A Security Protocol Animator Tool for AVISPA

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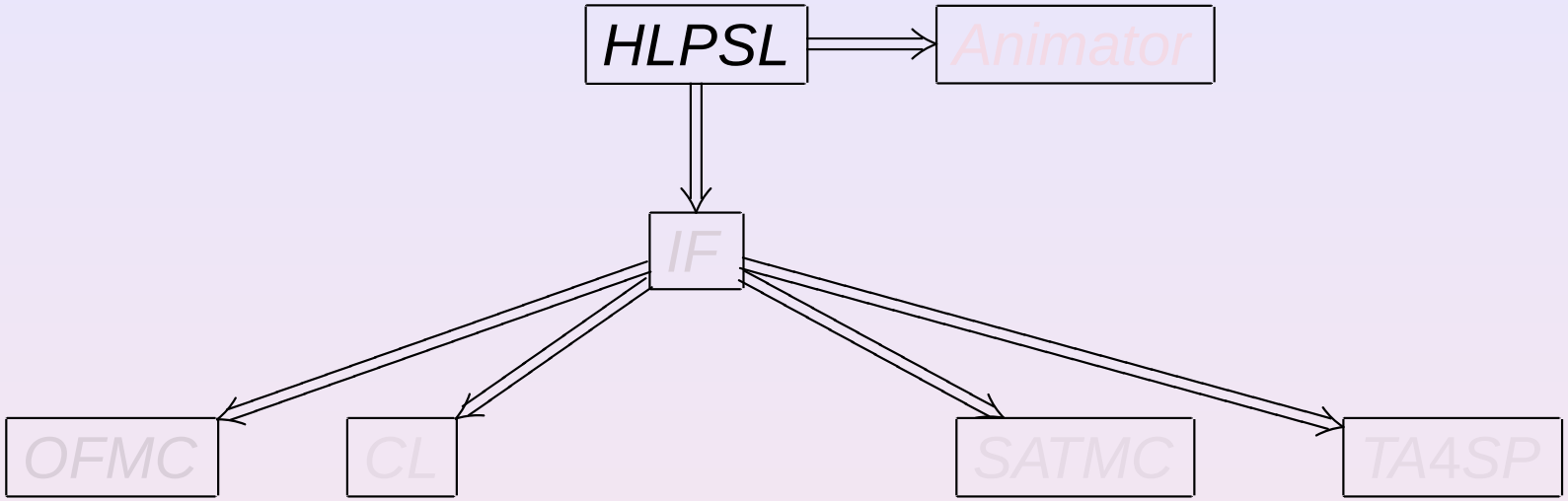
The Need for a protocol animator in the AVISPA System

Avispa project

- AVISPA is a verification tool for cryptographic protocols.
- High Level Protocol Specification Language (HLPSL).
- Ability to use different techniques on the same protocol specification.

The Need for a protocol animator in the AVISPA System



Avispa tools

1. On-the-Fly Model-Checker (OFMC)
2. Constraint-Logic-based model-checker (CL)
3. SAT-based Model-Checker (SATMC)
4. Tree Automata Automatic Approximations for the Analysis of Security Protocol (TA4SP)

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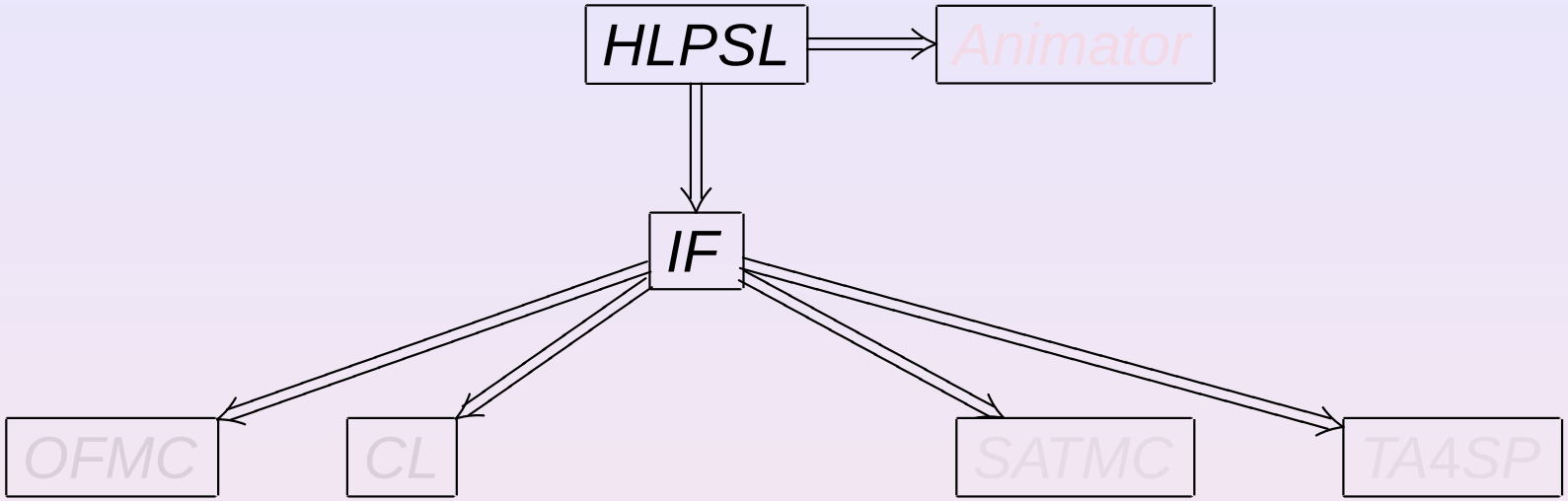

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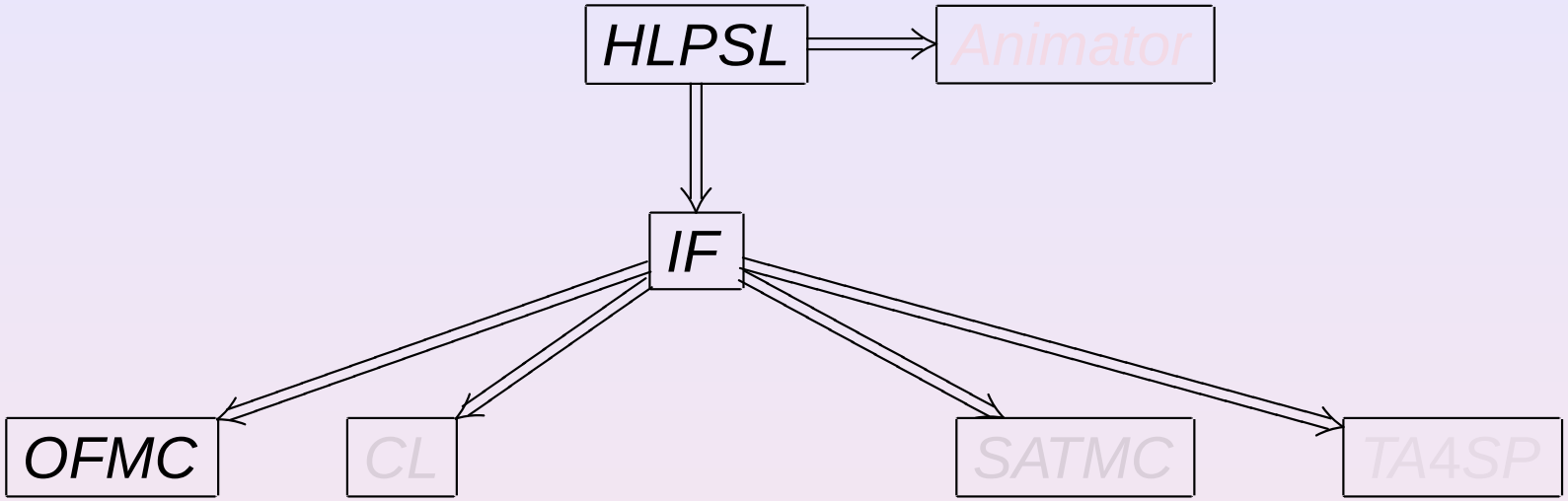

