MODULE *JupiterOT*

EXTENDS *Naturals*, *FiniteSets*, *Sequences*

CONSTANTS
CH, the characters allowed
NODE

VARIABLES
myMsgs,
otherMsgs,
outgoing, *outgoing*[*c*] and *outgoing*[*s*]
incoming, *incoming*[*c*] and *incoming*[*s*]
str *str*[*c*] and *str*[*s*]: the string (sequence of characters)

$OP \triangleq [type : \{\text{"Ins"}, \text{"Del"}\}, pos : Nat, ch : CH]$ set of all possible operations; ignoring READ now
$MSG \triangleq [op : OP, my : Nat, other : Nat]$ set of all possible messages

$TypeInvariant \triangleq$
FALSE

$Init \triangleq$
$\land$ FALSE

$Apply(o) \triangleq$ *TODO*: *pos*? (starting from 1 ???)
$\land \lor \land o.type = \text{"Ins"}$
$\land str' = Append(SubSeq(str, 1, o.pos - 1), o.ch) \circ SubSeq(str, o.pos, Len(str))$
$\lor \land o.type = \text{"Del"}$
$\land str' = SubSeq(str, 1, o.pos - 1) \circ SubSeq(str, o.pos, Len(str))$
$\land$ UNCHANGED $\langle myMsgs, otherMsgs, outgoing, incoming \rangle$

$Xform(o) \triangleq$
$\land$ FALSE

$Issue(node, o) \triangleq$ A node issues an operation
$\land Apply(o)$
$\land incoming' = [incoming$ EXCEPT $![1 - node] = Append(@, [op \mapsto o, my \mapsto myMsgs, other \mapsto otherMsgs]$
$\land outgoing' = [outgoing$ EXCEPT $![node] = Append(@, [op \mapsto o, my \mapsto myMsgs, other \mapsto otherMsgs])]$
$\land myMsgs' = myMsgs + 1$
$\land$ UNCHANGED *otherMsgs*

$Receive(node, msg) \triangleq$ A node receives an message
$\land \ incoming[node] \neq \langle\rangle$
$\land \ msg = Head(incoming[node])$
$\land \ incoming' = [incoming$ EXCEPT $![node] = Tail(@)]$ removing this *msg* from incoming; won't receive it again
$\land \ outgoing' = [outgoing$ EXCEPT $![node] = SelectSeq(@,$ LAMBDA $m : m.my < msg.other)]$
$\land \ Xform(msg.op)$
$\land \ otherMsgs' = otherMsgs + 1$
$\land$ UNCHANGED *myMsgs*

$\land$ FALSE

$Next \triangleq$
$\exists\, n \in NODE,\, o \in OP,\, m \in MSG :$
$\lor\, Issue(n,\, o)$
$\lor\, Receive(n,\, m)$

* Modification History
* Last modified *Fri Sep* 15 17:42:34 *CST* 2017 by *hengxin*
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* Specification of the *Jupiter* protocol described in the papers
* "High-Latency, Low-Bandwidth *Windowing* in the *Jupiter* Collaboration System"
* (*UIST* 1995) and "Achieving Convergence in Operational Transformation:
* Conditions, Mechanisms, and Systems" (*CSCW* 2014).