MODULE *Correctness*

EXTENDS *Naturals*, *CRDTInterface*, *FiniteSets*

CONSTANTS $Read(\_)$ $Read(r \in Replica)$: the read operation at r

$UMsg \triangleq [aid : Aid, update : \text{SUBSET } Aid]$ update message type

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VARIABLES

doset, *delset*, *uincoming*

doset[*r*]: the set of updates generated by replica $r \in Replica$

delset[*r*]: the set of updates delivered by replica $r \in Replica$

uincoming[*r*]: incoming channel for broadcasting/delivering updates at $r \in Replica$

$$
\begin{aligned}
&CTypeOK \triangleq \\
&\quad \land doset \in [Replica \to \text{SUBSET } Aid] \\
&\quad \land delset \in [Replica \to \text{SUBSET } Aid] \\
&\quad \land uincoming \in [Replica \to \text{SUBSET } UMsg]
\end{aligned}
$$

$$
\begin{aligned}
&CInit \triangleq \\
&\quad \land doset = [r \in Replica \mapsto \{\}] \\
&\quad \land delset = [r \in Replica \mapsto \{\}] \\
&\quad \land uincoming = [r \in Replica \mapsto \{\}]
\end{aligned}
$$

$$
\begin{aligned}
&CDo(r) \triangleq \\
&\quad \land doset' = [doset \text{ EXCEPT } ![r] = @ \cup \{[r \mapsto r,\ seq \mapsto seq[r]]\}] \\
&\quad \land delset' = [delset \text{ EXCEPT } ![r] = @ \cup \{[r \mapsto r,\ seq \mapsto seq[r]]\}] \\
&\quad \land \text{UNCHANGED } \langle uincoming \rangle
\end{aligned}
$$

$CSend(r) \triangleq$ UNCHANGED $\langle delset, doset \rangle$ implemented by *OpSEC* and *StateSEC*

$$
\begin{aligned}
&CDeliver(r, aid) \triangleq \quad \text{choose the update message } um \text{ according to aid} \\
&\quad \land \text{LET } um \triangleq \text{CHOOSE } m \in uincoming[r] : m.aid = aid \quad um \text{ is unique} \\
&\qquad \text{IN} \quad delset' = [delset \text{ EXCEPT } ![r] = @ \cup um.update] \\
&\quad \land \text{UNCHANGED } \langle uincoming, doset \rangle
\end{aligned}
$$

$SEC \triangleq \forall\, r1, r2 \in Replica : delset[r1] = delset[r2] \Rightarrow Read(r1) = Read(r2)$

$Liveness \triangleq \forall\, aid \in Aid, r \in Replica : aid \in doset[r] \rightsquigarrow (\forall\, s \in Replica : aid \in delset[s])$

* Modification History

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