Distributed Systems solution 2001

p49q1
p13q1
JMB

a) Computer's timer interrupts periodically – #/hr varies slightly & with temperature eg $1/10^6$ 1 sec in $11\frac{1}{2}$ days

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b) Radio stations and satellites - receiver can be bought accuracy varies with weather conditions
radio O(10ms) satellite $O(\frac{1}{2} \rightarrow 1\,ms)$
Bound on time at a given sink : published bound at receiver + network delay + OS delay – system specific

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c) Receive must be after send. If timestamp of message (at send) is $\geq$ time at receiver this must be increased to be $>$ send time.

1

d) Clock synch. protocol. Assume a time server with receiver
Periodically ask time server & receive value – adjust for comms
Compare with local value
if less - slow down interrupt rate of local clock (can't put it back)
if greater either step local clock forward or increase interrupt rate

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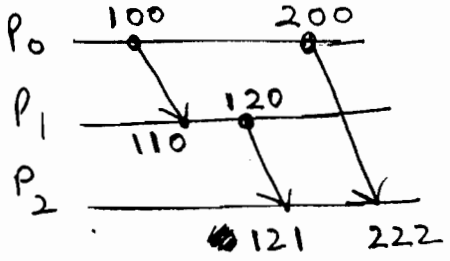
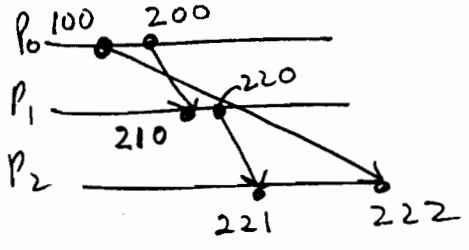
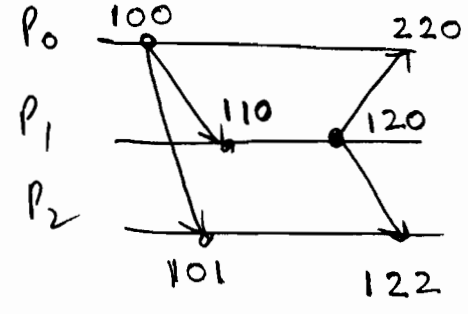
e) (i)



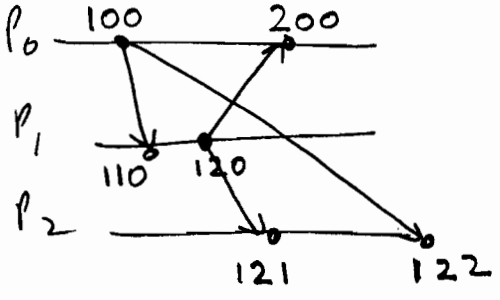
(ii)



(iii)



(iv)



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f) causal order property ($<$ = provably before)

if $send_i(m) < send_j(m')$
then $receive_K(m) < receive_K(m')$

Violated in e(ii) and e(iv).

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In both cases P_0's send is provably before P_1's send to P_2.

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