THEORY $LivenessCorrectness$

IMPORT THEORY $InvCorrectness$, $Theo4Liveness$, $NaturalOp$

TYPE PARAMETERS $STATE$, $EVENT$

THEOREMS

thm of correctness of Leads_From_P1_To_P2:

$$\forall m, tr, p1, p2 \cdot m \in Machine(STATE, EVENT) \wedge$$
$$Machine\_WellCons(m) \wedge$$
$$check\_Machine\_Consistency(m) \wedge$$
$$IsATrace(m, tr) \wedge$$
$$TLLeads\_From\_P1\_To\_P2(m, p1, p2)$$
$$\Rightarrow (\forall i \cdot i \in dom(tr) \wedge iSucc(i) \in dom(tr) \wedge tr(i) \in p1 \Rightarrow tr(iSucc(i)) \in p2)$$

Lemme Convergent_In_P:

$$\forall m, tr, variant, p \cdot variant \in STATE \to \mathbb{Z} \wedge m \in Machine(STATE, EVENT) \wedge$$
$$Machine\_WellCons(m) \wedge$$
$$check\_Machine\_Consistency(m) \wedge$$
$$IsATrace(m, tr) \wedge$$
$$TLConvergent\_In\_P(m, p, variant) \wedge$$
$$dom(tr) = iNAT$$
$$\Rightarrow (\forall i \cdot i \in dom(tr) \Rightarrow ((\forall k \cdot tr(iaddk) \in p)$$
$$\Rightarrow (\forall k \cdot variant(tr(iaddk)) \leq variant(tr(i)) - mk\_int(k))))$$

thm of correctness of Convergent_In_P:

$$\forall m, tr, variant, p \cdot variant \in STATE \to \mathbb{Z} \wedge m \in Machine(STATE, EVENT) \wedge$$
$$Machine\_WellCons(m) \wedge$$
$$check\_Machine\_Consistency(m) \wedge$$
$$IsATrace(m, tr) \wedge$$
$$TLConvergent\_In\_P(m, p, variant) \wedge$$
$$dom(tr) = iNAT$$
$$\Rightarrow (\forall i \cdot i \in dom(tr)$$
$$\Rightarrow (\exists j \cdot j \in iNAT \wedge mk\_int(j) \geq mk\_int(i) \wedge j \in dom(tr) \wedge tr(j) \notin p))$$

lemme 1 Divergent_In_P:

$$\forall m, tr, variant, p \cdot variant \in STATE \to \mathbb{Z} \wedge m \in Machine(STATE, EVENT) \wedge$$
$$Machine\_WellCons(m) \wedge$$
$$check\_Machine\_Consistency(m) \wedge$$
$$IsATrace(m, tr) \wedge$$
$$TLDivergent\_In\_P(m, p, variant) \wedge$$
$$dom(tr) = iNAT$$
$$\Rightarrow (\forall i \cdot \forall j \cdot variant(tr(iaddj)) \leq variant(tr(i)) \vee variant(tr(iaddj)) \notin \mathbb{N})$$

lemme 2 Divergent_In_P:

$$\forall m, tr, variant, p \cdot variant \in STATE \to \mathbb{Z} \wedge m \in Machine(STATE, EVENT) \wedge$$
$$Machine\_WellCons(m) \wedge$$
$$check\_Machine\_Consistency(m) \wedge$$
$$IsATrace(m, tr) \wedge$$
$$TLDivergent\_In\_P(m, p, variant) \wedge$$
$$dom(tr) = iNAT$$
$$\Rightarrow (\forall i \cdot \forall k \cdot (\exists j \cdot variant(tr(iaddj)) < variant(tr(i)) - mk\_int(k)) \vee$$
$$(\exists j \cdot variant(tr(iaddj)) \notin \mathbb{N}))$$

thm of correctness of Divergent_In_P:

$$\forall m, tr, variant, p \cdot variant \in STATE \to \mathbb{Z} \wedge m \in Machine(STATE, EVENT) \wedge$$
$$Machine\_WellCons(m) \wedge$$
$$check\_Machine\_Consistency(m) \wedge$$
$$IsATrace(m, tr) \wedge$$
$$TLDivergent\_In\_P(m, p, variant) \wedge$$
$$dom(tr) = iNAT$$
$$\Rightarrow (\exists i \cdot \forall j \cdot mk\_int(j) \geq mk\_int(i) \Rightarrow tr(j) \in p)$$

