

**es-axioms**<sup>11,40</sup>

$$\begin{aligned}
& \forall the\_es: \text{event\_system}\{i:l\}. \\
& \text{trans}(\text{es-E}(the\_es); e, e'.\text{es-locl}(the\_es; e; e')) \\
& \wedge \text{SWellFounded}(\text{es-locl}(the\_es; e; e')) \\
& \wedge (\forall e, e': \text{es-E}(the\_es). \\
& \quad (\text{loc}(e) = \text{loc}(e') \in \text{Id}) \\
& \quad \iff (\text{es-locl}(the\_es; e; e') \vee (e = e') \vee \text{es-locl}(the\_es; e'; e))) \\
& \wedge (\forall e: \text{es-E}(the\_es). \\
& \quad (\uparrow \text{es-first}(the\_es; e)) \iff (\forall e': \text{es-E}(the\_es). \neg \text{es-locl}(the\_es; e'; e))) \\
& \wedge (\forall e: \text{es-E}(the\_es). \\
& \quad (\neg(\uparrow \text{es-first}(the\_es; e))) \\
& \quad \Rightarrow (\text{es-locl}(the\_es; \text{es-pred}(the\_es; e); e) \\
& \quad \quad \wedge (\forall e': \text{es-E}(the\_es). \\
& \quad \quad \quad \neg(\text{es-locl}(the\_es; \text{es-pred}(the\_es; e); e') \wedge \text{es-locl}(the\_es; e'; e)))))) \\
& \wedge (\forall e: \text{es-E}(the\_es). \\
& \quad (\neg(\uparrow \text{es-first}(the\_es; e))) \\
& \quad \Rightarrow (\forall x: \text{Id}, t: \text{rationals}. \\
& \quad \quad \text{es\_state\_when}(the\_es; e)(x, t) \\
& \quad \quad = \\
& \quad \quad \text{es\_state\_after}(the\_es; \text{es-pred}(the\_es; e)) \\
& \quad \quad (x \\
& \quad \quad , t + (\text{es-time}(the\_es; e) - \text{es-time}(the\_es; \text{es-pred}(the\_es; e)))) \\
& \quad \quad \in \text{es-vartype}(the\_es; \text{loc}(e); x))) \\
& \wedge \text{trans}(\text{es-E}(the\_es); e, e'.\text{es-causl}(the\_es; e; e')) \\
& \wedge \text{SWellFounded}(\text{es-causl}(the\_es; e; e')) \\
& \wedge (\forall e: \text{es-E}(the\_es). \\
& \quad (\uparrow \text{es-isrcv}(the\_es; e)) \\
& \quad \Rightarrow (\text{es-sends}(the\_es; \text{es-lnk}(the\_es; e); \text{es-sender}(the\_es; e))[\text{es-index}(the\_es; e)] \\
& \quad \quad = \\
& \quad \quad \text{msg}(\text{es-lnk}(the\_es; e); \text{es-tag}(the\_es; e); \text{es-val}(the\_es; e)) \\
& \quad \quad \in \text{es-Msg}(the\_es))) \\
& \wedge (\forall e, e': \text{es-E}(the\_es). \text{es-locl}(the\_es; e; e') \Rightarrow \text{es-causl}(the\_es; e; e')) \\
& \wedge (\forall e: \text{es-E}(the\_es). (\uparrow \text{es-isrcv}(the\_es; e)) \Rightarrow \text{es-causl}(the\_es; \text{es-sender}(the\_es; e); e)) \\
& \wedge (\forall e, e': \text{es-E}(the\_es). \\
& \quad \text{es-causl}(the\_es; e; e') \\
& \quad \Rightarrow (((\neg(\uparrow \text{es-first}(the\_es; e')))) \\
& \quad \quad c \wedge (\text{es-causl}(the\_es; e; \text{es-pred}(the\_es; e')) \vee (e = \text{es-pred}(the\_es; e')))) \\
& \quad \quad \vee ((\uparrow \text{es-isrcv}(the\_es; e')) \\
& \quad \quad \quad c \wedge (\text{es-causl}(the\_es; e; \text{es-sender}(the\_es; e')) \vee (e = \text{es-sender}(the\_es; e')))))))) \\
& \wedge (\forall e: \text{es-E}(the\_es). \\
& \quad (\uparrow \text{es-isrcv}(the\_es; e)) \Rightarrow (\text{loc}(e) = \text{destination}(\text{es-lnk}(the\_es; e)) \in \text{Id})) \\
& \wedge (\forall e: \text{es-E}(the\_es), l: \text{IdLnk}. \\
& \quad (\neg(\text{loc}(e) = \text{source}(l) \in \text{Id}))
\end{aligned}$$

$$\begin{aligned}
& \Rightarrow (\text{es-sends}(the\_es; l; e) = [] \in (\text{es-Msgl}(the\_es; l) \text{ List})) \\
\wedge & (\forall e, e': \text{es-E}(the\_es). \\
& (\uparrow \text{es-isrcv}(the\_es; e)) \\
& \Rightarrow (\uparrow \text{es-isrcv}(the\_es; e')) \\
& \Rightarrow (\text{es-lnk}(the\_es; e) = \text{es-lnk}(the\_es; e') \in \text{IdLnk}) \\
& \Rightarrow (\text{es-locl}(the\_es; e; e') \\
& \iff (\text{es-locl}(the\_es; \text{es-sender}(the\_es; e); \text{es-sender}(the\_es; e')) \\
& \quad \vee ((\text{es-sender}(the\_es; e) = \text{es-sender}(the\_es; e') \in \text{es-E}(the\_es)) \\
& \quad \wedge (\text{es-index}(the\_es; e) < \text{es-index}(the\_es; e'))))) \\
\wedge & (\forall e: \text{es-E}(the\_es), l: \text{IdLnk}, n: \text{int\_seg}(0; \|\text{es-sends}(the\_es; l; e)\|). \\
& \exists e': \text{es-E}(the\_es) \\
& ((\uparrow \text{es-isrcv}(the\_es; e')) \\
& c \wedge ((\text{es-lnk}(the\_es; e') = l) \\
& \quad \wedge (\text{es-sender}(the\_es; e') = e) \\
& \quad \wedge (\text{es-index}(the\_es; e') = n \in \mathbb{Z})))
\end{aligned}$$