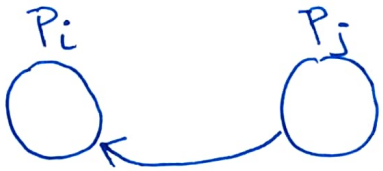
10 MAR 2022
2-3 PM

How do we implement CO?

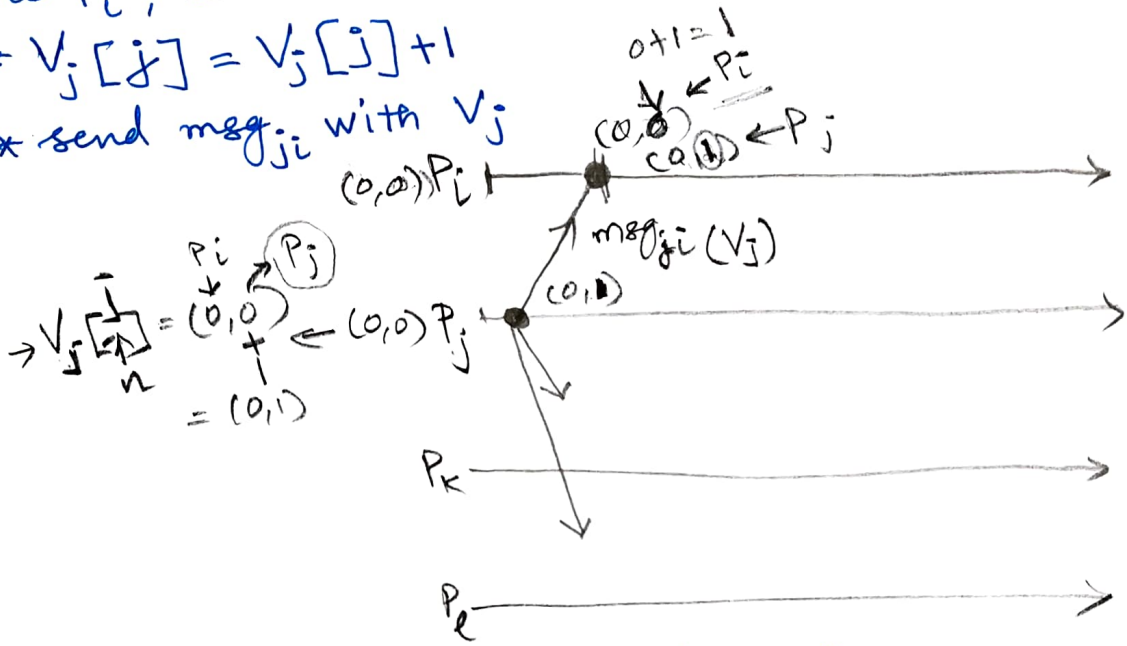
(Multicast Algo < sender / receiver ?!

Two Steps:



① When P_j sends a message to P_i, it does:

* $V_j[j] = V_j[j] + 1$
* send msg_{ji} with V_j



② When P_i receives a msg from P_j:

($\forall i \neq j$)

msg_{ji}

(A) * Is the message arrived in FIFO order:

Channel is reliable & no priority is associated.

→ V_i and V_j → of size n

P_i P_j → received

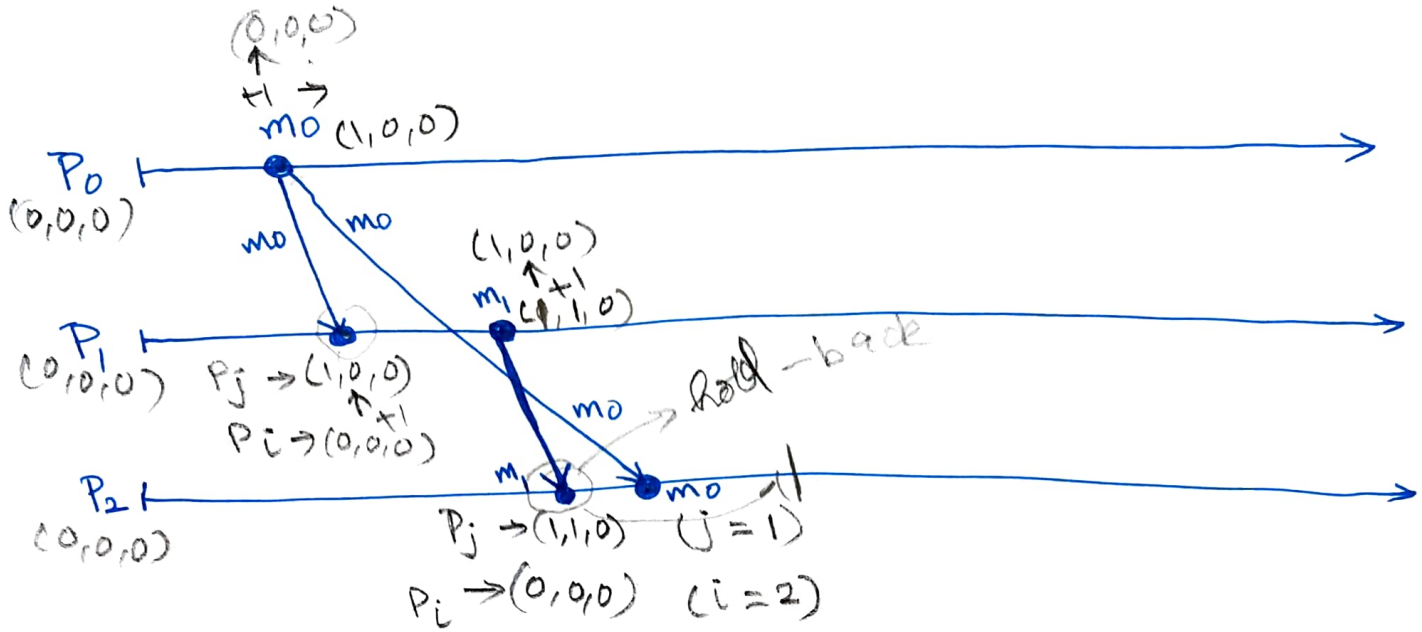
$V_j[j] = V_i[j] + 1$; ?! Yes – FIFO

No – Non-FIFO

(B) * $\forall k, k \neq j : V_j[k] \leq V_i[k]$?!

