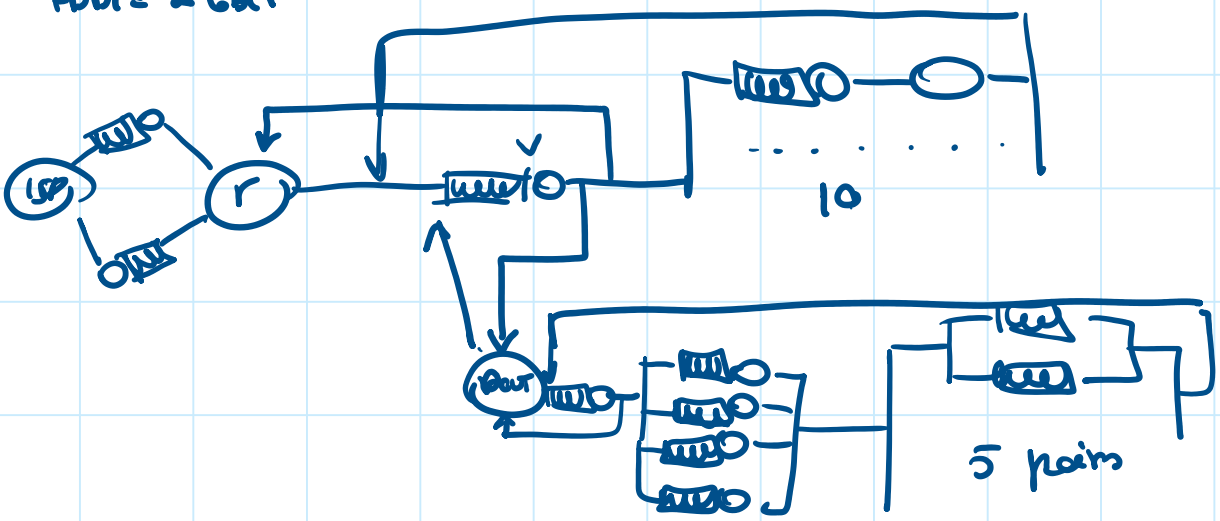
Esame 11/02/2016

martedì 4 giugno 2019 15:15

$\lambda = 300$ rps
Request = 600 bytes
ETH = 1 Gbit
FDDI = 2 Gbit

$D_{CPU,H} = 10$ ms
$D_{CPU,m} = 20$ ms
$D_{CPU,FS} = 10$ msec

$|FILE| = 100$ kbytes
$p_{HIT} = 50\%$



$$D_{DISK} = \frac{100.000}{10.000} \cdot \frac{1}{2} \cdot 10 = 50\,ms$$

$$D_{ethLC} = \frac{8[400 + 4 \cdot 38]}{256 \cdot 10^6} = 1{,}37 \cdot 10^{-3}\,sec$$

$$D_{ethLCout} = \frac{\lceil 100.000 + 68\,(20 \cdot 18) + 3 \cdot 58 \rceil 8}{256 \cdot 10^6} = 3.21$$