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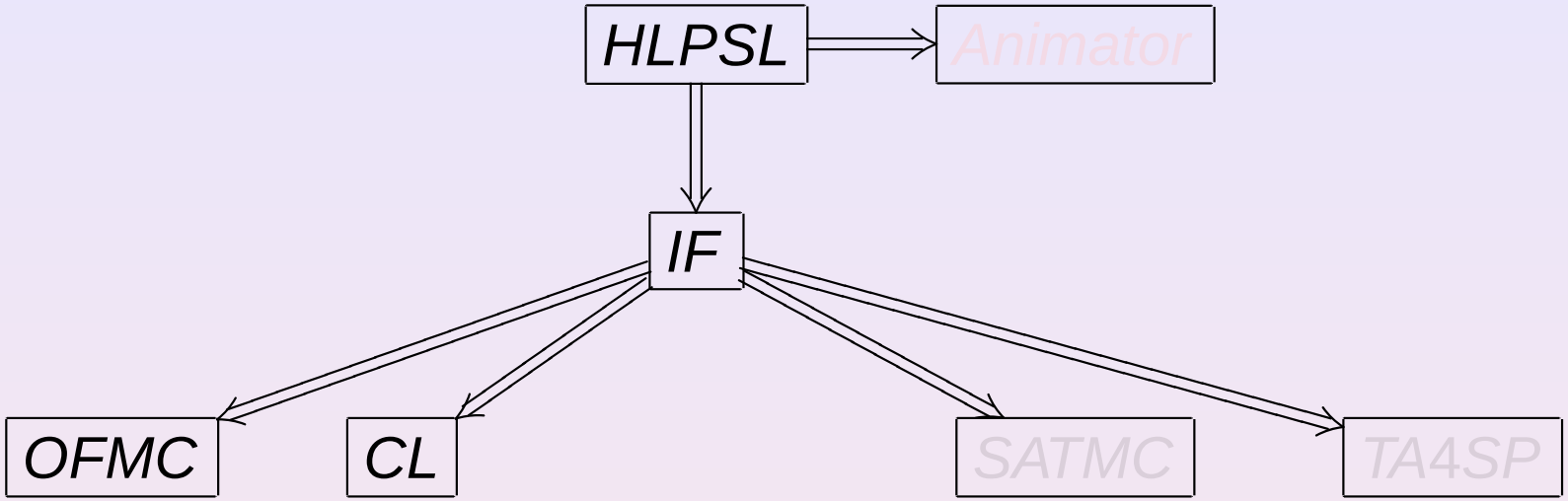

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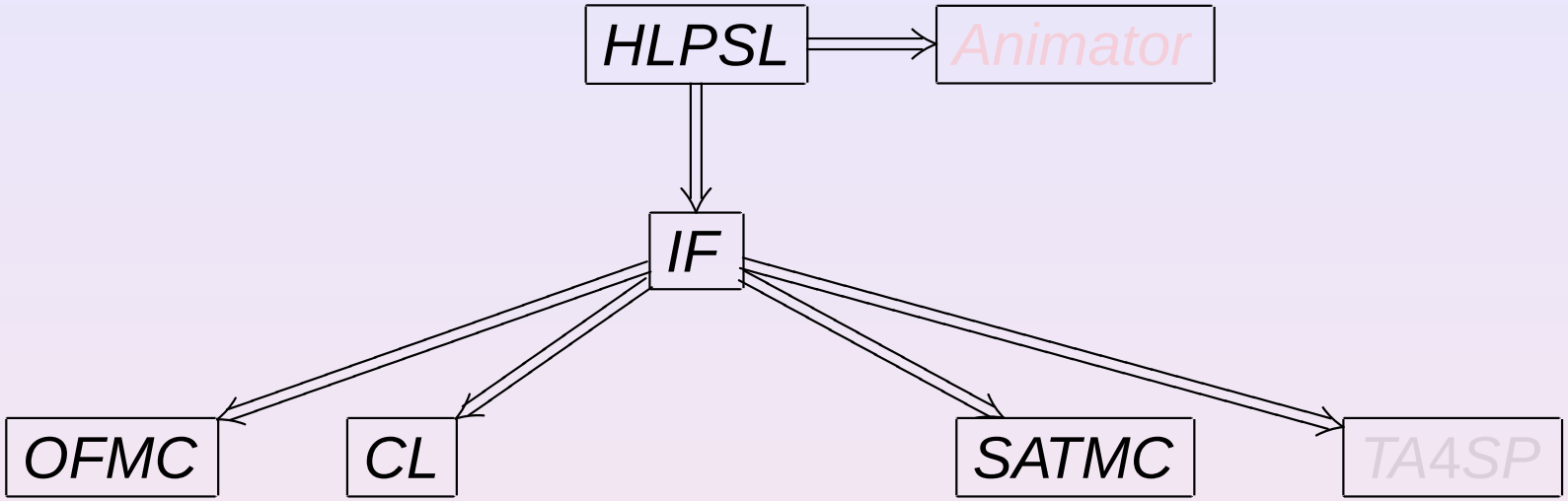

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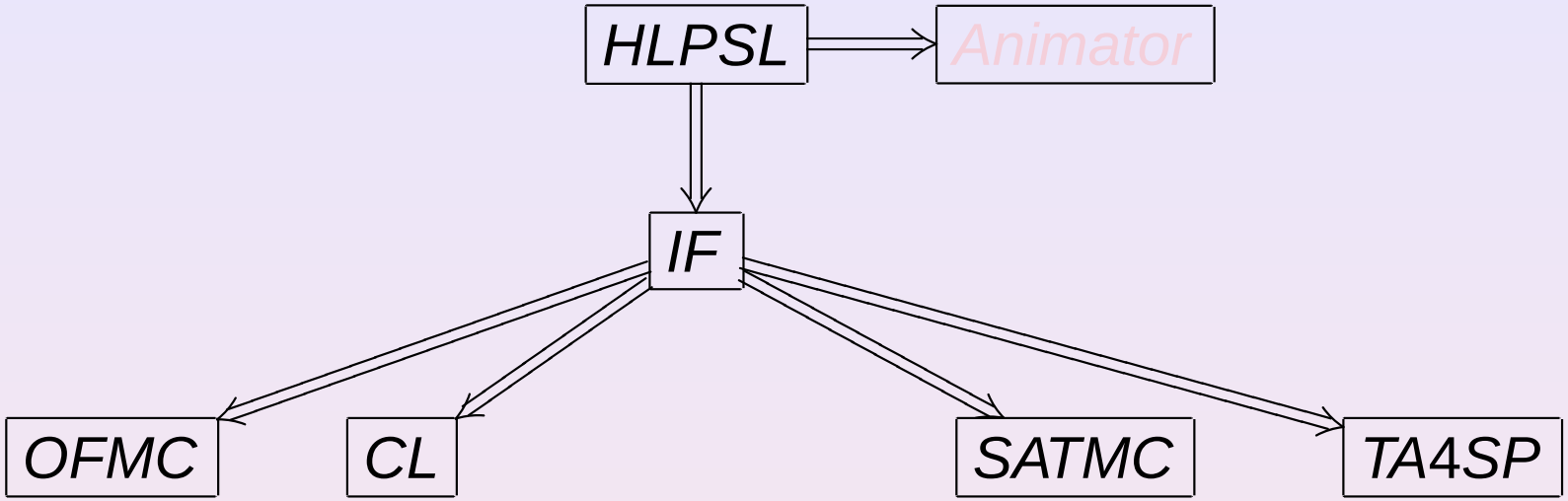

