MODULE *TPaxosWithVotes*

EXTENDS *TPaxos*

VARIABLE *votes* *votes*[*q*]: the set of votes cast by $q \in Participant$

$varsV \triangleq \langle vars,\ votes \rangle$

$InitV \triangleq$
$\quad \land\ Init$
$\quad \land\ votes = [q \in Participant \mapsto \{\}]$

$PrepareV(p,\ b) \triangleq$
$\quad \land\ Prepare(p,\ b)$
$\quad \land\ votes' = votes$

$AcceptV(p,\ b,\ v) \triangleq$
$\quad \land\quad Accept(p,\ b,\ v)$
$\quad \land\quad votes' = [votes \text{ EXCEPT } ![p] = @ \cup \{\langle b,\ v \rangle\}]$ collecting proposal $\langle b,\ v \rangle$

$OnMessageV(q) \triangleq$
$\quad \land\ OnMessage(q)$
$\quad \land\ \text{IF } state'[q][q].maxVBal \neq state[q][q].maxVBal$ accept
$\qquad \text{THEN } votes' = [votes \text{ EXCEPT } ![q] = @ \cup$ collecting proposal
$\qquad\qquad\qquad\qquad \{\langle state'[q][q].maxVBal,\ state'[q][q].maxVVal \rangle\}]$
$\qquad \text{ELSE UNCHANGED } votes$

$NextV \triangleq \exists\, p \in Participant :$
$\qquad\qquad \lor\ OnMessageV(p)$
$\qquad\qquad \lor \exists\, b \in Ballot :\ \lor\ PrepareV(p,\ b)$
$\qquad\qquad\qquad\qquad\qquad\quad \lor \exists\, v \in Value : AcceptV(p,\ b,\ v)$
$SpecV \triangleq InitV \land \Box[NextV]_{varsV}$

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To verify *Spec* $\Rightarrow$ *Voting*, we should define votes and *maxBal*
votes, $\setminus * votes[a]$ is the set of votes cast by *Participant* a
maxBal $\setminus * maxBal[a]$ is a ballot number. Participant a will cast
$\setminus *$ further votes only in ballots numbered $\geq maxBal[a]$
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$maxBal \triangleq [p \in Participant \mapsto state[p][p].maxBal]$

$V \triangleq$ INSTANCE *Voting* WITH *Acceptor* $\leftarrow$ *Participant*
votes $\leftarrow$ *votes*, *maxBal* $\leftarrow$ *maxBal*

THEOREM $SpecV \Rightarrow V\,!\,Spec$

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