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1  |----- MODULE UniversalPaxosStoreWithVotes -----|
   | Extend UniversalPaxosStore with an explicit record of votes that have been accepted by partici- |
   | pants. This is used to demonstrate that UniversalPaxosStore refines EagerVoting. |
7  | EXTENDS UniversalPaxosStore, TLC |
8  |-----|
9  | VARIABLE votes |
11 | TypeOKV  $\triangleq$  |
12 |    $\wedge$  TypeOK |
13 |    $\wedge$  votes  $\in$  [Participant  $\rightarrow$  SUBSET (Ballot  $\times$  Value)] |
14 |-----|
15 | InitV  $\triangleq$  |
16 |    $\wedge$  Init |
17 |    $\wedge$  votes = [p  $\in$  Participant  $\mapsto$  {}] |
19 | PrepareV(p, b)  $\triangleq$  |
20 |    $\wedge$  Prepare(p, b) |
21 |    $\wedge$  UNCHANGED votes |
23 | UpdateStateV(q, p, pp)  $\triangleq$  |
24 |    $\wedge$  UpdateState(q, p, pp) |
25 |    $\wedge$  IF state[q][q].maxBal  $\leq$  pp.maxVVal  $\wedge$  pp.maxVVal  $\neq$  -1 accept |
26 |     THEN votes' = [votes EXCEPT ![q] = @  $\cup$  {<pp.maxVVal, pp.maxVVal>}] |
27 |     ELSE UNCHANGED votes |
29 | OnMessageV(q)  $\triangleq$  |
30 |    $\exists$  m  $\in$  msgs : |
31 |      $\wedge$  q  $\in$  m.to |
32 |      $\wedge$  LET p  $\triangleq$  m.from |
33 |       IN UpdateStateV(q, p, m.state[p]) replacing UpdateState |
34 |      $\wedge$  IF  $\vee$  m.state[q].maxBal < state'[q][q].maxBal |
35 |        $\vee$  m.state[q].maxVVal < state'[q][q].maxVVal |
36 |       THEN Send([from  $\mapsto$  q, to  $\mapsto$  {m.from}, state  $\mapsto$  state'[q]]) |
37 |       ELSE UNCHANGED msgs |
39 | AcceptV(p, b, v)  $\triangleq$  |
40 |    $\wedge$  Accept(p, b, v) |
41 |    $\wedge$  votes' = [votes EXCEPT ![p] = @  $\cup$  {<b, v>}] accept |
42 |-----|
43 | NextV  $\triangleq$   $\exists$  p  $\in$  Participant :  $\vee$  OnMessageV(p) |
44 |                                      $\vee$   $\exists$  b  $\in$  Ballot :  $\vee$  PrepareV(p, b) |
45 |                                      $\vee$   $\exists$  v  $\in$  Value : AcceptV(p, b, v) |
46 | SpecV  $\triangleq$  InitV  $\wedge$   $\Box$ [NextV]{vars, votes} |
47 |-----|
   | UniversalPaxosStore refines EagerVoting. |

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51  $maxBal \triangleq [p \in Participant \mapsto state[p][p].maxBal]$   
 53  $EV \triangleq \text{INSTANCE } EagerVoting \text{ WITH } Acceptor \leftarrow Participant$   
 55 THEOREM  $SpecV \Rightarrow EV!Spec$   
 56 

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 \ \* Modification History  
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