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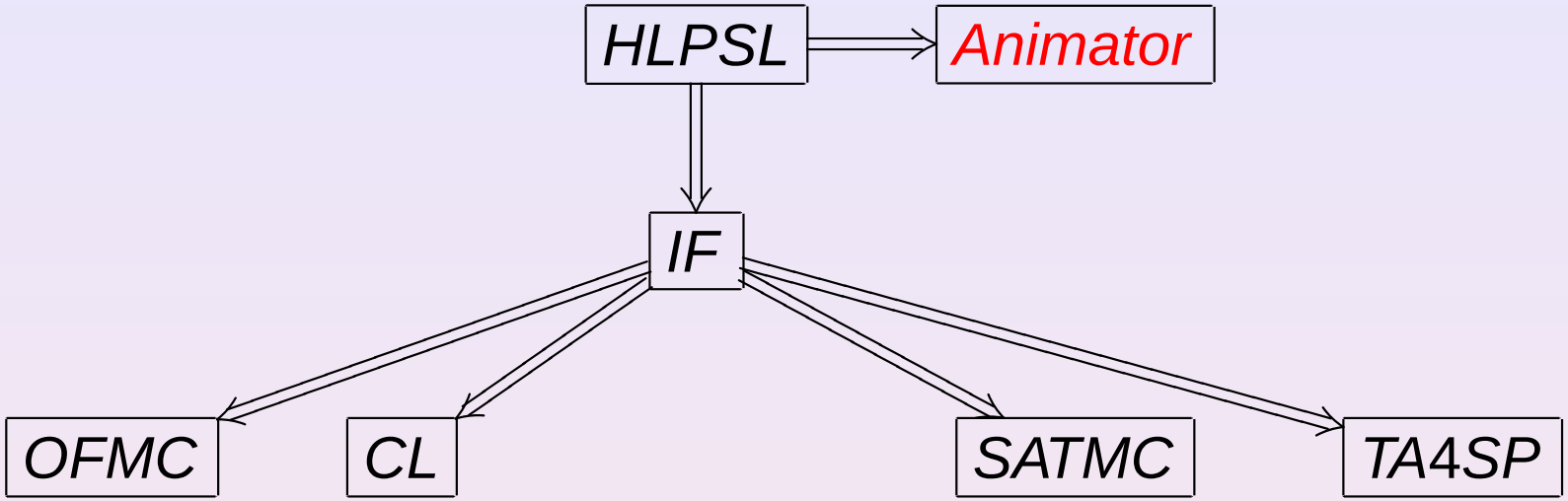

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The Need for a protocol animator in the AVISPA System

```
role a(...)
 State=0 ∧ RCV(start)
  =|> State’:=1 ∧ Na’:=new()
      ∧ SND({Na’.A}_Kb)
 State=1 ∧ RCV(Na.Nb’_Ka)
  =|> State’:=2
       ∧ SND({Nb’}_Kb)
role b(...)
 State=0 ∧ RCV({Na’.A’}_Kb)
  =|> State’:=1 ∧ Nb’:=new()
      ∧ SND({Na’.Nb}_Ka)
  State=1 ∧ RCV({Nb}_Kb)
  =|> State’:=2
```

$$A \rightarrow B : \{Na, A\}_{Kb}$$
$$A \rightarrow B : \{Na, Nb\}_{Ka}$$
$$A \rightarrow B : \{Nb\}_{Kb}$$

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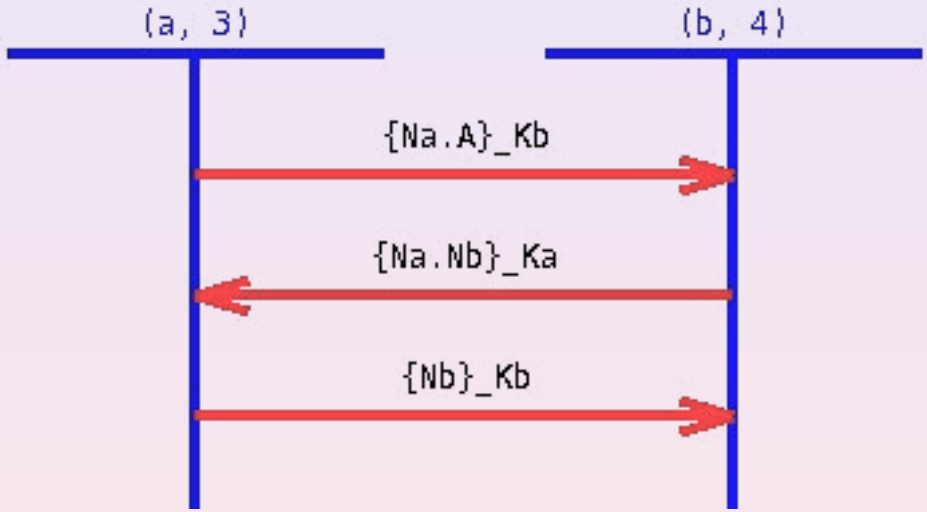

The Need for a protocol animator

- ⇒ produce interactively MSC from an HLPSL specification.

The protocol animator

Protocol specification

- Protocol specifications in HLPSL are divided into roles.

Example (Protocol specification)

- Roles declaration

```
role a(A : agent...)
 State=0 ∧ RCV(start)
  =|> State’:=1 ∧ Na’:=new() ∧ SND({Na’.A}_Kb)
 State=1 ∧ RCV(Na.Nb’_Ka) =|> State’:=2 ∧ SND({Nb’}_Kb)
role b(B : agent...)
 State=0 ∧ RCV({Na’.A’}_Kb)
  =|> State’:=1 ∧ Nb’:=new() ∧ SND({Na’.Nb}_Ka)
  State=1 ∧ RCV({Nb}_Kb) =|> State’:=2
```

- Session declaration

```
role one_session(A, B : agent...)  composition
  a(A...)  ∧ b(B...)
```

- Scenario declaration

```
one_session(alice, bob...)∧one_session(charlie, dane...)
```

The protocol animator

Protocol specification

- Protocol specifications in HLPSL are divided into roles.

Example (Protocol specification)

