Encoding the π_{esc}-Calculus into Pure Ambients

$$
\begin{aligned}
&\mathit{server}\ n\ .P \triangleq !\ \mathit{enter}[\ \mathit{in}\ n\ .\ \overline{\mathit{open}}\ \mathit{enter}\ .P]\\
&\mathit{request}\ \mathit{rw}\ n\ \triangleq\ \mathit{in}\ n\ .\ \overline{\mathit{in}}\ \mathit{rw}\ .\ \mathit{open}\ \mathit{enter}\\
&\mathit{request}\ \mathit{rw}\ x\ \triangleq\ \mathit{in}\ x\ .\ \overline{\mathit{in}}\ \mathit{rw}\ .\ \mathit{open}\ \mathit{enter}\ .\ \mathit{out}\ x\\
&\mathit{fwd}\ M\ \triangleq\ \mathit{server}\ \mathit{write}\ .\ \mathit{request}\ \mathit{write}\ M\ \mid\ \mathit{server}\ \mathit{read}\ .\ \mathit{request}\ \mathit{read}\ M\\
&n\ \mathit{be}\ m\ .P \triangleq m[\ \mathit{out}\ n\ .\ \overline{\mathit{in}}\ m\ .(\ \mathit{open}\ n\ \mid P)]\mid\ \overline{\mathit{out}}\ n\ .\ \mathit{in}\ m\ .\ \overline{\mathit{open}}\ n\\
&\mathit{allowIO}\ n\ \triangleq !\ \overline{\mathit{in}}\ n\ \mid !\ \overline{\mathit{out}}\ n
\end{aligned}
$$

$$
\begin{aligned}
&\{\!\!\{(\nu n)\ P\}\!\!\}\ \triangleq\ (\nu n)\ \{\!\!\{P\}\!\!\} \qquad\qquad \{\!\!\{\mathbf{0}\}\!\!\}\ \triangleq\ \mathbf{0}\\
&\{\!\!\{P\mid Q\}\!\!\}\ \triangleq\ \{\!\!\{P\}\!\!\}\mid\{\!\!\{Q\}\!\!\} \qquad\qquad \{\!\!\{!P\}\!\!\}\ \triangleq\ !\{\!\!\{P\}\!\!\}\\
&\{\!\!\{\overline{M}\langle M'\rangle.P\}\!\!\}\ \triangleq\ (\nu p)\quad (\ \mathit{write}\ \ [\ \mathit{request}\ \mathit{write}\ M\\
&\qquad\qquad\qquad\qquad\qquad\qquad \mid \mathit{fwd}\ M'\\
&\qquad\qquad\qquad\qquad\qquad\qquad \mid p[\ \mathit{out}\ \mathit{read}\ .\ \overline{\mathit{open}}\ p\ .\{\!\!\{P\}\!\!\}]]\\
&\qquad\qquad\qquad\qquad \mid \mathit{open}\ p\ )\\
&\{\!\!\{M(x).P\}\!\!\}\ \triangleq\ (\nu p)\quad (\ \mathit{read}\ \ [\ \mathit{request}\ \mathit{read}\ M\\
&\qquad\qquad\qquad\qquad\qquad \mid \mathit{open}\ \mathit{write}\ .\ \overline{\mathit{out}}\ \mathit{read}\ .\ (\nu x)\ \ \mathit{read}\ \mathit{be}\ x\ .\\
&\qquad\qquad\qquad\qquad\qquad\qquad\qquad (\ \overline{\mathit{out}}\ x\ .\ \mathit{allowIO}\ x\\
&\qquad\qquad\qquad\qquad\qquad\qquad\qquad \mid p[\ \mathit{out}\ x\ .\ \overline{\mathit{open}}\ p\ .\{\!\!\{P\}\!\!\}])]\\
&\qquad\qquad\qquad\quad \mid \mathit{open}\ p\ )\\
&\{\!\!\{[n:S]\}\!\!\}\ \triangleq\ (\nu p_1)\ \dots(\nu p_k) \qquad \text{(where } \{p_1,\dots,p_k\} \text{ are the fresh names in } S)\\
&\qquad (\ n\ \ [\ \mathit{allowIO}\ n\\
&\qquad\qquad \mid \mathit{server}\ \mathit{read}\ .\ (\nu p)\\
&\qquad\qquad\qquad (\ \overline{\mathit{out}}\ \mathit{read}\ .\ \mathit{read}\ \mathit{be}\ p\ .\ \overline{\mathit{in}}\ p\ .\ \mathit{out}\ n\ .\ p\ \mathit{be}\ \mathit{read}\\
&\qquad\qquad\qquad \mid \mathit{enter}[\ \mathit{out}\ \mathit{read}\ .\ \mathit{in}\ \mathit{write}\ .\ \overline{\mathit{open}}\ \mathit{enter}\ .\ \mathit{in}\ p\ .\ \overline{\mathit{open}}\ \mathit{write}\ ])\\
&\qquad\qquad \mid\{\!\!\{S\}\!\!\}_n]\\
&\qquad \mid \mathit{open}\ p_1\ \mid\ \dots\ \mid\ \mathit{open}\ p_k\ )\\
&\{\!\!\{(\nu x:M)\ P\}\!\!\}\ \triangleq\ (\nu x)\quad (x[\ \mathit{fwd}\ M\ \mid\ \mathit{allowIO}\ x\ ]\mid\{\!\!\{P\}\!\!\})\\
&\{\!\!\{\varepsilon\}\!\!\}_n\ \triangleq\ \mathbf{0} \qquad\qquad \{\!\!\{S\mid S'\}\!\!\}_n\ \triangleq\ \{\!\!\{S\}\!\!\}_n\mid\{\!\!\{S'\}\!\!\}_n\\
&\{\!\!\{\langle M\rangle.P\}\!\!\}_n\ \triangleq\ \mathit{write}\ \ [\ \overline{\mathit{in}}\ \mathit{write}\ .\ \mathit{open}\ \mathit{enter}\\
&\qquad\qquad\qquad\qquad \mid \mathit{fwd}\ M\\
&\qquad\qquad\qquad\qquad \mid p[\ \mathit{out}\ \mathit{read}\ .\ \overline{\mathit{open}}\ p\ .\{\!\!\{P\}\!\!\}]] \qquad \text{(where } p \text{ is fresh)}\\
&\{\!\!\{(x).P\}\!\!\}_n\ \triangleq\ (\nu q)\quad (\ q\ \ [\ \overline{\mathit{in}}\ q\ .\ \mathit{out}\ n\ .\ q\ \mathit{be}\ \mathit{read}\\
&\qquad\qquad\qquad\qquad\quad \mid \mathit{open}\ \mathit{write}\ .\ \overline{\mathit{out}}\ \mathit{read}\ .\ (\nu x)\ \ \mathit{read}\ \mathit{be}\ x\ .\\
&\qquad\qquad\qquad\qquad\qquad\qquad (\ \overline{\mathit{out}}\ x\ .\ \mathit{allowIO}\ x\\
&\qquad\qquad\qquad\qquad\qquad\qquad \mid p[\ \mathit{out}\ x\ .\ \overline{\mathit{open}}\ p\ .\{\!\!\{P\}\!\!\}])] \qquad \text{(where } p \text{ is fresh)}\\
&\qquad\qquad\qquad \mid \mathit{enter}[\ \mathit{in}\ \mathit{write}\ .\ \overline{\mathit{open}}\ \mathit{enter}\ .\ \mathit{in}\ q\ .\ \overline{\mathit{open}}\ \mathit{write}\ ])
\end{aligned}
$$

