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MODULE XJupiter
Specification of the Jupiter protocol described in CSCW'2014 by Xu, Sun, and Li.
EXTENDS GraphStateSpace
VARIABLES
    c2ss,    c2ss[c]: the 2D state space (2ss, for short) at client c ∈ Client
    s2ss     s2ss[c]: the 2D state space maintained by the Server for client c ∈ Client
vars ≜ ⟨intVars, ctxVars, c2ss, s2ss⟩
TypeOK ≜
    ∧  TypeOKInt
    ∧  TypeOKCtx
    ∧  ∀ c ∈ Client : IsSS(c2ss[c]) ∧ IsSS(s2ss[c])
Init ≜
    ∧ InitInt
    ∧ InitCtx
    ∧ c2ss = [c ∈ Client ↦ EmptySS]
    ∧ s2ss = [c ∈ Client ↦ EmptySS]
NextEdge(r, u, ss) ≜  Return the unique outgoing edge from u in 2D state space ss
    CHOOSE e ∈ ss.edge : e.from = u  before a transformation at u (r is not used).
ClientPerform(c, cop) ≜
    LET xform ≜ xForm(NextEdge, c, cop, c2ss[c])  xform: [xcop, xss, lss]
    IN  ∧ c2ss′ = [c2ss EXCEPT ![c] = @ ⊕ xform.xss]
        ∧ SetNewAop(c, xform.xcop.op)
ServerPerform(cop) ≜
    LET c ≜ ClientOf(cop)
    xform ≜ xForm(NextEdge, Server, cop, s2ss[c])  xform: [xcop, xss, lss]
     xcop ≜ xform.xcop
    IN  ∧ s2ss′ = [cl ∈ Client ↦ IF cl = c
                                 THEN s2ss[cl] ⊕ xform.xss
                                 ELSE s2ss[cl] ⊕ xform.lss]
        ∧ SetNewAop(Server, xcop.op)
        ∧ Comm!SSendSame(c, xcop)  broadcast the transformed xcop
DoOp(c, op) ≜
    LET cop ≜ [op ↦ op, oid ↦ [c ↦ c, seq ↦ cseq[c]], ctx ↦ ds[c]]
    IN  ∧ ClientPerform(c, cop)
        ∧ Comm!CSend(cop)
Do(c) ≜
    ∧ DoInt(DoOp, c)
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        ∧ DoCtx(c)
        ∧ UNCHANGED s2ss

Rev(c) ≜
        ∧ RevInt(ClientPerform, c)
        ∧ RevCtx(c)
        ∧ UNCHANGED s2ss

SRev ≜
      ∧ SRevInt(ServerPerform)
      ∧ SRevCtx
      ∧ UNCHANGED c2ss
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Next ≜
      ∨ ∃ c ∈ Client : Do(c) ∨ Rev(c)
      ∨ SRev

Fairness ≜
     WF_vars(SRev ∨ ∃ c ∈ Client : Rev(c))

Spec ≜ Init ∧ □[Next]_vars  ∧ Fairness
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CSSync ≜  Each client c ∈ Client is synchonized with the Server.
     ∀ c ∈ Client : (ds[c] = ds[Server]) ⇒ c2ss[c] = s2ss[c]

THEOREM Spec ⇒ □CSSync
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