- Roles declaration

```
role a(A : agent...)
 State=0 ∧ RCV(start)
  =|> State'=1 ∧ Na'=new() ∧ SND({Na'.A}_Kb)
 State=1 ∧ RCV(Na.Nb'_Ka) =|> State'=2 ∧ SND({Nb'}_Kb)
role b(B : agent...)
 State=0 ∧ RCV({Na'.A'}_Kb)
  =|> State'=1 ∧ Nb'=new() ∧ SND({Na'.Nb}_Ka)
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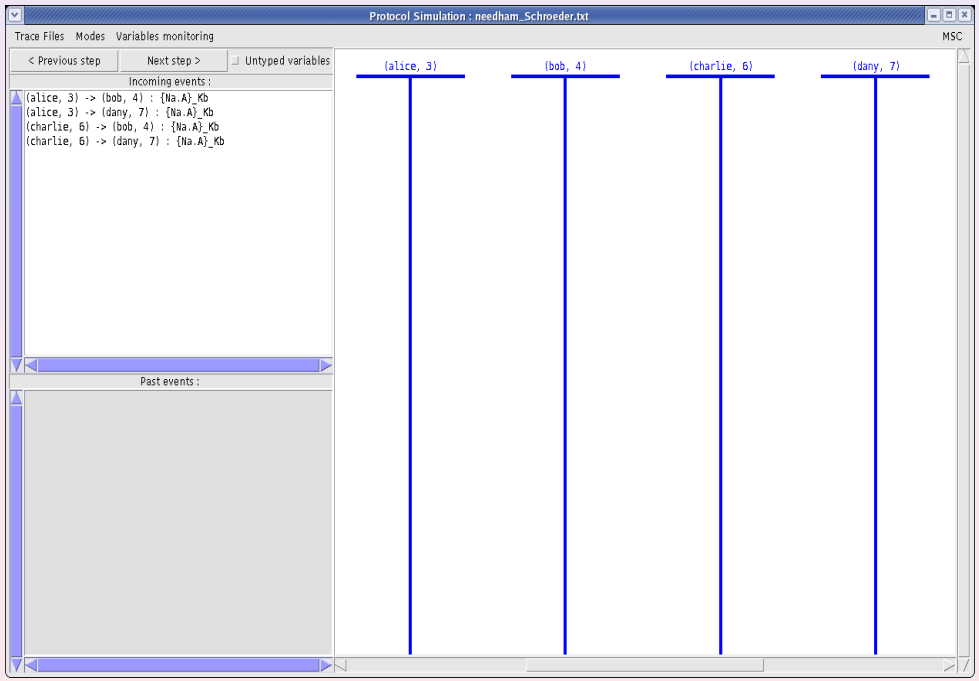
$$\texttt{one\_session(alice, bob...)} \wedge \texttt{one\_session(charlie, dane...)}$$