thm of correctness of Deadlock_Free_In_P:

$$\forall m, tr, variant, p \cdot variant \in STATE \to \mathbb{Z} \wedge m \in Machine(STATE, EVENT) \wedge$$
$$Machine\_WellCons(m) \wedge$$
$$check\_Machine\_Consistency(m) \wedge$$
$$IsATrace(m, tr) \wedge$$
$$TLDeadlock\_Free\_In\_P(m, p)$$
$$\Rightarrow (dom(tr) = iNAT \vee (\exists n \cdot n \in iNAT \wedge$$
$$tr \in \{i \mid mk\_int(i) \in 0..mk\_int(n)\} \to STATE \wedge tr(n) \notin p))$$

thm of correctness of Globally:

$$\forall m, tr, variant, p \cdot variant \in STATE \to \mathbb{Z} \wedge m \in Machine(STATE, EVENT) \wedge$$
$$Machine\_WellCons(m) \wedge$$
$$check\_Machine\_Consistency(m) \wedge$$
$$IsATrace(m, tr) \wedge$$
$$TLGlobally(m, p)$$
$$\Rightarrow (\forall i \cdot i \in dom(tr) \Rightarrow tr(i) \in p)$$

thm of correctness of Existence:

$$\forall m, tr, variant, p \cdot variant \in STATE \to \mathbb{Z} \wedge m \in Machine(STATE, EVENT) \wedge$$
$$Machine\_WellCons(m) \wedge$$
$$check\_Machine\_Consistency(m) \wedge$$
$$IsATrace(m, tr) \wedge$$
$$TLExistence(m, p, variant)$$
$$\Rightarrow (\forall i \cdot i \in dom(tr) \Rightarrow (\exists j \cdot mk\_int(j) \geq mk\_int(i) \wedge j \in dom(tr) \wedge tr(j) \in p))$$

thm of correctness of Until:

$$\forall m, tr, variant, p1, p2 \cdot variant \in STATE \to \mathbb{Z} \wedge m \in Machine(STATE, EVENT) \wedge$$
$$Machine\_WellCons(m) \wedge$$
$$check\_Machine\_Consistency(m) \wedge$$
$$IsATrace(m, tr) \wedge$$
$$TLUntil(m, variant, p1, p2)$$
$$\Rightarrow (\forall i \cdot i \in dom(tr) \wedge tr(i) \in p1$$
$$\Rightarrow (\exists j \cdot mk\_int(j) \geq mk\_int(i) \wedge j \in dom(tr) \wedge tr(j) \in p2 \wedge$$
$$(\forall k \cdot k \in mk\_int(i)..(mk\_int(j) - 1) \Rightarrow tr(mk\_iNAT(k)) \in p1)))$$

thm of correctness of Progress:

$$\forall m, tr, variant, p1, p2, p3 \cdot variant \in STATE \to \mathbb{Z} \wedge m \in Machine(STATE, EVENT) \wedge$$
$$Machine\_WellCons(m) \wedge$$
$$check\_Machine\_Consistency(m) \wedge$$
$$IsATrace(m, tr) \wedge$$
$$TLProgress(m, variant, p1, p2, p3)$$
$$\Rightarrow (\forall i \cdot i \in dom(tr) \wedge tr(i) \in p1$$
$$\Rightarrow (\exists j \cdot mk\_int(j) \geq mk\_int(i) \wedge j \in dom(tr) \wedge tr(j) \in p2))$$

thm of correctness of Persistence:

$$\forall m, tr, variant, p \cdot variant \in STATE \to \mathbb{Z} \land m \in Machine(STATE, EVENT) \land$$
$$Machine\_WellCons(m) \land$$
$$check\_Machine\_Consistency(m) \land$$
$$IsATrace(m, tr) \land$$
$$TLPersistence(m, p, variant)$$
$$\Rightarrow (\exists i \cdot i \in dom(tr) \land (\forall j \cdot mk\_int(j) \geq mk\_int(i) \land j \in dom(tr) \Rightarrow tr(j) \in p))$$

END