$$R_{in} = \frac{D_{in}}{1 - U_{in}} \qquad U_{in} = \lambda \cdot D_{in}$$

Esame 22/03/2016

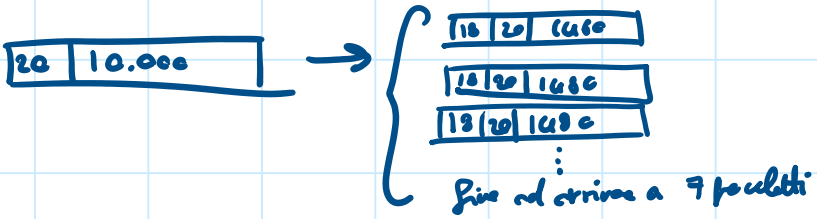
martedì 4 giugno 2019 16:09

Esercizio 2

10.000 byte to send

element = 18 header

$\frac{10.000 + 20}{1480} = 6,7 \rightarrow 7$ pacchetti



Alternative

Esame 22/5/2017

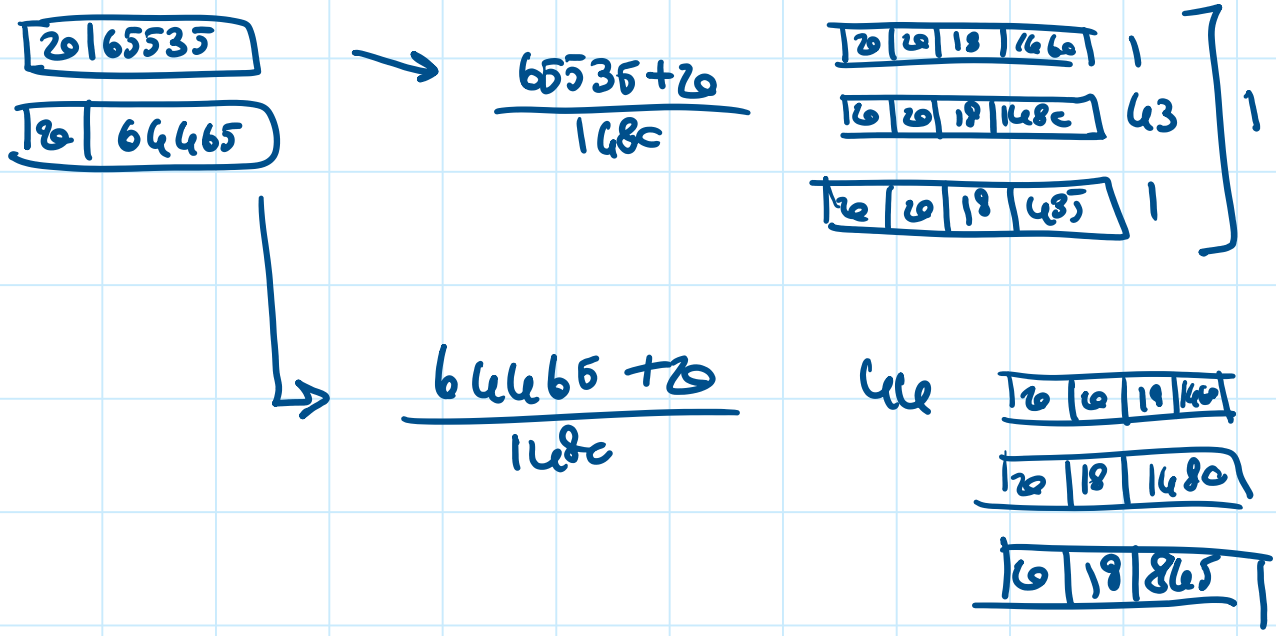
martedì 4 giugno 2019 17:50

Esercizio 2

TCP segment = 130.000

M. frammenti = $\frac{130.000}{65535} = 1.7 \cdot 2$

M. datagrammi = $\frac{130.000 + 2 \cdot 20}{1480} = 88$ pacchetti



$2(58) + 87(38) + 130.000$

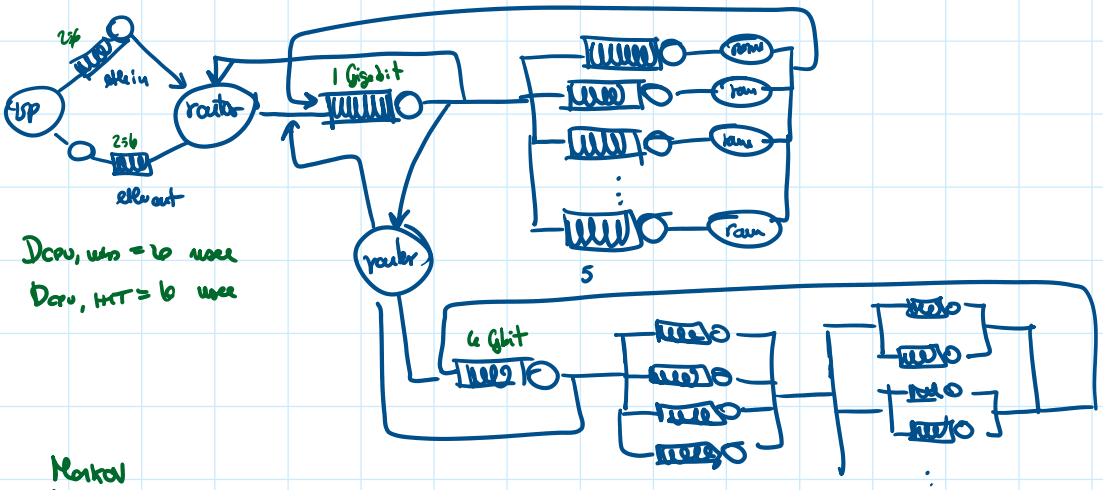
Esame 4/24/2015

martedì 4 giugno 2019 18:12

$\lambda = 100$ rps

|request| = 400 bytes

|file| = 200 kbyte



$D_{CPU,user} = 10$ msec

$D_{CPU,HTT} = 6$ msec

Markov

$D_{CPU} = 0.7 \cdot 10 + 0.3 \cdot 26 = 7 + 6 = 13$ msec (10 cpu, 6 hdd)