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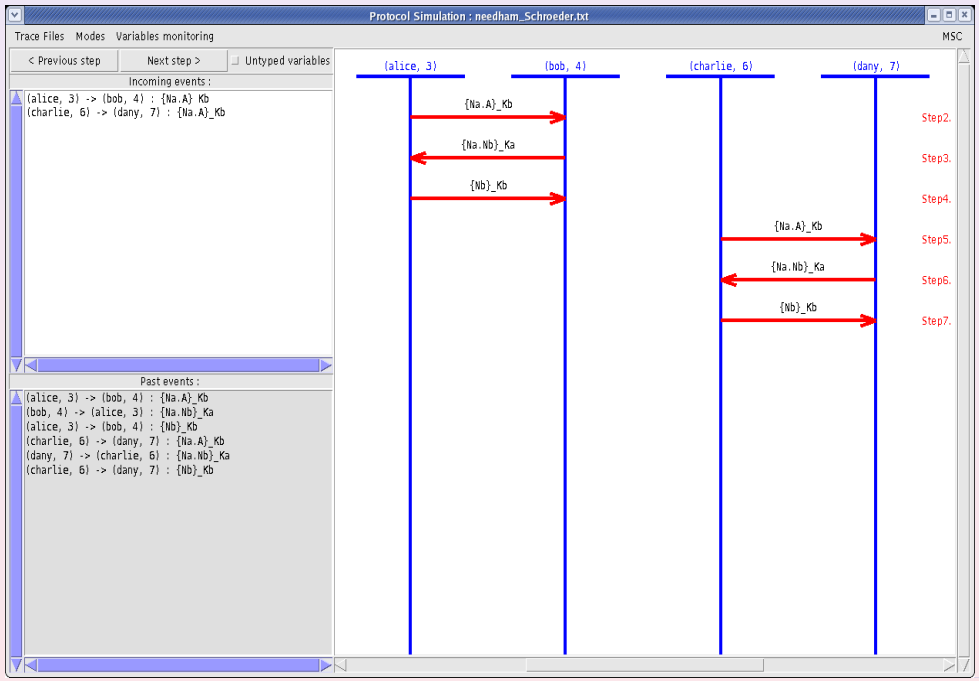

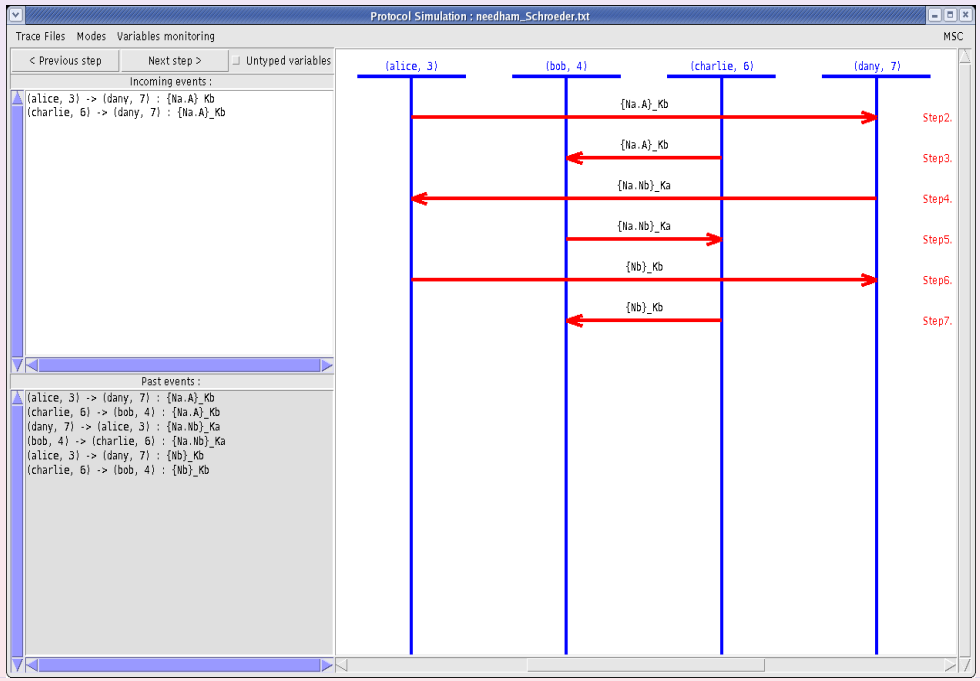

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The features of current version

- Full support of HLPSL
- Interactive construction of MSC guided by the user because of
  - non deterministic protocols
  - choices in interleaved sessions
- usual undo/redo in constructed MSCs
