MODULE *CausalNetwork*

EXTENDS *BasicNetwork*, *Naturals*

VARIABLES

vc *vc*[*r*][*s*] denotes the latest message from $s \in Replica$ observed by $r \in Replica$

$cnVars \triangleq \langle incoming,\ lmsg,\ vc \rangle$

$ts(cm) \triangleq cm.lvc$ timestamp (vector clock) for *cm*

$sender(cm) \triangleq cm.m.aid.r$ the replica that sends *cm*

$Max(a,\ b) \triangleq \text{IF } a > b \text{ THEN } a \text{ ELSE } b$

$CNTypeOK \triangleq$

$\land\ SMTypeOK$

$\land\ vc = [Replica \to [Replica \to Nat]]$ *vc*[*r*] : vector clock at $r \in Replica$

$CNInit \triangleq$

$\land\ BNInit$

$\land\ vc = [r \in Replica \mapsto [s \in Replica \mapsto 0]]$ $\forall\, r,\ s,\ vc[r][s] = 0$

$CNBroadcast(r,\ m) \triangleq$

$\land\ vc' = [vc \text{ EXCEPT } ![r][r] = @ + 1]$

$\land$ LET $cm \triangleq [m \mapsto m,\ lvc \mapsto vc'[r]]$ assign *lvc* to *m*

IN $BNBroadcast(r,\ cm)$

$CNCausallyReady(r,\ cm) \triangleq$ whether *cm* is causally ready to be delivered by $r \in Replica$

LET $mr \triangleq sender(cm.m)$ *cm* : message with vector clock

IN $\land\ ts(cm)[mr] \leq vc[r][mr] + 1$

$\land\ \forall\, s \in Replica \setminus \{mr\} : ts(cm)[s] \leq vc[r][s]$

$CNDeliver(r) \triangleq$

$\land\ incoming[r] \neq \{\}$

$\land\ \exists\, cm \in incoming[r] :$

$\land\ CNCausallyReady(r,\ cm)$

$\land$ LET $mr \triangleq sender(cm)$

IN $vc' = [vc \text{ EXCEPT } ![r][mr] = Max(@,\ ts(cm)[mr])]$ update *vc*[*r*]

$\land\ lmsg' = [lmsg \text{ EXCEPT } ![r] = cm.m]$

$\land$ UNCHANGED $\langle incoming \rangle$

* Modification History

* Last modified *Wed Jul* 31 23:10:05 *CST* 2019 by *xhdn*

* Last modified *Mon* May 06 16:07:03 *CST* 2019 by *jywellin*

* Created *Wed Mar* 27 20:03:44 *CST* 2019 by *jywellin*