$\mu = 1/13 \cdot 10^{-3} = 77$

$$\begin{cases} P_0 \lambda/5 = P_1 \mu \\ P_1 \lambda/5 = P_2 \mu \\ P_2 \lambda/5 = P_3 \mu \\ \sum_i P_i \end{cases}$$

$P_0 = 0{,}75$

$P_1 = 0{,}18$

$P_2 = 0{,}04$

$P_3 = 0{,}01$

Ethin

$D_{ethin} = \frac{((3+1)58 + 400)}{256 \cdot 10^6} = 2{,}46 \cdot 10^{-6}$

$U_{ethin} = \lambda \cdot 2{,}46 \cdot 10^{-6} = 7{,}46 \cdot 10^{-4}$

$R = \frac{D}{1-U}$

Ethout

$D = \frac{3 \cdot 58 + 4 \cdot 20 + (45 \cdot 3 + 3)(38) + 200000}{256 \cdot 10^6} = 8{,}02 \cdot 10^{-4}$

$U = \left(P_{lost}((1-P_3) \cdot \lambda \cdot D) + P_{win3}((1-P_3)^2 \cdot \lambda \cdot D\right) = 0.078$

$R = \frac{D}{U-1}$

Router

$n = (1-P_3)(4 + (45 \cdot 3 + 3)) + P_3(4) = 141$

$D = 1.4 \cdot 10^{-3}$

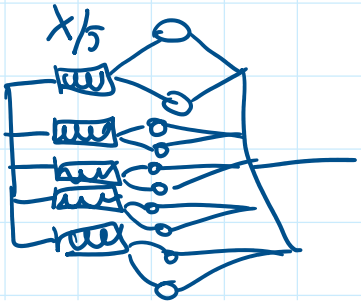
$R = D$

Ethout int

$$D = \left[P_{lost}(400 + (4 \cdot 38) + (1-P_3)(4 \cdot 20 + 4 \cdot 58 + (4 + (45 \cdot 3 + 3)38 + 200.000)) + 2P_{win3}\left((1-P_3)(400 \cdot 4 \cdot 58 + 45 \cdot 3 \cdot 38 + 4 \cdot 20 \cdot 4 \cdot 58) + P_3(400 \cdot 4 \cdot 38)\right)\right] \cdot 8 \cdot 10^{-3}$$

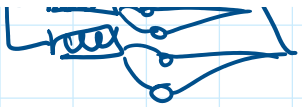
$U = \lambda \cdot D$

$R =$



Disk

R=



CPU

$D = (1-P_3)(P_{vis} \cdot 20ms + P_{ext} \cdot 10) =$

$U = \lambda \cdot D$

$R = D/(1-U)$

Disk

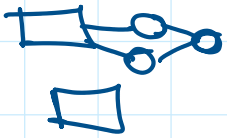
$D = \frac{20000}{2 \cdot (20000)} \cdot 10ms = 50$ ms

$U = (P_{vis})(1-P_3) D \cdot \lambda = 1.5$

R=

Food

$D = \frac{P_{vis}\left((1-P_3)(400 \cdot 4.58 + 4.20 + 3.58 + (45.3+3)38\right) \cdot 8}{4 \cdot 10^{-5}}$