- MSCs import/export

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We have applied the animator to several protocols

- all the protocols of the AVISPA Library
- a new protocol developped by Thomson called User Supervised Device Pairing (USDP) for pairing two devices

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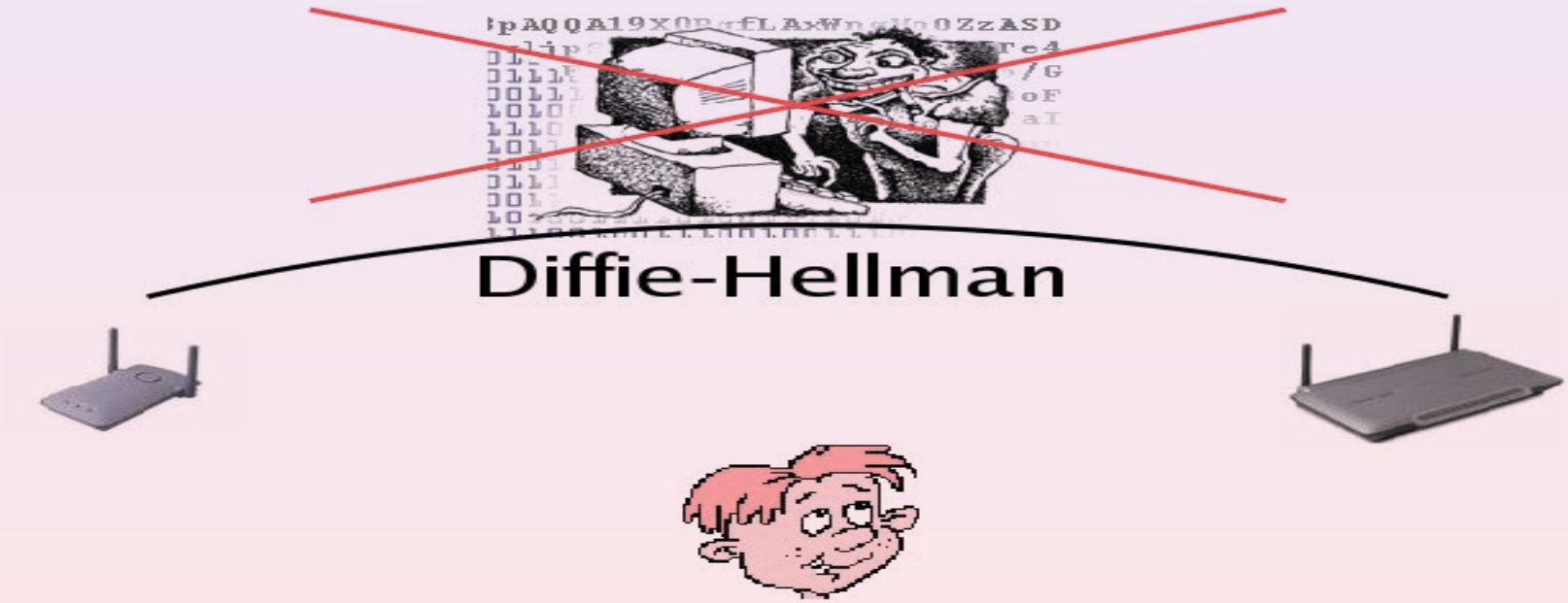

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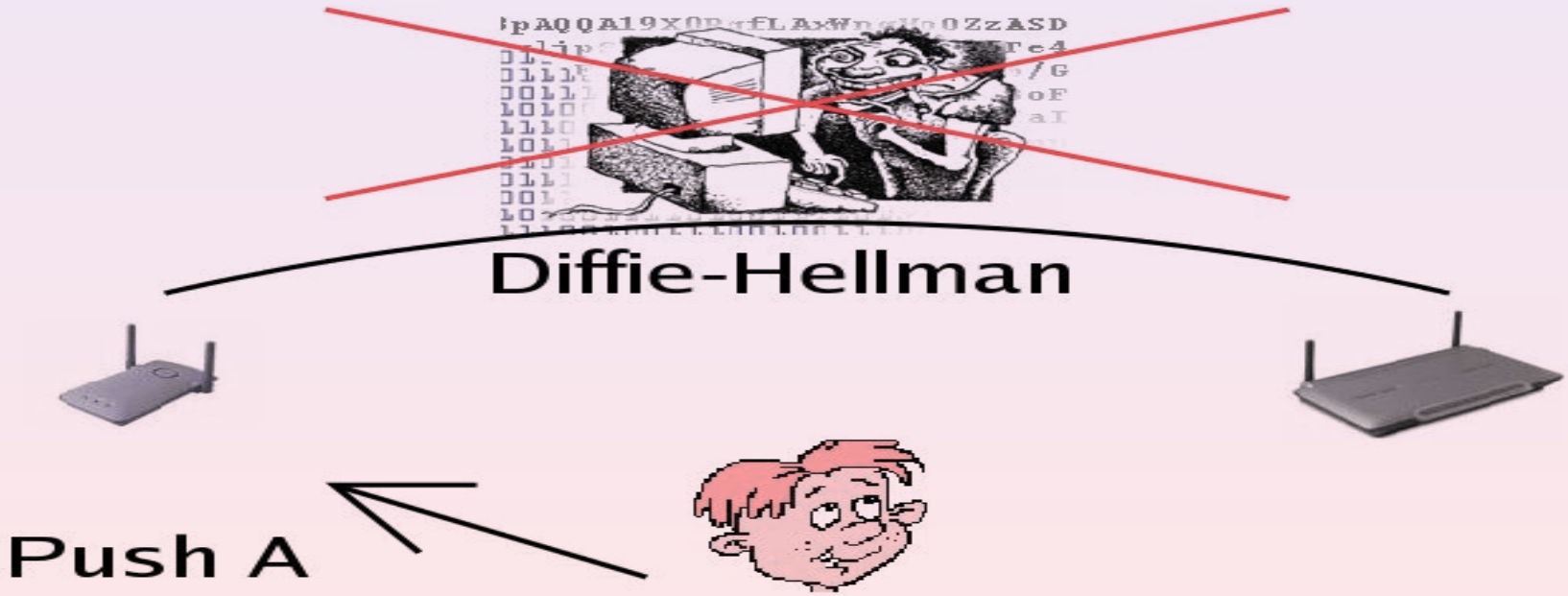

