```
MODULE XJupiterImplCJupiter
We show that XJupiter (XJupiterExtended) implements CJupiter.
EXTENDS XJupiterExtended

VARIABLES
    op2ss,   a function from an operation (represented by its Oid)
             to the part of 2D state space produced while the operation is transformed
    c2ssX    c2ssX[c]: redundant (eXtra) 2D state space maintained for client c ∈ Client

varsImpl ≜ ⟨varsEx, op2ss, c2ssX⟩
----------------------------------------------------------------
TypeOKImpl ≜
    ∧ TypeOKEx
    ∧ ∀ oid ∈ DOMAIN op2ss : oid ∈ Oid ∧ IsSS(op2ss[oid])
    ∧ ∀ c ∈ Client : IsSS(c2ssX[c])
----------------------------------------------------------------
InitImpl ≜
    ∧ InitEx
    ∧ op2ss = ⟨⟩
    ∧ c2ssX = [c ∈ Client ↦ [node ↦ {{}}, edge ↦ {}]]
----------------------------------------------------------------
Take union of 2D state spaces ss1 and ss2.
ss1 ⊕ ss2 ≜
   [ss1 EXCEPT !.node = @ ∪ ss2.node,
               !.edge = @ ∪ ss2.edge]
Ignore the lr field in edges of 2D state space ss.
IgnoreDir(ss) ≜
    [ss EXCEPT !.edge =
        {[field ∈ (DOMAIN e \ {"lr"}) ↦ e.field] : e ∈ @}]
      {[from ↦ e.from, to ↦ e.to, cop ↦ e.cop] : e ∈ @}]
----------------------------------------------------------------
DoImpl(c) ≜
    ∧ DoEx(c)
    ∧ UNCHANGED ⟨op2ss, c2ssX⟩

RevImpl(c) ≜
    ∧   RevEx(c)
    ∧   LET cop ≜ Head(cincoming[c])
          IN  c2ssX' = [c2ssX EXCEPT ![c] = @ ⊕ op2ss[cop.oid]]
    ∧   UNCHANGED ⟨op2ss⟩

SRevImpl ≜
    ∧ SRevEx
    ∧ LET cop ≜ Head(sincoming)
          c   ≜ cop.oid.c
```

```
52              ss ≜ xForm(cop, s2ss[c], cur[Server], Remote)   TODO: performance!!!
53          IN  op2ss′ = op2ss @@ (cop.oid :> [node ↦ Range(ss.node), edge ↦ Range(ss.edge)])
54      ∧ UNCHANGED ⟨c2ssX⟩
55 ├──────────────────────────────────────────────────────────────────────────┤
56  NextImpl ≜
57      ∨ ∃ c ∈ Client : DoImpl(c) ∨ RevImpl(c)
58      ∨ SRevImpl

60  SpecImpl ≜ InitImpl ∧ □[NextImpl]_varsImpl
61      ∧ WF_varsImpl(SRevImpl ∨ ∃ c ∈ Client : RevImpl(c))

63  CJ ≜ INSTANCE CJupiter
64              WITH cincoming ← cincomingCJ,   sincoming needs no substitution
65                   css ← [r ∈ Replica ↦
66                              IF r = Server
67                               THEN IgnoreDir(SetReduce( ⊕ , Range(s2ss),
68                                                 [node ↦ {{}}, edge ↦ {}]))
69                               ELSE IgnoreDir(c2ss[r] ⊕ c2ssX[r])]

71  THEOREM SpecImpl ⇒ CJ!Spec
72 └──────────────────────────────────────────────────────────────────────────┘
    \* Modification History
    \* Last modified Wed Nov 07 13:45:05 CST 2018 by hengxin
    \* Created Fri Oct 26 15:00:19 CST 2018 by hengxin
```