$U = \lambda \cdot D$

$R = D/(1-U)$

1649040

$D = 0.5 \cdot (40)$

$10 \cdot 20$

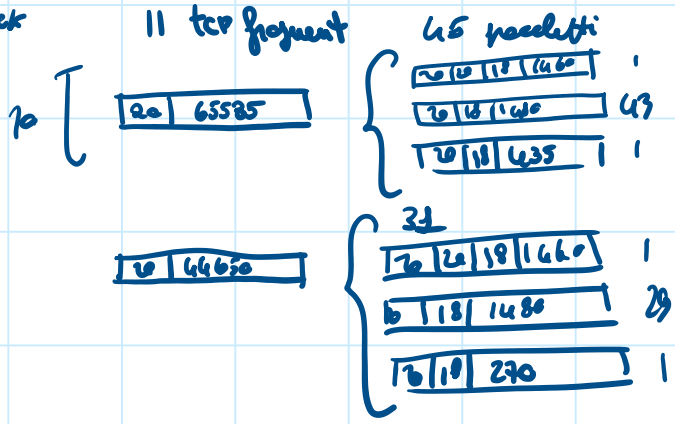
Esame 16/06/11

mercoledì 5 giugno 2019 10:19

Esercizio 2

File = rock

Ethernet



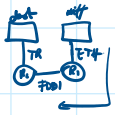
$$\frac{10(58 + 38 \cdot 44 + 65535) + (58 + 38(30) + 44650)}{20 \cdot 16t}$$

Esame 03/07/2006

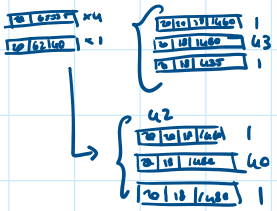
mercoledì 5 giugno 2019 10:34

Esercizio 2

200.000 B



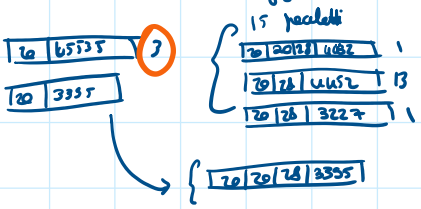
200K = 4 TCP segments



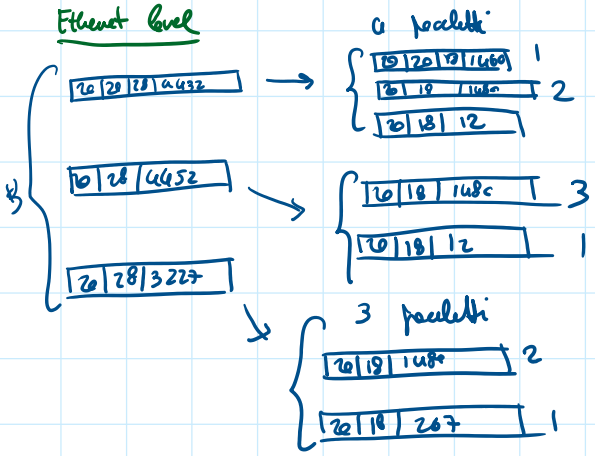
Su FDDI e TR vengono eliminati header con 28

Ricostruisco l'ordine

20.000 TCP frament = 4 fragment

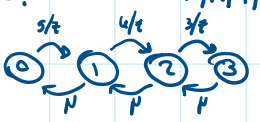


Ethernet level



Esercizio 11.3

$\overline{R}$ = ? M/M/1/3/5



Service rate = 10 sec

$$\begin{cases} P(0)\ 5/t = P_1 N \\ P(1)\ 4/t = P_2 N \\ P(2)\ 3/t = P_3 N \\ \sum_i P_i = 1 \end{cases}$$

P_0, P_1, P_2, P_3

$N = \sum_i i \cdot P_i$

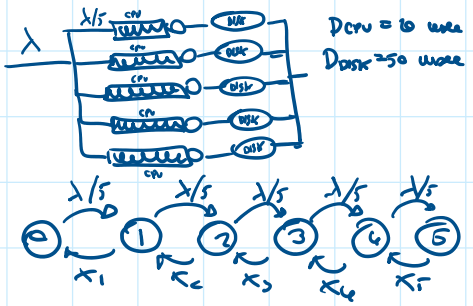
$X = \sum_i N_i \cdot P_i$

$R = N/X$

Esercizio 11.4

Esercizio 11.4

$\lambda = 25$ req/s cluster da 5 server



Caso $u=1$

$R_{CPU} = 20$ ms
$R_{DISK} = 50$ ms
$X_{TOT} = 1/\tau_C = 14.28$
$N_{CPU} = 0.28$
$N_{DISK} = 0.714$