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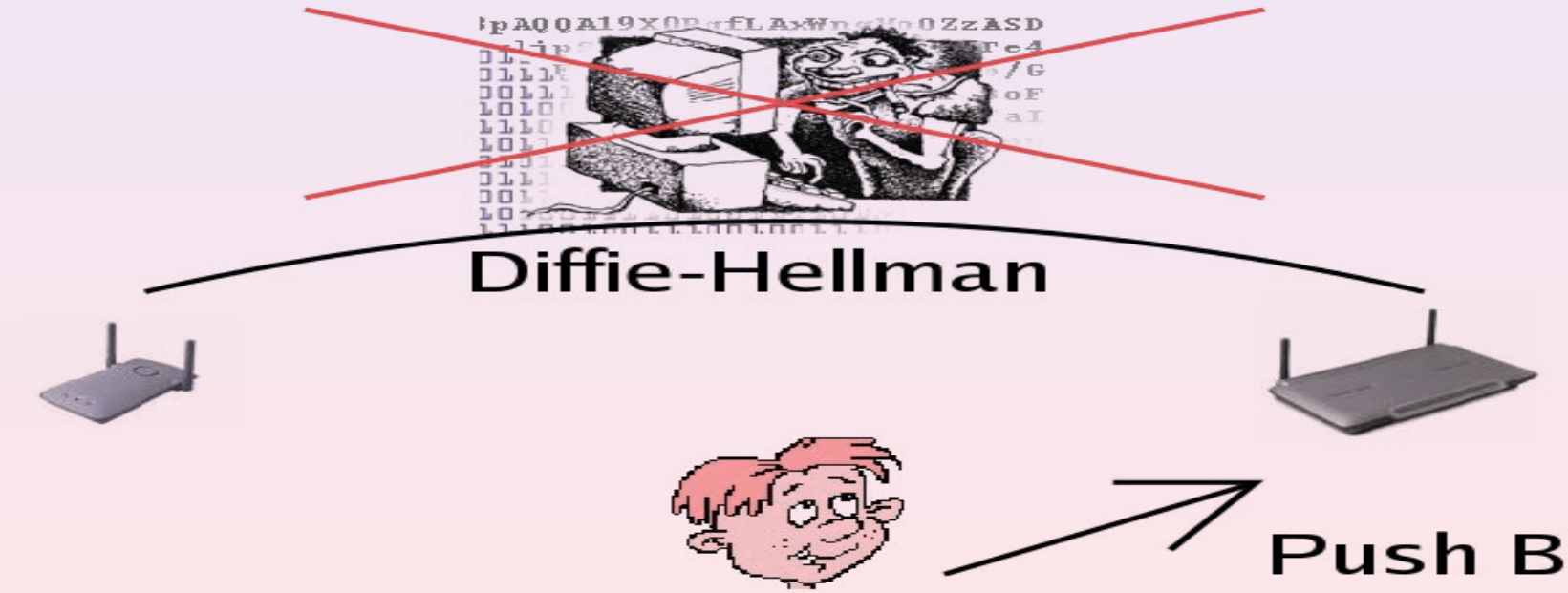
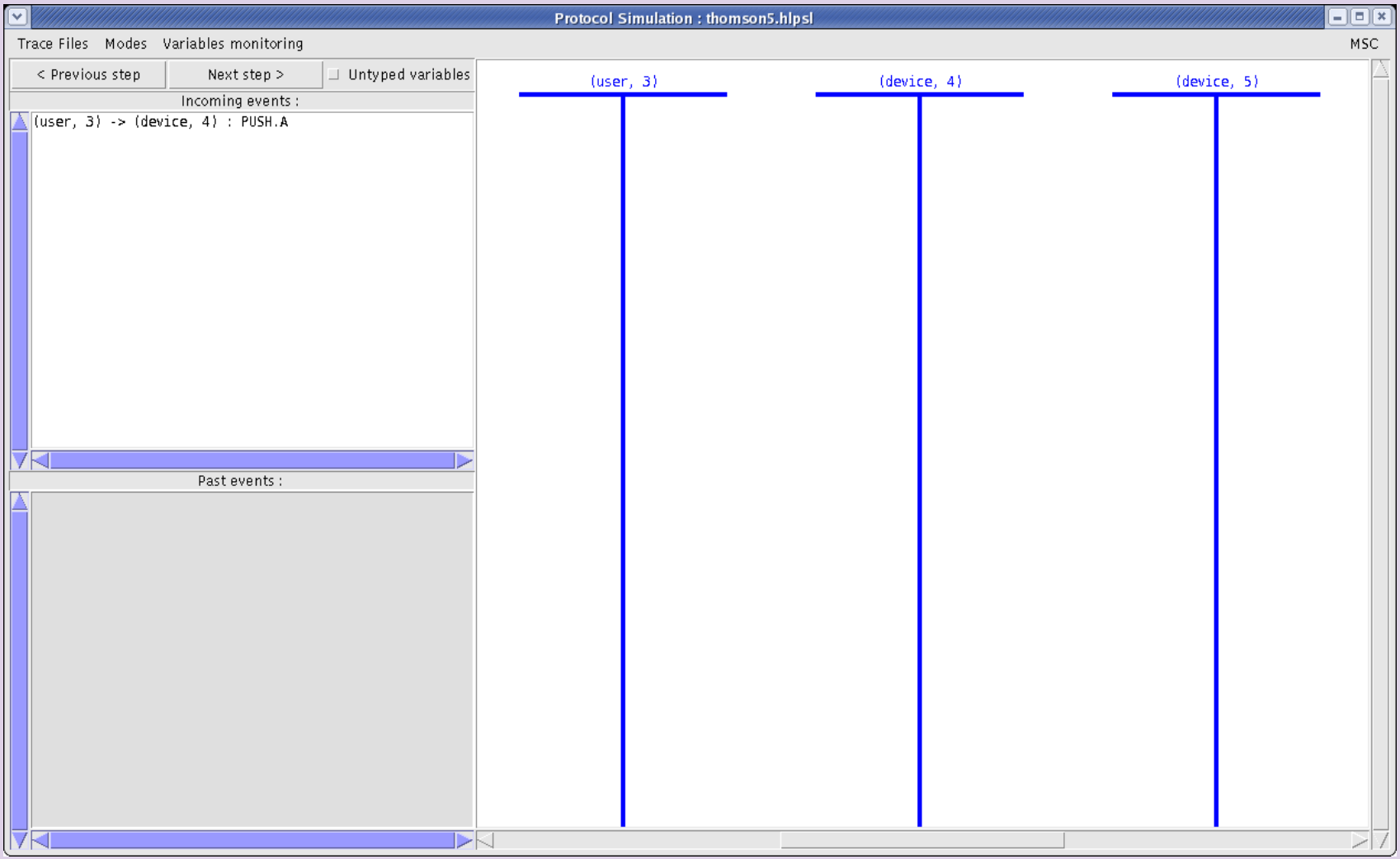


Experiments

An execution trace of Thomson's USDP protocol



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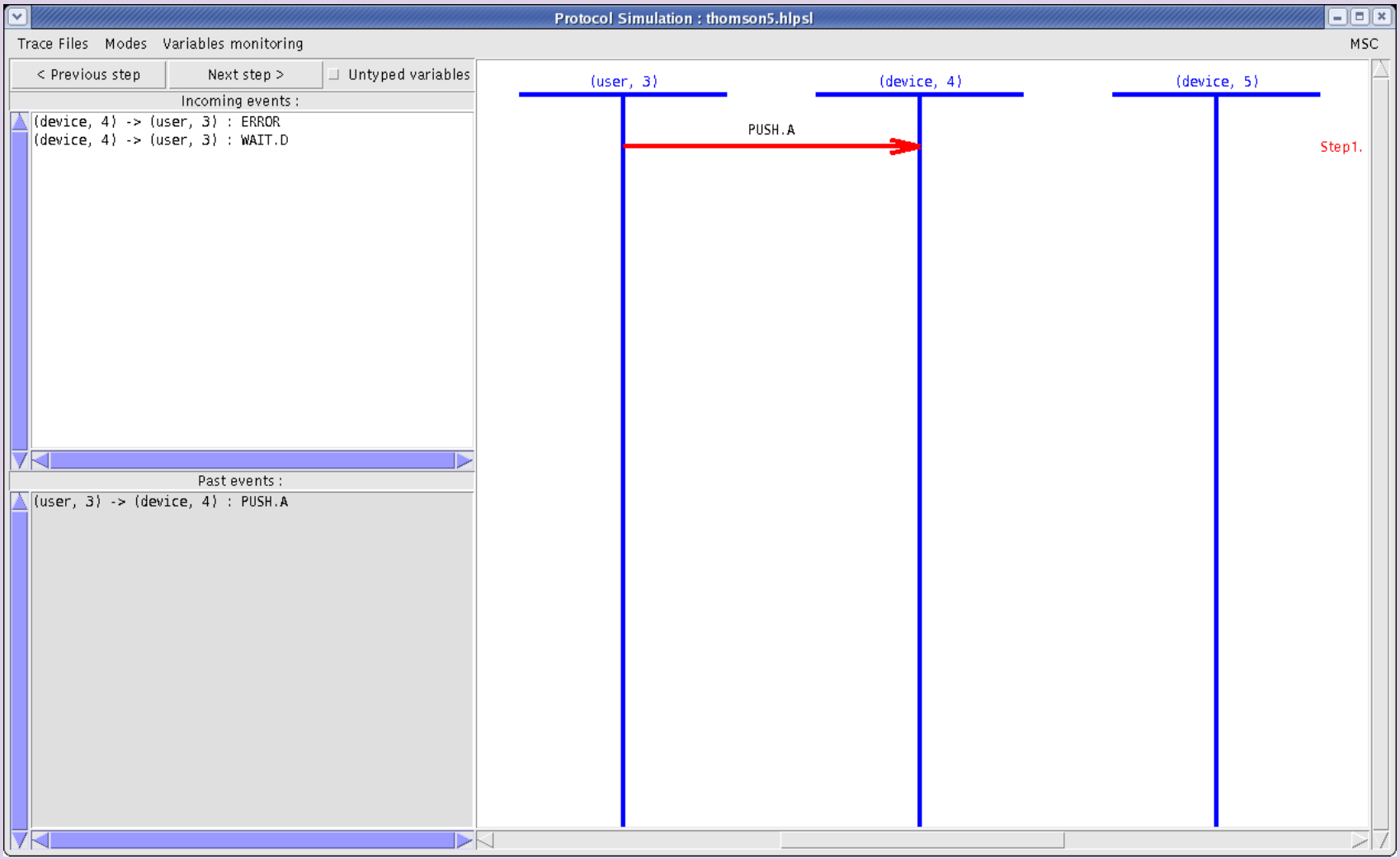

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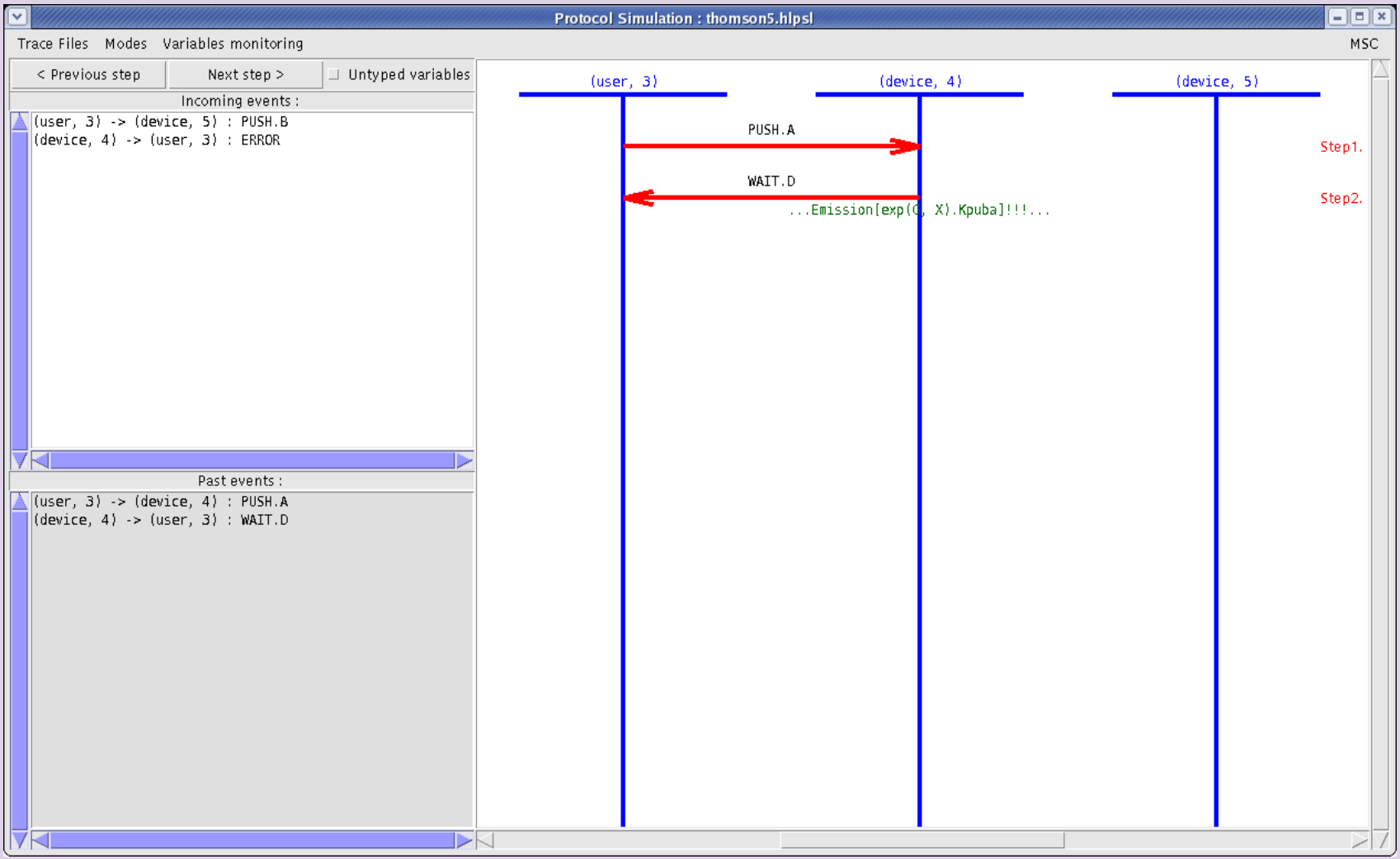

