section *DisBufferSpec* **parents** *circus_toolkit*

$$
\begin{array}{|l}
maxbuff : \mathbb{N}_1 \\
maxring : \mathbb{N}_1 \\
\hline
maxring = maxbuff - 1
\end{array}
$$

$$RingIndex == 1 \mathinner{..} maxring$$

channel $input, output : \mathbb{N}$
channel $read, write : (RingIndex) \times \mathbb{N}$
channel $rd, wrt : \mathbb{N}$
channel $rd\_i, wrt\_i : (RingIndex) \times \mathbb{N}$

$$
\begin{array}{l}
\textbf{process}\ \mathit{Controller} \mathrel{\widehat=} \textbf{begin} \\
\quad \textbf{state}\ \mathit{ControllerState} == [\\
\qquad \mathit{size} : 0 \mathinner{..} \mathit{maxbuff}; \\
\qquad \mathit{ringsize} : 0 \mathinner{..} \mathit{maxring}; \\
\qquad \mathit{cache} : \mathbb{N}; \\
\qquad \mathit{top}, \mathit{bot} : \mathit{RingIndex} \mid \\
\qquad \mathit{ringsize} \bmod \mathit{maxring} = (\mathit{top} - \mathit{bot}) \bmod \mathit{maxring} \land \\
\qquad \mathit{ringsize} = \mathit{max}\,\{\, 0, \mathit{size} - 1 \,\}\,] \\
\quad \mathit{ControllerInit} == [\, (\mathit{ControllerState})' \mid \\
\qquad \mathit{top}' = 1 \land \mathit{bot}' = 1 \land \mathit{size}' = 0\,] \\
\quad \mathit{CacheInput} == [\, \Delta \mathit{ControllerState};\ x? : \mathbb{N} \mid \\
\qquad \mathit{size} = 0 \land \mathit{size}' = 1 \land \\
\qquad \mathit{cache}' = x? \land \mathit{bot}' = \mathit{bot} \land \mathit{top}' = \mathit{top}\,] \\
\quad \mathit{StoreInputController} == [\, \Delta \mathit{ControllerState} \mid \\
\qquad 0 < \mathit{size} \land \mathit{size} < \mathit{maxbuff} \land \mathit{size}' = \mathit{size} + 1 \land \\
\qquad \mathit{cache}' = \mathit{cache} \land \mathit{bot}' = \mathit{bot} \land \mathit{top}' = (\mathit{top} \bmod \mathit{maxring}) + 1\,] \\
\quad \mathit{InputController} \mathrel{\widehat=} \big(\mathit{size} < \mathit{maxbuff}\big)\ \&\ \mathit{input}?x \longrightarrow \\
\qquad \big(\big(\mathit{size} = 0\big)\ \&\ \big(\mathit{CacheInput}\big) \Box \\
\qquad \big(\mathit{size} > 0\big)\ \&\ \mathit{write}.\mathit{top}!x \longrightarrow \big(\mathit{StoreInputController}\big)\big) \\
\quad \mathit{NoNewCache} == [\, \Delta \mathit{ControllerState} \mid \\
\qquad \mathit{size} = 1 \land \mathit{size}' = 0 \land \\
\qquad \mathit{cache}' = \mathit{cache} \land \mathit{bot}' = \mathit{bot} \land \mathit{top}' = \mathit{top}\,] \\
\quad \mathit{StoreNewCacheController} == [\, \Delta \mathit{ControllerState};\ x? : \mathbb{N} \mid \\
\qquad \mathit{size} > 1 \land \mathit{size}' = \mathit{size} - 1 \land \\
\qquad \mathit{cache}' = x? \land \mathit{bot}' = (\mathit{bot} \bmod \mathit{maxring}) + 1 \land \\
\qquad \mathit{top}' = \mathit{top}\,] \\
\quad \mathit{OutputController} \mathrel{\widehat=} \big(\mathit{size} > 0\big)\ \&\ \mathit{output}!(\mathit{cache}) \longrightarrow \\
\qquad \big(\big(\mathit{size} > 1\big)\ \&\ \mathit{read}.\mathit{bot}?x \longrightarrow \big(\mathit{StoreNewCacheController}\big) \Box \\
\qquad \big(\mathit{size} = 1\big)\ \&\ \big(\mathit{NoNewCache}\big)\big) \\
\quad \bullet\ \big(\mathit{ControllerInit}\big)\ ;\ (\mu X \bullet (\mathit{InputController} \Box \mathit{OutputController})\ ;\ X) \\
\textbf{end}
\end{array}
$$

$$
\begin{array}{l}
\textbf{process}\ \mathit{RingCell} \mathrel{\widehat=} \textbf{begin} \\
\quad \textbf{state}\ \mathit{CellState} == [\, v : \mathbb{N} \mid \mathit{true}\,] \\
\quad \mathit{CellWrite}\ == [\, \Delta \mathit{CellState};\ x? : \mathbb{N} \mid v' = x?\,] \\
\quad \mathit{Read} \mathrel{\widehat=} \mathit{rd}!v \longrightarrow \textbf{Skip} \\
\quad \mathit{Write} \mathrel{\widehat=} \mathit{wrt}?x \longrightarrow \big(\mathit{CellWrite}\big) \\
\quad \bullet\ (\mu X \bullet (\mathit{Read} \Box \mathit{Write})\ ;\ X) \\
\textbf{end}
\end{array}
$$

$$
\textbf{process}\ \mathit{IRCell} \mathrel{\widehat=} (\, i : \mathit{RingIndex} \odot \mathit{RingCell}\,)[\mathit{rd\_i}, \mathit{wrt\_i} := \mathit{read}, \mathit{write}]
$$

$$\textbf{process}\ \ Ring \mathrel{\widehat{=}} (\ \Big|\Big|\Big|\ i : RingIndex \bullet IRCell\lfloor i \rfloor\ )$$

$$\textbf{process}\ \ Buffer \mathrel{\widehat{=}} (\ Controller\ [\![\ \{\!|\ read, write\ |\!\}\ ]\!]\ Ring\ ) \setminus \{\!|\ read, write\ |\!\}$$