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1  |----- MODULE CJupiter -----|
   | Specification of our own CJupiter protocol; see Wei@OPODIS'2018. |
5  | EXTENDS JupiterSerial, GraphStateSpace |
6  |-----|
7  | VARIABLES |
8  |   css      css[r]: the n-ary ordered state space at replica r ∈ Replica |
10 |   vars  $\triangleq$   $\langle \textit{intVars}, \textit{ctxVars}, \textit{serialVars}, \textit{css} \rangle$  |
11 |-----|
12 |   TypeOK  $\triangleq$  |
13 |      $\wedge$    TypeOKInt |
14 |      $\wedge$    TypeOKCtx |
15 |      $\wedge$    TypeOKSerial |
16 |      $\wedge$     $\forall r \in \textit{Replica} : \textit{IsSS}(\textit{css}[r])$  |
17 |-----|
18 |   Init  $\triangleq$  |
19 |      $\wedge$  InitInt |
20 |      $\wedge$  InitCtx |
21 |      $\wedge$  InitSerial |
22 |      $\wedge$  css =  $[r \in \textit{Replica} \mapsto \textit{EmptySS}]$  |
23 |-----|
24 |   NextEdge(r, u, ss)  $\triangleq$  Return the first outgoing edge from u in ss at replica r |
25 |     CHOOSE e ∈ ss.edge : |
26 |        $\wedge$  e.from = u |
27 |        $\wedge \forall ue \in \textit{ss.edge} \setminus \{e\} :$  |
28 |          $(ue.from = u) \Rightarrow \textit{tb}(e.cop.oid, ue.cop.oid, \textit{serial}[r])$  |
30 |   Perform(r, cop)  $\triangleq$  |
31 |     LET xform  $\triangleq$  xForm(NextEdge, r, cop, css[r]) | xform: [xcop, xss, lss] |
32 |     IN    $\wedge$  css' = [css EXCEPT ![r] = @  $\oplus$  xform.xss] |
33 |          $\wedge$  SetNewAop(r, xform.xcop.op) |
35 |   ClientPerform(c, cop)  $\triangleq$  Perform(c, cop) |
37 |   ServerPerform(cop)  $\triangleq$  |
38 |      $\wedge$  Perform(Server, cop) |
39 |      $\wedge$  Comm!SSendSame(ClientOf(cop), cop) | broadcast the original cop |
40 |-----|
41 |   DoOp(c, op)  $\triangleq$  |
42 |     LET cop  $\triangleq$  [op  $\mapsto$  op, oid  $\mapsto$  [c  $\mapsto$  c, seq  $\mapsto$  cseq[c]], ctx  $\mapsto$  ds[c]] |
43 |     IN    $\wedge$  ClientPerform(c, cop) |
44 |          $\wedge$  Comm!CSend(cop) |
46 |   Do(c)  $\triangleq$  |
47 |      $\wedge$  DoInt(DoOp, c) |
48 |      $\wedge$  DoCtx(c) |

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49       $\wedge DoSerial(c)$ 
51   $Rev(c) \triangleq$ 
52       $\wedge RevInt(ClientPerform, c)$ 
53       $\wedge RevCtx(c)$ 
54       $\wedge RevSerial(c)$ 
56   $SRev \triangleq$ 
57       $\wedge SRevInt(ServerPerform)$ 
58       $\wedge SRevCtx$ 
59       $\wedge SRevSerial$ 
60  |
61   $Next \triangleq$ 
62       $\vee \exists c \in Client : Do(c) \vee Rev(c)$ 
63       $\vee SRev$ 
65   $Fairness \triangleq$ 
66       $WF_{vars}(SRev \vee \exists c \in Client : Rev(c))$ 
68   $Spec \triangleq Init \wedge \Box [Next]_{vars} \wedge Fairness$ 
69  |
70   $Compactness \triangleq$  Compactness of CJupiter: the CSSes at all replicas are the same.
71       $Comm!EmptyChannel \Rightarrow Cardinality(Range(css)) = 1$ 
73  THEOREM  $Spec \Rightarrow \Box Compactness$ 
74  |
    
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