1 ────────────────── MODULE *XJupiterImplCJupiter* ──────────────────

In this module, we show that *XJupiter* implements *CJupiter*. To this end, we first extends *XJupiter* by replace its *Cop* with that used in *CJupiter*.

7 EXTENDS *XJupiterExtended*

9 VARIABLES

10 *cincomingCJ*,   *cincoming* for *CJupiter* which contains original operations

11 instead of transformed ones in *XJupiter*

12 *cxss*   *cxss[c]*: *eXtra ss* created during *OT* at the *Server* for client $c \in Client$

14 *varsImpl* $\triangleq$ $\langle vars, cincomingCJ, cxss \rangle$

The *Init* predicate.

19 *InitImpl* $\triangleq$

20 $\wedge$ *Init*

21 $\wedge$ *cincomingCJ* $= [c \in Client \mapsto \langle \rangle]$

22 $\wedge$ *cxss* $= [c \in Client \mapsto [node \mapsto \{\{\}\}, edge \mapsto \{\}]]$

24 *DoImpl(c)* $\triangleq$

25 $\wedge$ *Do(c)*

26 $\wedge$ UNCHANGED $\langle cincomingCJ, cxss \rangle$

28 *RevImpl(c)* $\triangleq$

29 $\wedge$ *Rev(c)*

30 $\wedge$ *cincomingCJ[c]* $\neq \langle \rangle$ there are (original) operations to handle with

31 $\wedge$ *cincomingCJ′* $= [cincomingCJ$ EXCEPT $![c] = Tail(@)]$ also consume a message

32 $\wedge$ UNCHANGED $\langle cxss \rangle$

Also broadcast the original operation to clients (using the *cincomingCJ* channels)

37 *SRevImpl* $\triangleq$

38 $\wedge$ *SRev*

39 $\wedge$ LET *cop* $\triangleq$ $[Head(sincoming)$ EXCEPT $!.sctx = soids]$

40 *c* $\triangleq$ *cop.oid.c*

41 *ss* $\triangleq$ *xForm(cop, s2ss[c], scur[c], Remote)*

42 IN $\wedge$ *cincomingCJ′* $= [cl \in Client \mapsto$

43 IF *cl* = *c*

44 THEN *cincomingCJ[cl]*

45 ELSE *Append(cincomingCJ[cl], cop)]*

46 $\wedge$ *cxss′* $= [cl \in Client \mapsto$

47 IF *cl* = *c*

48 THEN *cxss[cl]*

49 ELSE $[cxss[cl]$ EXCEPT $!.node = @ \cup Range(ss.node),$

50 $!.edge = @ \cup Range(ss.edge)]]$

The next-state relation.

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55 $NextImpl \stackrel{\Delta}{=}$
56     $\lor \exists c \in Client : DoImpl(c) \lor RevImpl(c)$
57     $\lor SRevImpl$

The specification.

62 $SpecImpl \stackrel{\Delta}{=} InitImpl \land \Box[NextImpl]_{varsImpl} \land \mathrm{WF}_{varsImpl}(NextImpl)$

64 $ss1 \oplus ss2 \stackrel{\Delta}{=}$
65     $[ss1 \text{ EXCEPT } !.node = @ \cup ss2.node,$
66                 $!.edge \ = @ \cup ss2.edge]$

68 $IgnoreDir(ss) \stackrel{\Delta}{=}$
69     $[ss \text{ EXCEPT } !.edge =$
70         $\{[\textit{field} \in (\text{DOMAIN } e \setminus \{\text{``lr''}\}) \mapsto e.\textit{field}] : e \in @\}]$
71        $\{[from \mapsto e.from, \ to \mapsto e.to, \ cop \mapsto e.cop] : e \in @\}]$

73 $CJ \stackrel{\Delta}{=} \text{INSTANCE } CJupiter$
74         $\text{WITH } cincoming \leftarrow cincomingCJ,$
75           $css \leftarrow [r \in Replica \mapsto$
76               $\text{IF } r = Server$
77               $\text{THEN } IgnoreDir(SetReduce(\ \oplus\ , \ Range(s2ss), \ [node \mapsto \{\{\}\}, \ edge \mapsto \{\}]))$
78               $\text{ELSE } \ IgnoreDir(c2ss[r] \oplus cxss[r])],$
79           $cur \leftarrow [r \in Replica \mapsto$
80               $\text{IF } r = Server$
81   It SHOULD be that $Cardinality(Range(scur)) = 1$
82               $\text{THEN CHOOSE } n \in Range(scur) : \text{TRUE}$
83               $\text{ELSE } \ ccur[r]]$

85 $\text{THEOREM } SpecImpl \Rightarrow CJ!Spec$
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