Caso $u=7$

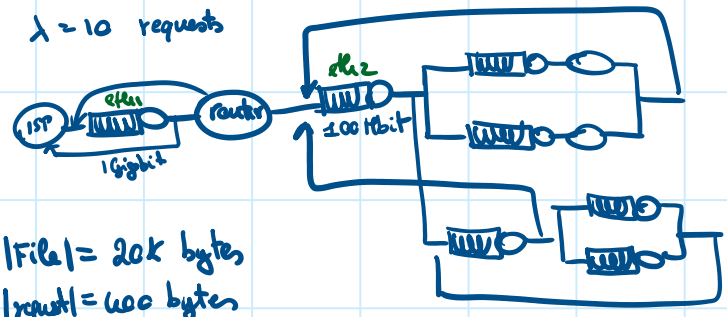
$R_{CPU} = 20(1 + 0.28) = 25.6$
$R_{DISK} = 50(1 + 0.14) = 85$ ...
$X_{TOT} = 3/m = 18$
$N_{CPU} = 0.46$
$N_{DISK} = 1.53$

$$\begin{cases} P_0 \cdot \lambda/5 = P_1 X_1 \\ P_1 \cdot \lambda/5 = P_2 X_2 \\ P_2 \cdot \lambda/5 = P_3 X_3 \\ P_3 \cdot \lambda/5 = P_4 X_4 \\ P_4 \cdot \lambda/5 = P_5 X_5 \end{cases}$$

$$\overline{X} = A_{5\,\text{serv}}(P_1 \cdot X_1 + P_2 \cdot X_2 \cdots) + \binom{5}{1}(A)^4(1-A)(P_1 \cdot X_1 + P_2 \cdot X_2 \cdots) + \binom{5}{2}(A)^3(1-A)^2(P_1 \cdots)$$
$$+ \binom{5}{3}(A)^2(1-A)^3(P_1 \cdots) + \binom{5}{4}(A)(1-A)^4(P X_1 \cdots)$$

Esame 15/11/2012

mercoledì 5 giugno 2019 15:42



|File| = 20k bytes
|request| = 400 bytes
$D_{CPU,Fast}$ = 10 msec
$D_{CPU,S}$ = 20 msec
$D_{CPU,FS}$ = 10 msec
D_{Disk} = 20 msec

$P_{Pers} = 0.5$
$P_{Flat} = 0.5$
MTTF = 100.000 hours
MTTR = 1 hour

Delta =

$$Delta = \frac{8[4.58 + 400 + 6.58 + 13(38) + 20.000]}{1 \cdot 10^9} = 1.7 \cdot 10^{-4}$$

$U = 1.7 \cdot 10^{-3}$

$R = \frac{D}{1-U} = 1.7 \cdot 10^{-4}$

Router

m = 21 packets

$D = 20 \cdot delay = 2.1 \cdot 10^{-3}$

Delta2

$$6.58 + 1.5(2.58 + 400 + 2000 + 13.38)$$

$$Delta_2 = 8[P_{Flat}(1.58 + 400 + 4 \cdot 58 + 13(38) + 2000) + 2P_{Pers}(1.58 + 400 + 1.58 + 13(38) + 100 eq] = 2.55 \cdot 10^{-3}$$

$U = 10 \cdot 2.55 \cdot 10^{-3} = 2.55 \cdot 10^{-2}$

$R = \frac{2.55 \cdot 10^{-3}}{1 - 2.55 \cdot 10^{-2}} = 2,61 \cdot 10^{-3}$

CPU

$D_{CPU} = 0.5 \cdot 10 + 0.5 \cdot 20 = 15$

$U = 10 \cdot 15 \cdot 10^{-3} = 75 \cdot 10^{-3}$

$R = \frac{15 \cdot 10^{-3}}{1 - 75 \cdot 10^{-3}} = 0,01$ sec

CPU - FS

$D = 0.5 \cdot 10$ ms $= 5 \cdot 10^{-3}$ ms

$U = 10 \cdot 5 \cdot 10^{-3} = 0.05$

$R = \frac{5 \cdot 10^{-3}}{1 - 0.05} = 5.26 \cdot 10^{-3}$

FS

$D_{Disk} = 0.5 \cdot 20$ msec $= 10 \cdot 10^{-3}$ msec

$U = 0.5 \cdot 10 \cdot 10 \cdot 10^{-3} = 0.05$

$R = \frac{D}{(1-U)} = 0.010$ sec

$V = 0.5 \cdot 10 \cdot 10 \cdot 10 = 0.$

$R = \frac{D}{1-V} = 0.010$ sec