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Distributed System Assignment 2 Submission **Date: 19st Oct '15**

Solution 1> Client should choose the minimum round trip time of 20ms = 0.02 sec. It then estimate the current time to be 10:54:28.342 + (0.02/2) = 10:54:28.352. The accuracy is +/- 10ms.

If the minimum transfer time changes to 8ms, then the setting remains the same but the accuracy improves to +/- 2 ms.

Solution 2 and 3 > Submitted as a Jpeg.

Solution 4> No, the algorithm does not guarantee mutual exclusion for critical section execution as long as there are 1 another process which could potentially be executing in the critical section and has not been considered for voting in the majority group of (N/2 + 1) processes.

This is actually a vulnerable situation and should be avoided, as even if the majority of the processes have replied with positive response, it is not sufficient information for a process to start the execution of critical section. So, we need to consider all the remaining processes, which potentially could execute the common critical section to be certain before any process could gain access to it.

Solution 5>

As it is almost impossible to get the response and gain a lock from all the overlapping processes simultaneously in distributed network, with Maekawa's algorithm, we could encounter deadlock condition easily. For example.

For the given processes, let us make a process grid as

1	2	3
4	5	6
7	8	9

So if process 1 and 9 tries to enter the critical section simultaneously, it will send a request for approval for an access of critical section to all the overlapping processes. So, process 1 will send its request to processes 2, 3, 4, 7 for the access to critical section. Similarly, process 9 also sends the same request to its common neighbor processes 7, 8, 3, 6. Among these, there are two processes, 3 and 7 which are the common process to both of the requesting process.

Now, in distributed network, it is uncertain about which process will be the first to receive the request and respond. So, if process 3 receives request first from process 1 and approves it, it will not approve process 9 request (arrived later) as it has already approved to process 1. So, process 9 will be waiting for process 1 to finish the execution of critical section so that it will enter the critical section. However, on the other hand, if process 7 receives request to enter critical section from process 9 came earlier then process 1, process 9 will be approved. On which case, process 1 (arriving later) is waiting for process 9 to complete. So here, both

processes 1 and 9 are waiting for the approval response from it's overlapping process infinitely, as both of them could not get the access approval from all of the overlapping processes at a time causing a deadlock situation.

Solution 6>

As P5 recognizes the failure of P10, it will initiate the election to all higher order processors. So, P5 will send the election message to P6, P7, P8 and P9 (4 Messages). Now P7 does the same and send election message to P8, P9 and P10 (3 Messages), P9 does the same and send to P10. So total number of election messages are 4+3+1 =8.

Now response will only come from the processes that are alive / active. So P7 responds to P5 and P9 will respond to P7 and P5. So total response message count is 1+2 = 3.

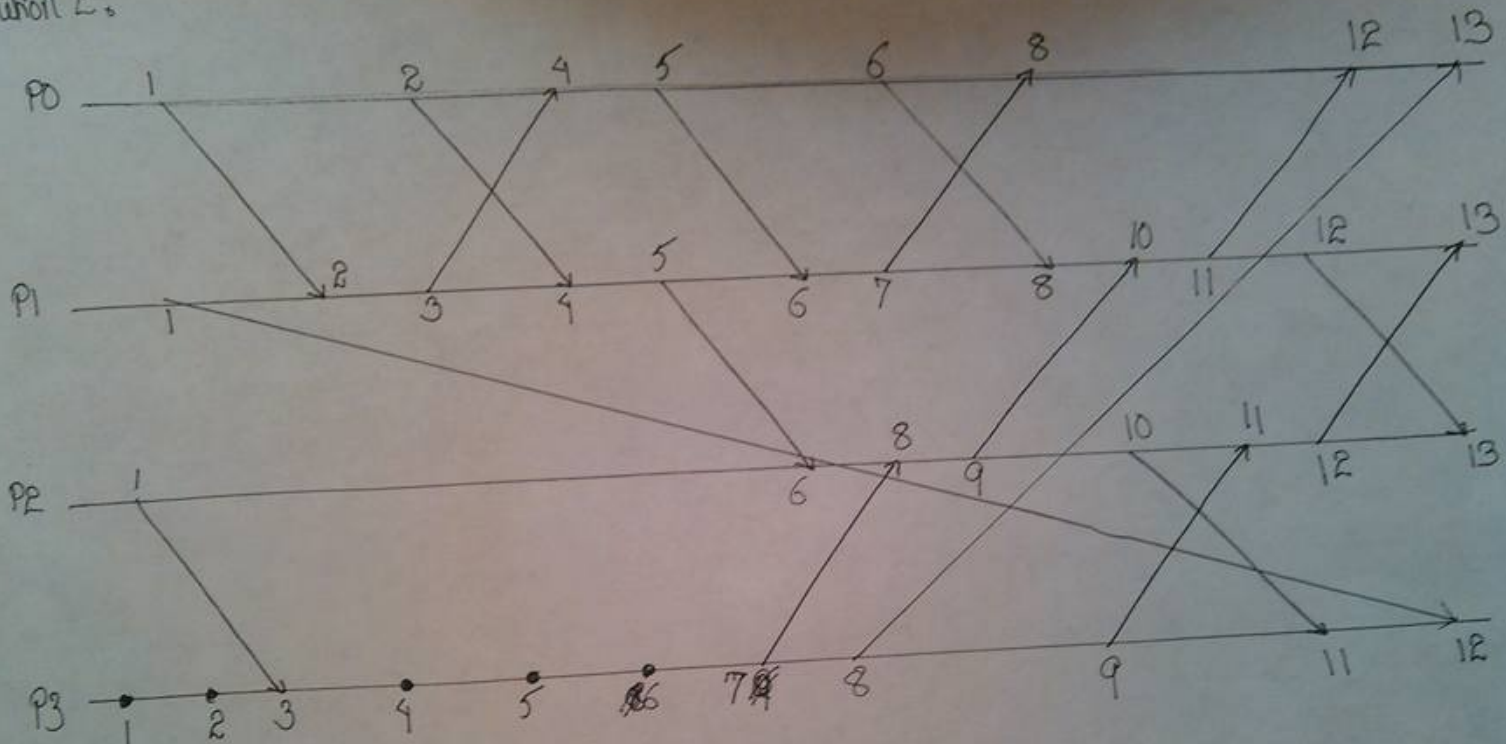
Now, once the new coordinator has been assigned, the coordinator will broadcast itself to all the processes in the network. So P9 will broadcast messages to all processes from P1 to P8. So total broadcast messages are 8.

