MODULE a_abp

EXTENDS $Naturals$, $Sequences$

CONSTANTS $Data$

VARIABLES $msgQ$, $ackQ$, $sBit$, $sAck$, $rBit$, $sent$, $rcvd$

$$
\begin{aligned}
ABInit \triangleq\ & \land msgQ = \langle\rangle \\
& \land ackQ = \langle\rangle \\
& \land sBit \in \{0, 1\} \\
& \land sAck = sBit \\
& \land rBit = sBit \\
& \land sent = \langle\rangle \\
& \land rcvd = \langle\rangle
\end{aligned}
$$

$$
\begin{aligned}
TypeInv \triangleq\ & \land msgQ \in Seq(\{0, 1\} \times Data) \\
& \land ackQ \in Seq(\{0, 1\}) \\
& \land sBit \in \{0, 1\} \\
& \land sAck \in \{0, 1\} \\
& \land rBit \in \{0, 1\} \\
& \land sent \in Seq(Data) \\
& \land rcvd \in Seq(Data)
\end{aligned}
$$

$$
\begin{aligned}
SndNewValue(d) \triangleq\ & \land sAck = sBit \\
& \land sent' = Append(sent, d) \\
& \land sBit' = 1 - sBit \\
& \land msgQ' = Append(msgQ, \langle sBit', d\rangle) \\
& \land \text{UNCHANGED } \langle ackQ, sAck, rBit, rcvd\rangle
\end{aligned}
$$

$$
\begin{aligned}
ReSndMsg \triangleq\ & \land sAck \neq sBit \\
& \land msgQ' = Append(msgQ, \langle sBit, sent[Len(sent)]\rangle) \\
& \land \text{UNCHANGED } \langle ackQ, sBit, sAck, rBit, sent, rcvd\rangle
\end{aligned}
$$

$$
\begin{aligned}
RcvMsg \triangleq\ & \land msgQ \neq \langle\rangle \\
& \land msgQ' = Tail(msgQ) \\
& \land rBit' = Head(msgQ)[1] \\
& \land rcvd' = \text{IF } rBit' \neq rBit \text{ THEN } Append(rcvd, Head(msgQ)[2]) \\
& \qquad\qquad\qquad\qquad \text{ELSE } rcvd \\
& \land \text{UNCHANGED } \langle ackQ, sBit, sAck, sent\rangle
\end{aligned}
$$

$$
\begin{aligned}
SndAck \triangleq\ & \land ackQ' = Append(ackQ, rBit) \\
& \land \text{UNCHANGED } \langle msgQ, sBit, sAck, rBit, sent, rcvd\rangle
\end{aligned}
$$

$$
\begin{aligned}
RcvAck \triangleq\ & \land ackQ \neq \langle\rangle \\
& \land ackQ' = Tail(ackQ) \\
& \land sAck' = Head(ackQ) \\
& \land \text{UNCHANGED } \langle msgQ, sBit, rBit, sent, rcvd\rangle
\end{aligned}
$$

$$
\begin{array}{l}
Lose(c) \triangleq \\
\quad \land\ c \neq \langle\rangle \\
\quad \land\ \exists\, i \in 1 \,..\, Len(c) : \\
\qquad c' = [j \in 1 \,..\, (Len(c) - 1) \mapsto \text{IF } j \leq i \text{ THEN } c[j] \\
\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad \text{ELSE } c[j+1]] \\
\quad \land\ \text{UNCHANGED } \langle sBit,\ sAck,\ rBit,\ sent,\ rcvd\rangle
\end{array}
$$

$$
LoseMsg \triangleq Lose(msgQ) \land \text{UNCHANGED } ackQ
$$

$$
LoseAck \triangleq Lose(ackQ) \land \text{UNCHANGED } msgQ
$$

$$
\begin{array}{l}
ABNext \triangleq \lor\ \exists\, d \in Data : SndNewValue(d) \\
\qquad\qquad \lor\ ReSndMsg \lor RcvMsg \lor SndAck \lor RcvAck \\
\qquad\qquad \lor\ LoseMsg \lor LoseAck
\end{array}
$$

$$
vars \triangleq \langle msgQ,\ ackQ,\ sBit,\ sAck,\ rBit,\ sent,\ rcvd\rangle
$$

$$
Spec \triangleq ABInit \land \Box[ABNext]_{vars}
$$

$$
\begin{array}{l}
Inv \triangleq \land\ Len(rcvd) \in \{Len(sent) - 1,\ Len(sent)\} \\
\qquad\ \land\ \forall\, i \in 1 \,..\, Len(rcvd) : rcvd[i] = sent[i] \\
\qquad\ \land\ Len(rcvd) \neq 5
\end{array}
$$

$$
\begin{array}{l}
Init \triangleq ABInit \\
Next \triangleq ABNext
\end{array}
$$

$$
test \triangleq rcvd \neq \langle \text{“deux”},\ \text{“deux”}\rangle
$$
