MODULE *CausalNetwork*

EXTENDS *Network*, *Naturals*

VARIABLES

vc

$Vector \triangleq [Replica \to Nat]$

$InitVector \triangleq [r \in Replica \mapsto 0]$

$$
\begin{aligned}
&CInit \triangleq \land NInit \\
&\qquad\quad \land vc = [r \in Replica \mapsto initvector] \\
&CBroadcast(r,\, m) \triangleq \land NBroadcast(r,\, m) \\
&\qquad\qquad\qquad\quad \land vc' = [vc \text{ EXCEPT } ![r][r] = @ + 1] \\
&CDeliver(r) \triangleq \\
&\quad \land incoming[r] \neq EmptyBag \\
&\quad \land \exists\, m \in BagToSet(incoming[r]) : \\
&\qquad \land \forall\, s \in Replica : \\
&\qquad\quad \lor m.vc[s] \leq vc[r][s] \\
&\qquad\quad \lor s = m.r \\
&\qquad \land \lor m.vc[m.r] = vc[r][m.r] \\
&\qquad\quad \lor m.vc[m.r] = vc[r][m.r] + 1 \\
&\qquad \land vc' = [vc \text{ EXCEPT } ![r][m.r] = m.vc[m.r]] \\
&\qquad \land msg' = m \\
&\qquad \land MDeliver(r,\, m) \\
&\quad \land \text{UNCHANGED } \langle incoming \rangle
\end{aligned}
$$

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