$$
\begin{aligned}
\{\!\!\{\{{}^{M_1}/_{x_1}\}\uplus\dots\uplus\{{}^{M_k}/_{x_k}\},P\}\!\!\}\ \triangleq\ &\ \ x_1[\ \mathit{fwd}\ M_1\ \mid\ \mathit{allowIO}\ x_1\ ]\\
&\mid\ \dots\\
&\mid\ x_k[\ \mathit{fwd}\ M_k\ \mid\ \mathit{allowIO}\ x_k\ ]\\
&\mid\ \{\!\!\{P\}\!\!\}
\end{aligned}
$$

Direct Encoding of the π-Calculus

$$\langle\!\langle \mathbf{0} \rangle\!\rangle \triangleq \mathbf{0}$$

$$\langle\!\langle P \mid Q \rangle\!\rangle \triangleq \langle\!\langle P \rangle\!\rangle \mid \langle\!\langle Q \rangle\!\rangle$$

$$\langle\!\langle !P \rangle\!\rangle \triangleq !\langle\!\langle P \rangle\!\rangle$$

$$\begin{array}{l}
\langle\!\langle (\nu n)\ P \rangle\!\rangle \triangleq (\nu n) \\
\quad (\ n\ \ [\ allowIO\ n \\
\qquad\quad \mid server\ read\ .\ (\nu p) \\
\qquad\qquad (\ \overline{out}\ read\ .\ read\ be\ p\ .\ \overline{in}\ p\ .\ out\ n\ .\ p\ be\ read \\
\qquad\qquad \mid enter[\ out\ read\ .\ in\ write\ .\ \overline{open}\ enter\ .\ in\ p\ .\ \overline{open}\ write\ ])] \\
\quad \mid \langle\!\langle P \rangle\!\rangle)
\end{array}$$

$$\begin{array}{lll}
\langle\!\langle \overline{M}\langle M' \rangle.P \rangle\!\rangle \triangleq (\nu p) & (\ write & [\ request\ write\ M \\
 & & \mid fwd\ M' \\
 & & \mid p[\ out\ read\ .\ \overline{open}\ p\ .\langle\!\langle P \rangle\!\rangle]] \\
 & \mid open\ p\ ) &
\end{array}$$

$$\begin{array}{lll}
\langle\!\langle M(x).P \rangle\!\rangle \triangleq (\nu p) & (\ read & [\ request\ read\ M \\
 & & \mid open\ write\ .\ \overline{out}\ read\ .\ (\nu x)\ \ read\ be\ x\ . \\
 & & \qquad (\ \overline{out}\ x\ .\ allowIO\ x \\
 & & \qquad \mid p[\ out\ x\ .\ \overline{open}\ p\ .\langle\!\langle P \rangle\!\rangle])] \\
 & \mid open\ p\ ) &
\end{array}$$