In the program

\texttt{chan c: int c?}

(a) add the time spent waiting for input according to the transit time measure.

(b) including the time (from part (a)), rewrite the program without using \texttt{chan} or \texttt{?}, and simplify as much as possible.

After trying the question, scroll down to the solution.
(a) add the time spent waiting for input according to the transit time measure.

\[ \text{chan } c: \text{in} \rightarrow t := t^+(F_r + 1). \quad c? \]

(b) including the time (from part (a)), rewrite the program without using \text{chan} or \text{?}, and simplify as much as possible.

\[ \text{chan } c: \text{in} \rightarrow t := t^+(F_r + 1). \quad c? \]

= \[ \exists M, F, r, r', w, w'. \ (\forall i, j: \text{nat} \ i \leq j \Rightarrow t \leq F_i \leq F_j \leq t') \land r = w = 0 \]
\[ \land (t := t^+(F_r + 1). \ r := r + 1) \]

replace final assignment

= \[ \exists M, F, r, r', w, w'. \ (\forall i, j: \text{nat} \ i \leq j \Rightarrow t \leq F_i \leq F_j \leq t') \land r = w = 0 \]
\[ \land (t := t^+(F_r + 1). \ r' := r + 1 \land w' = w \land t' = t) \]

substitution law

= \[ \exists M, F, r, r', w, w'. \ (\forall i, j: \text{nat} \ i \leq j \Rightarrow t \leq F_i \leq F_j \leq t') \land r = w = 0 \]
\[ \land r' = r + 1 \land w' = w \land t' = t^+(F_{r'} + 1) \]

one-point law twice

= \[ \exists F \ (\forall i, j: \text{nat} \ i \leq j \Rightarrow t \leq F_i \leq F_j \leq t') \land t' = t^+(F_0 + 1) \]

one-point and unused quantifiers

= \[ t' \geq t \]