Both are true then deliver the message

else hold the message in the hold-back queue



P_i

P_0 P_1 P_2

$V_1 \rightarrow (1, 1, 0) \rightarrow P_{j=1}$ (sender)

$V_2 \rightarrow (0, 0, 0) \rightarrow P_{i=2}$ (receiver)

* $V_j[j] = V_i[j] + 1$

$1 = 0 + 1 \Rightarrow 1 = 1$ ✓ Yes, the msg is in FIFO

* $\forall k \mid k \neq j$ | $V_j[k] \leq V_i[k]$?!

$k = 0, 2$.

$k = 0$

$V_1[0] \leq V_2[0]$

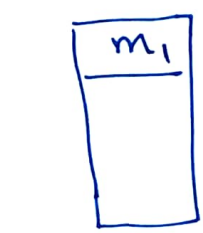
$1 \leq 0$ Not true.

$\Rightarrow P_2$ does not see message sent by P_0 (through the message sent by P_1)

$\Rightarrow P_1$ is aware of P_0's event (send)

but P_2 is not !!

$\Rightarrow m_1$ can be put it in the hold-back Q.



→ m_0 ✓

* $V_0 = (1,0,0)$ $V_2 = (0,0,0)$
j i

$V_j[0] = V_i[0] + 1$

$1 = 0 + 1$ Yes ✓

m_0 is in FIFO order.

$(1,0,0)$ $(0,0,0)$

* $\forall K$ $\quad V_j[K] \leq V_i[K]$

$K \neq j (=0)$ $\quad =0 \quad =2$.

$K = \{1,2\}$ $\quad K=1 \Rightarrow V_j[1] \leq V_i[1]$

$0 \leq 0$ ✓

$K=2 \Rightarrow V_j[2] \leq V_i[2]$

$0 \leq 0$ ✓

$\Rightarrow m_0$ is following CO !!

$\Rightarrow m_0$ can be put in delivery Queue

$\Rightarrow$ update $V_2 = (1,0,0)$

Now m_1 (first in hbq)

$j=1$, $V_1 = (1,1,0)$

$i=2$, $V_2 = (1,0,0)$

* $V_j[j] = V_i[j] + 1$. (for FIFO)

$1 = 0+1$

$1 = 1$ ✓ Yes, the message is in FIFO.

$(1,1,0)$ $(1,0,0)$

* $\forall K$ $\quad V_j[K] \leq V_i[K]$

$(K \neq j)$ $\quad j=1 \quad =2$

$K = 0,2 \Rightarrow K=0, V_j[0] \leq V_i[0]$

$1 \leq 1$ ✓ Yes.

$K=2, V_j[2] \leq V_i[2]$

$0 \leq 0$ ✓ Yes

$\Rightarrow$ Both conditions are satisfied

$\Rightarrow m_1$ can be put in the delivery Queue.

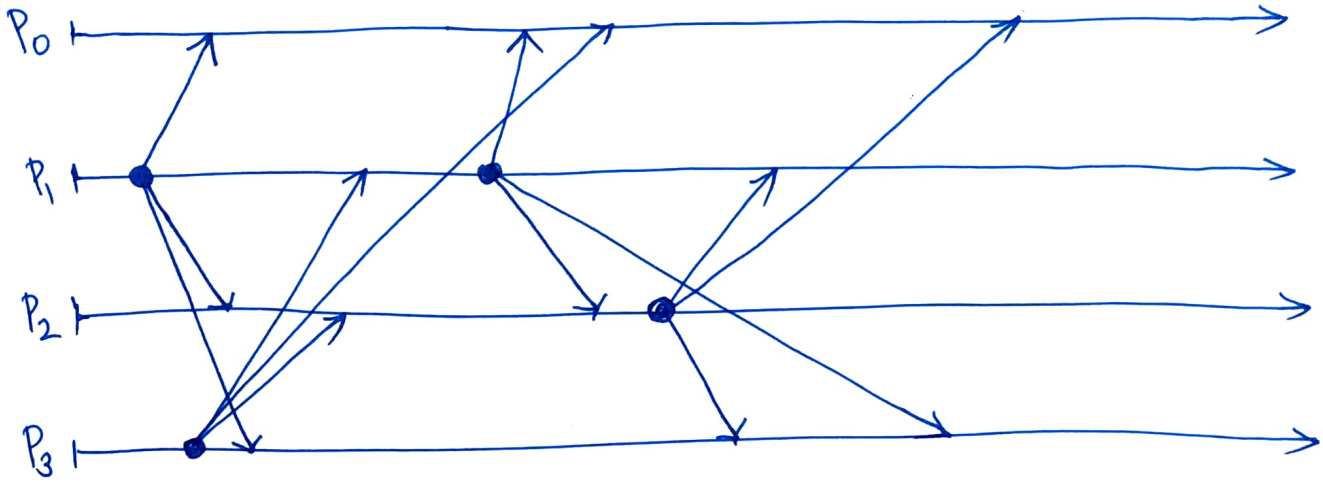
$P_2 \rightarrow V_2 = (1,1,0)$

P_0 P_1

(m_0) (m_1)

Problem : 1

N = 4



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Problem : 2

N = 3