MODULE *AltImplHandshake*

EXTENDS *Integers*

$a \oplus b \triangleq (a+b)\%2$

```
****************************************************************************
--algorithm AltImplHandshake{
  variable $p = 0,\ c = 0$ ;

  process ( $Producer = 0$ )
    variable $tp = 0$ ;
    {  pe: while ( TRUE )
             {      await $p = c$;
                    $tp := c$ ;
               pe1: if ( $p \neq tp$ ) { goto pe }  ;
               put: skip ;
               px:  $p := p \oplus 1$
              }
     }

  process ( $Consumer = 1$ )
    variable $tc = 0$ ;
    {  ce: while ( TRUE )
             {      await $p \neq c$;
                    $tc := p$ ;
               ce1: if ( $c = tc$ ) { goto ce }  ;
               get: skip ;
               cx:  $c := c \oplus 1$
              }
     }
 }
****************************************************************************
```

BEGIN TRANSLATION

VARIABLES $p,\ c,\ pc,\ tp,\ tc$

$vars \triangleq \langle p,\ c,\ pc,\ tp,\ tc \rangle$

$ProcSet \triangleq \{0\} \cup \{1\}$

$Init \triangleq$ Global variables

$\land\ p = 0$

$\land\ c = 0$

Process *Producer*

$\land\ tp = 0$

Process *Consumer*

$\land\ tc = 0$

$\land\ pc = [self \in ProcSet \mapsto \text{CASE } self = 0 \rightarrow$ “pe”

$$\square \quad \mathit{self} = 1 \rightarrow \text{“ce”}]$$

$$\mathit{pe} \triangleq \begin{array}[t]{l} \land\ \mathit{pc}[0] = \text{“pe”} \\ \land\ \mathit{tp}' = c \\ \land\ \mathit{pc}' = [\mathit{pc}\ \textsc{except}\ ![0] = \text{“pe1”}] \\ \land\ \textsc{unchanged}\ \langle p,\ c,\ \mathit{tc} \rangle \end{array}$$

$$\mathit{pe}1 \triangleq \begin{array}[t]{l} \land\ \mathit{pc}[0] = \text{“pe1”} \\ \land\ \textsc{if}\ \ p \neq \mathit{tp} \\ \qquad\quad \textsc{then}\ \ \land\ \mathit{pc}' = [\mathit{pc}\ \textsc{except}\ ![0] = \text{“pe”}] \\ \qquad\quad \textsc{else}\ \ \ \land\ \mathit{pc}' = [\mathit{pc}\ \textsc{except}\ ![0] = \text{“put”}] \\ \land\ \textsc{unchanged}\ \langle p,\ c,\ \mathit{tp},\ \mathit{tc} \rangle \end{array}$$

$$\mathit{put} \triangleq \begin{array}[t]{l} \land\ \mathit{pc}[0] = \text{“put”} \\ \land\ \textsc{true} \\ \land\ \mathit{pc}' = [\mathit{pc}\ \textsc{except}\ ![0] = \text{“px”}] \\ \land\ \textsc{unchanged}\ \langle p,\ c,\ \mathit{tp},\ \mathit{tc} \rangle \end{array}$$

$$\mathit{px} \triangleq \begin{array}[t]{l} \land\ \mathit{pc}[0] = \text{“px”} \\ \land\ p' = p \oplus 1 \\ \land\ \mathit{pc}' = [\mathit{pc}\ \textsc{except}\ ![0] = \text{“pe”}] \\ \land\ \textsc{unchanged}\ \langle c,\ \mathit{tp},\ \mathit{tc} \rangle \end{array}$$

$$\mathit{Producer} \triangleq \mathit{pe} \lor \mathit{pe}1 \lor \mathit{put} \lor \mathit{px}$$

$$\mathit{ce} \triangleq \begin{array}[t]{l} \land\ \mathit{pc}[1] = \text{“ce”} \\ \land\ \mathit{tc}' = p \\ \land\ \mathit{pc}' = [\mathit{pc}\ \textsc{except}\ ![1] = \text{“ce1”}] \\ \land\ \textsc{unchanged}\ \langle p,\ c,\ \mathit{tp} \rangle \end{array}$$

$$\mathit{ce}1 \triangleq \begin{array}[t]{l} \land\ \mathit{pc}[1] = \text{“ce1”} \\ \land\ \textsc{if}\ \ c = \mathit{tc} \\ \qquad\quad \textsc{then}\ \ \land\ \mathit{pc}' = [\mathit{pc}\ \textsc{except}\ ![1] = \text{“ce”}] \\ \qquad\quad \textsc{else}\ \ \ \land\ \mathit{pc}' = [\mathit{pc}\ \textsc{except}\ ![1] = \text{“get”}] \\ \land\ \textsc{unchanged}\ \langle p,\ c,\ \mathit{tp},\ \mathit{tc} \rangle \end{array}$$

$$\mathit{get} \triangleq \begin{array}[t]{l} \land\ \mathit{pc}[1] = \text{“get”} \\ \land\ \textsc{true} \\ \land\ \mathit{pc}' = [\mathit{pc}\ \textsc{except}\ ![1] = \text{“cx”}] \\ \land\ \textsc{unchanged}\ \langle p,\ c,\ \mathit{tp},\ \mathit{tc} \rangle \end{array}$$

$$\mathit{cx} \triangleq \begin{array}[t]{l} \land\ \mathit{pc}[1] = \text{“cx”} \\ \land\ c' = c \oplus 1 \\ \land\ \mathit{pc}' = [\mathit{pc}\ \textsc{except}\ ![1] = \text{“ce”}] \\ \land\ \textsc{unchanged}\ \langle p,\ \mathit{tp},\ \mathit{tc} \rangle \end{array}$$

$$\mathit{Consumer} \triangleq \mathit{ce} \lor \mathit{ce}1 \lor \mathit{get} \lor \mathit{cx}$$

$$Next \triangleq Producer \lor Consumer$$

$$Spec \triangleq Init \land \Box[Next]_{vars}$$

END TRANSLATION

$$pcBar \triangleq [i \in \{0, 1\} \mapsto \textsc{case}\ \begin{array}{cl} & i = 0 \to \textsc{if}\ pc[0] = \text{“}\mathsf{pe1}\text{”}\ \begin{array}{l} \textsc{then}\ \text{“}\mathsf{pe}\text{”} \\ \textsc{else}\ pc[0] \end{array} \\ \Box & i = i \to \textsc{if}\ pc[1] = \text{“}\mathsf{ce1}\text{”}\ \begin{array}{l} \textsc{then}\ \text{“}\mathsf{ce}\text{”} \\ \textsc{else}\ pc[1]] \end{array} \end{array}$$

$$A \triangleq \textsc{instance}\ AltSpec\ \textsc{with}\ b \leftarrow p \oplus c,\ pc \leftarrow pcBar$$