Hence Final message count is equal to total message for electing new leader plus the broadcast message, which is election message + response message + broadcast message = 8 + 3 + 8 = 19.

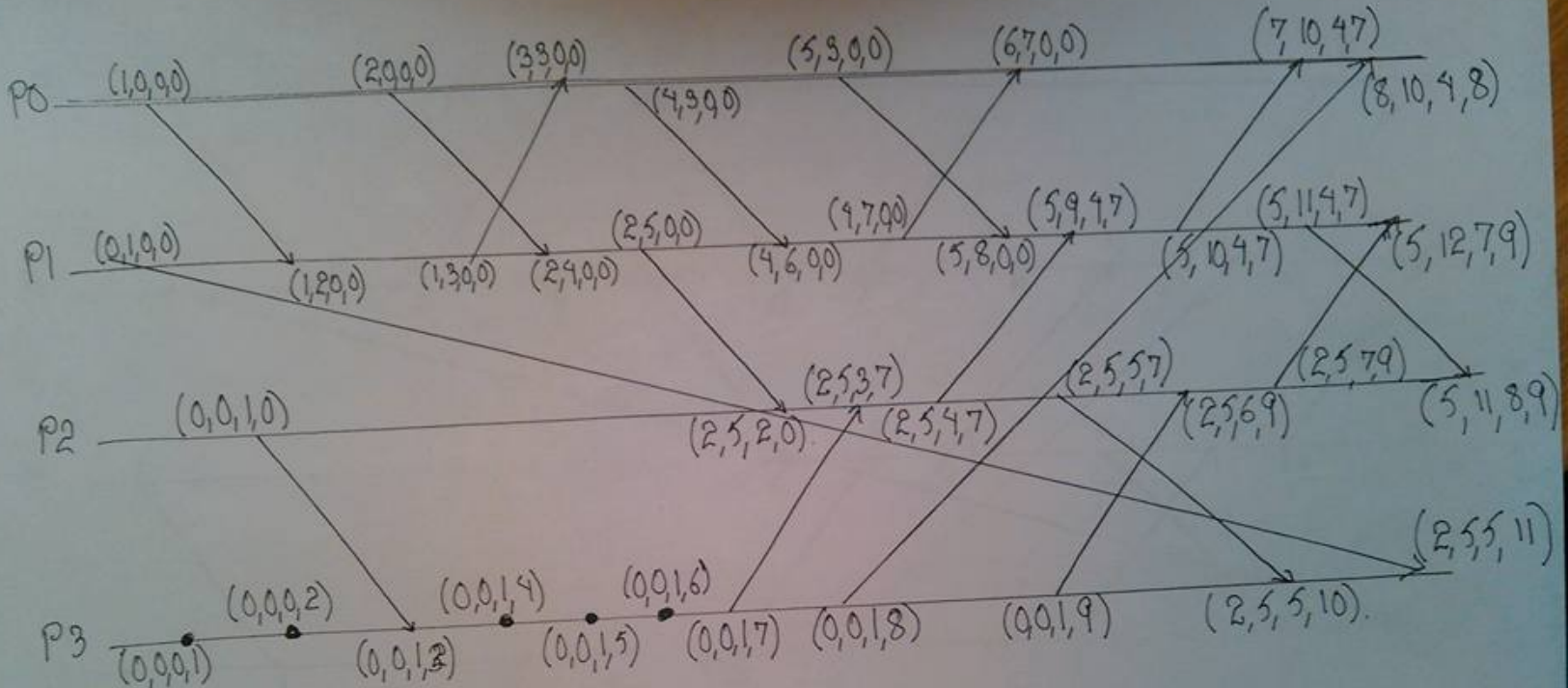
Solution 7> Global Snapshot after Chandy-Lamport is

