Let \( a \) and \( b \) be binary interactive variables. Define
\[
\text{loop} = \text{if } b \text{ then loop else ok fi}
\]
Add a time variable according to any reasonable measure, and then express
\[
b := \bot \parallel \text{loop}
\]
as an equivalent program but without using \( \parallel \).

The left process owns \( b \). Variable \( a \) could belong to either process; let's give it to the right process. Let assignment take time 1. Then the left process is
\[
\neg \varphi(1) \land \tau' = t + 1
\]
Add recursive time to \( \text{loop} \), and the right process is
\[
\text{loop} = \text{if } b \varphi t \text{ then } t := t + 1 . \text{loop else ok fi}
\]
\[\text{unroll}\]
\[
\text{loop} = \text{if } b \varphi t \text{ then } t := t + 1 . \text{loop else ok fi}
\]
\[\text{unroll}\]
\[
\text{loop} = \text{if } b \varphi t \text{ then } t := t + 1 . \text{if } b \varphi t \text{ then } t := t + 1 . \text{loop else ok fi else ok fi}
\]
Substitution Law
\[
The left process gives us \( \neg \varphi(1) \)
\]
The independent composition is
\[
\exists L, R: \neg \varphi(1) \land t \varphi L = t + 1 \land a t \varphi R = a t \land \text{if } b \varphi t \text{ then } t \varphi R = t + 1 \text{ else } t \varphi R = t \fi
\]
\[\text{The left process takes time 1 and the right process takes time 0 or 1, so the maximum is 1}\]
\[
\neg \varphi(1) \land a(t + 1) = a t \land \tau' = t + 1
\]
We no longer have an independent composition, so \( a \) and \( b \) are both variables
\[
b := \bot
\]