P0 = S(b), c10={},c20={c}
P1 ={}, c01={b}, c21 = {a}
P2 =S(a,c), c02={}, c12 ={}

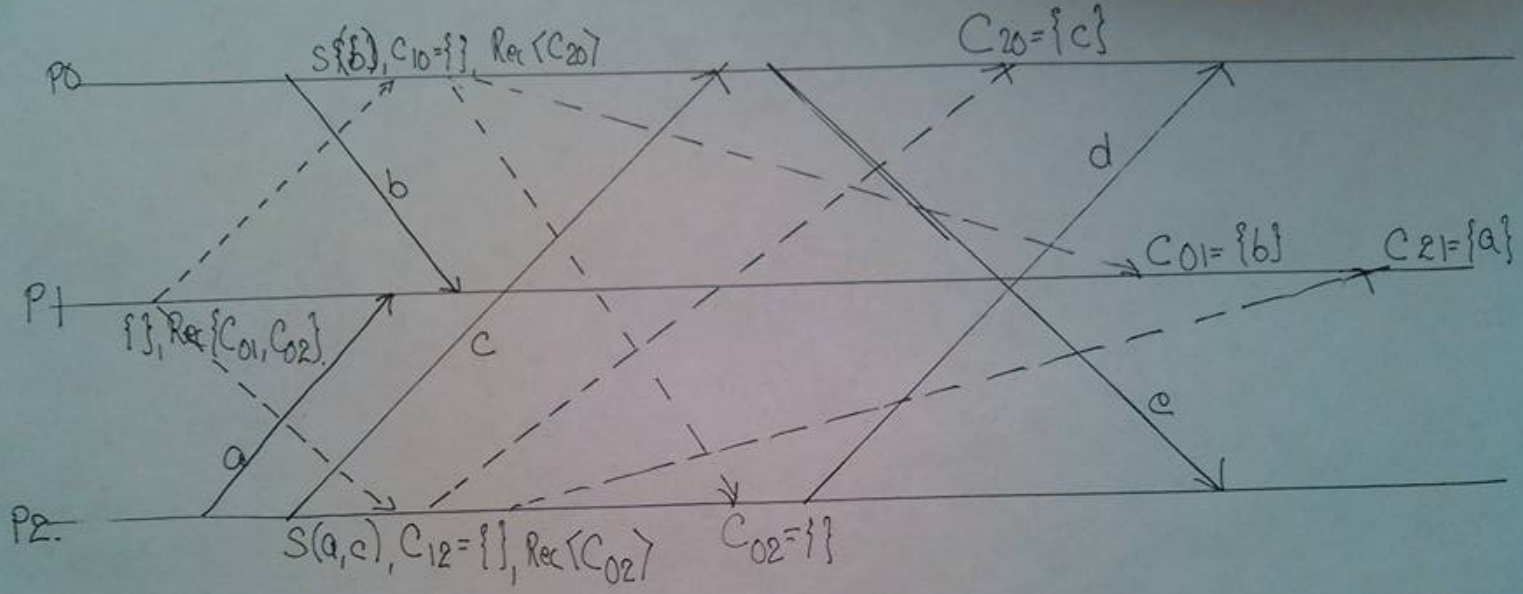
Solution 2:



Solution 3


P0
P1
P2
P3
(1,0,0,0)
(2,0,0,0)
(3,3,0,0)
(4,3,0,0)
(5,3,0,0)
(6,7,0,0)
(7,10,4,7)
(8,10,4,8)
(0,1,0,0)
(1,2,0,0)
(1,3,0,0)
(2,4,0,0)
(2,5,0,0)
(4,6,0,0)
(4,7,0,0)
(5,8,0,0)
(5,9,4,7)
(5,10,4,7)
(5,11,4,7)
(5,12,7,9)
(0,0,1,0)
(2,5,2,0)
(2,5,3,7)
(2,5,4,7)
(2,5,5,7)
(2,5,6,9)
(2,5,7,9)
(5,11,8,9)
(2,5,5,11)
(0,0,0,1)
(0,0,0,2)
(0,0,1,3)
(0,0,1,4)
(0,0,1,5)
(0,0,1,6)
(0,0,1,7)
(0,0,1,8)
(0,0,1,9)
(2,5,5,10)

Solution 7:



Global Snapshot is.

$P0 = S(b), C_{10} = \{\}, C_{20} = \{c\}$

$P1 = \{\}, C_{01} = \{b\}, C_{21} = \{a\}$

$P3 = S(a,c), C_{02} = \{\}, C_{12} = \{\}$