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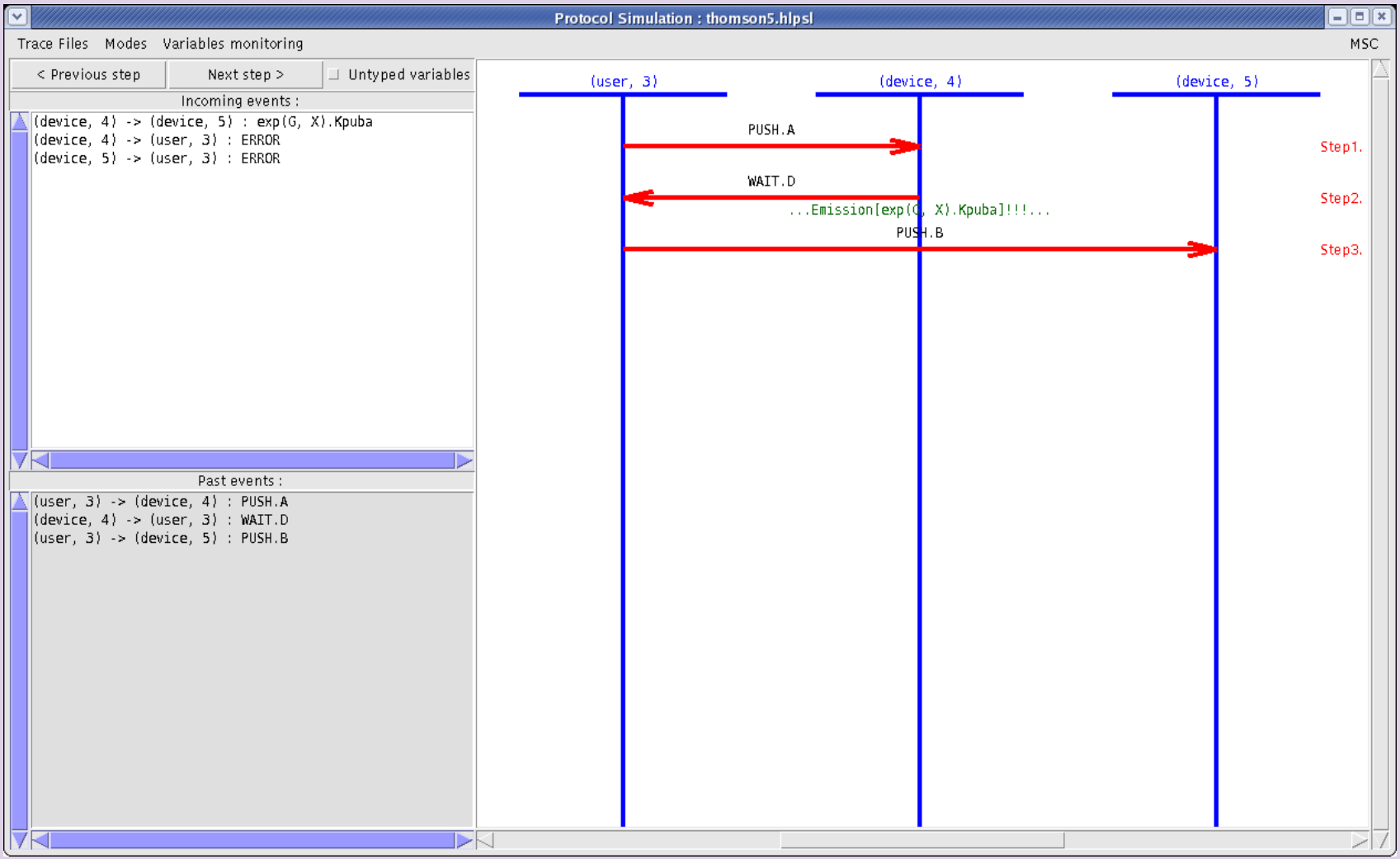

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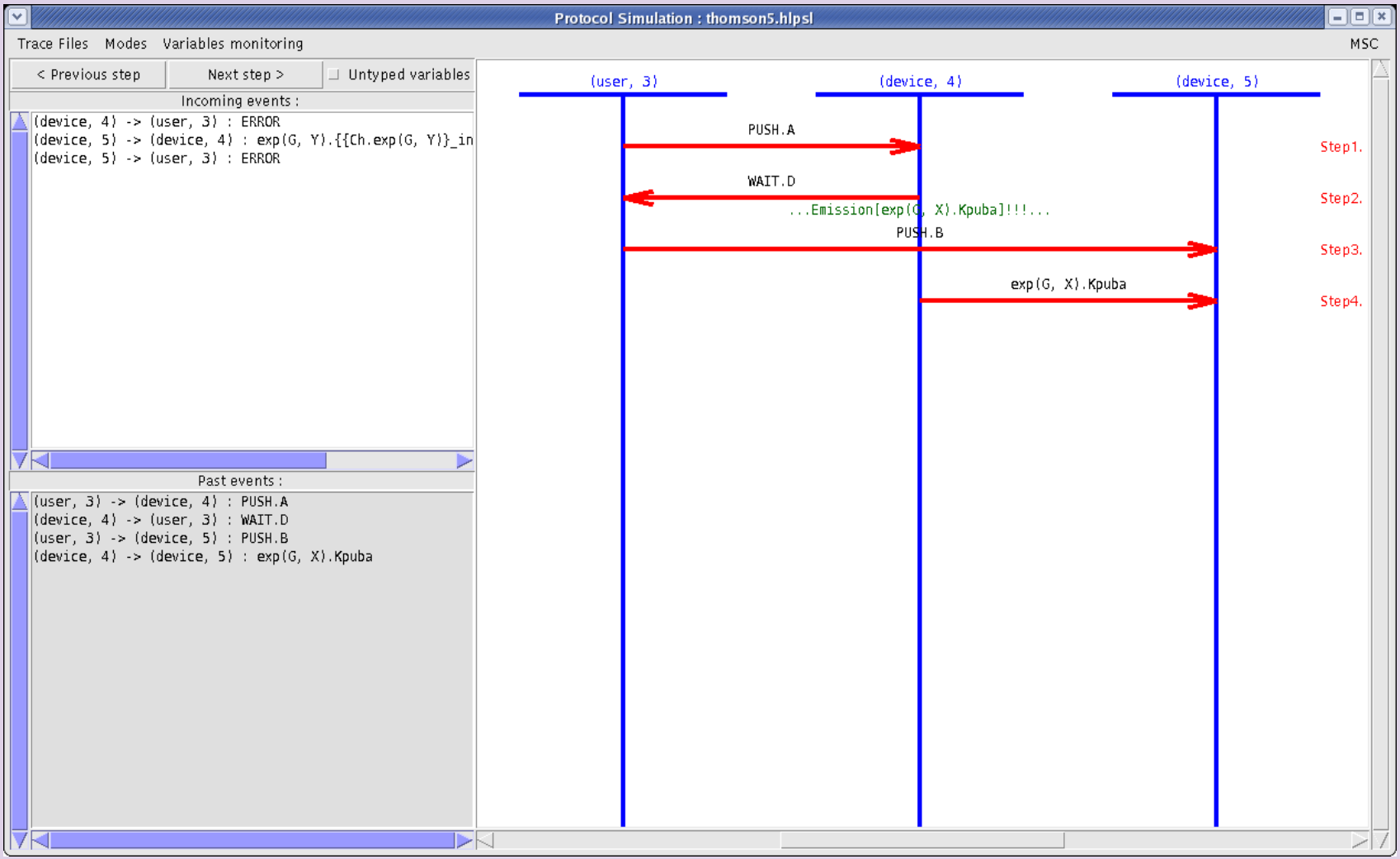

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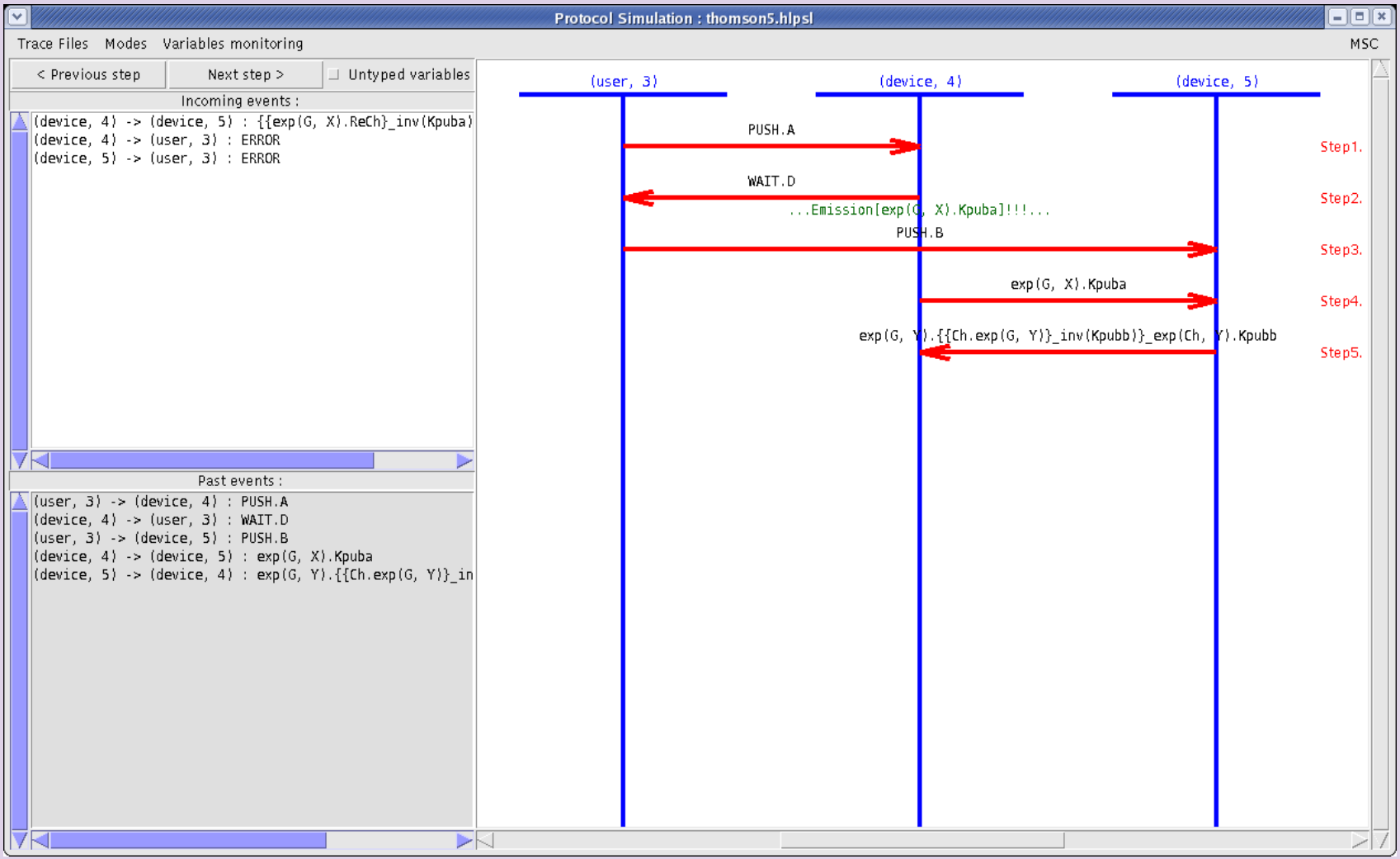

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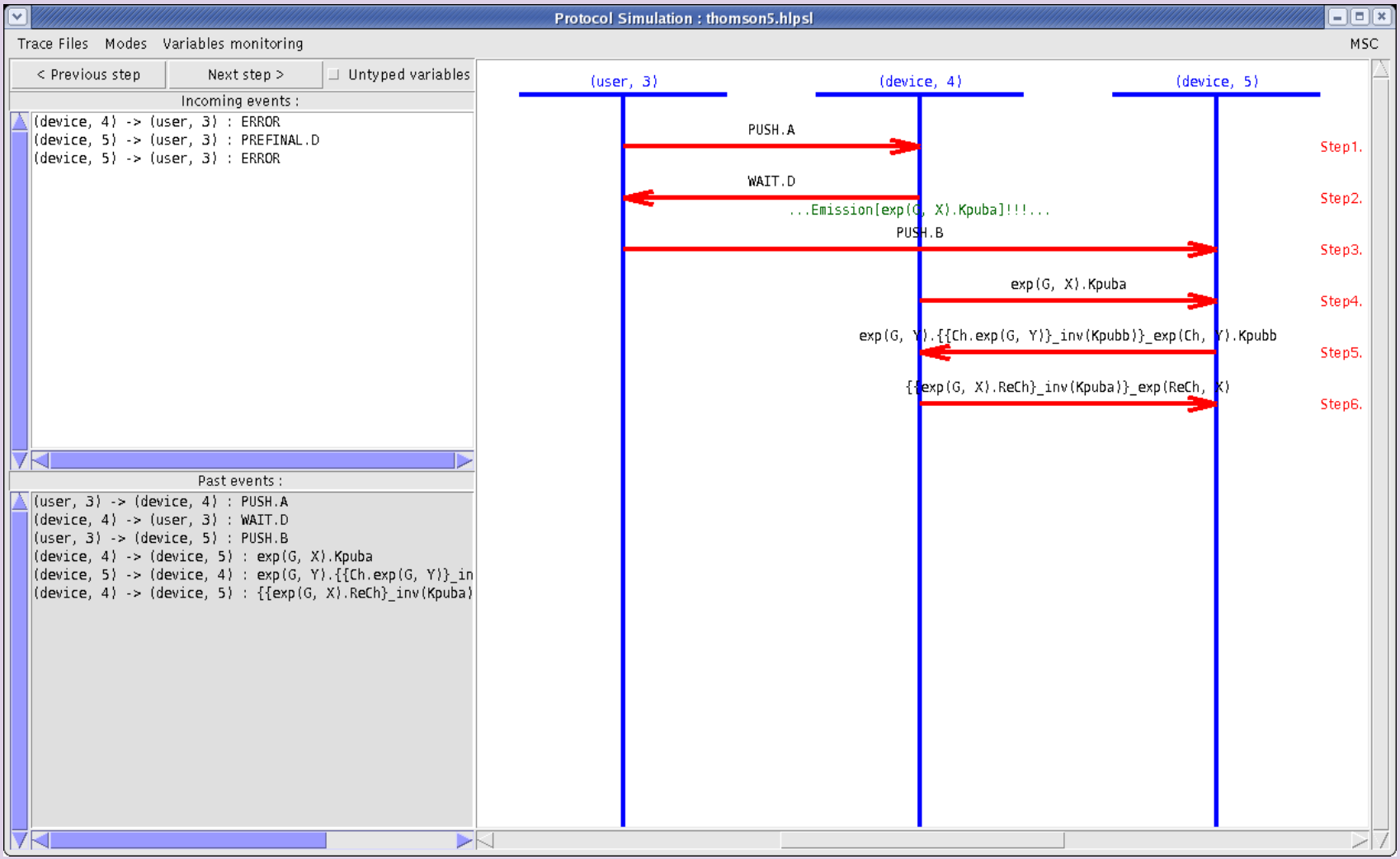

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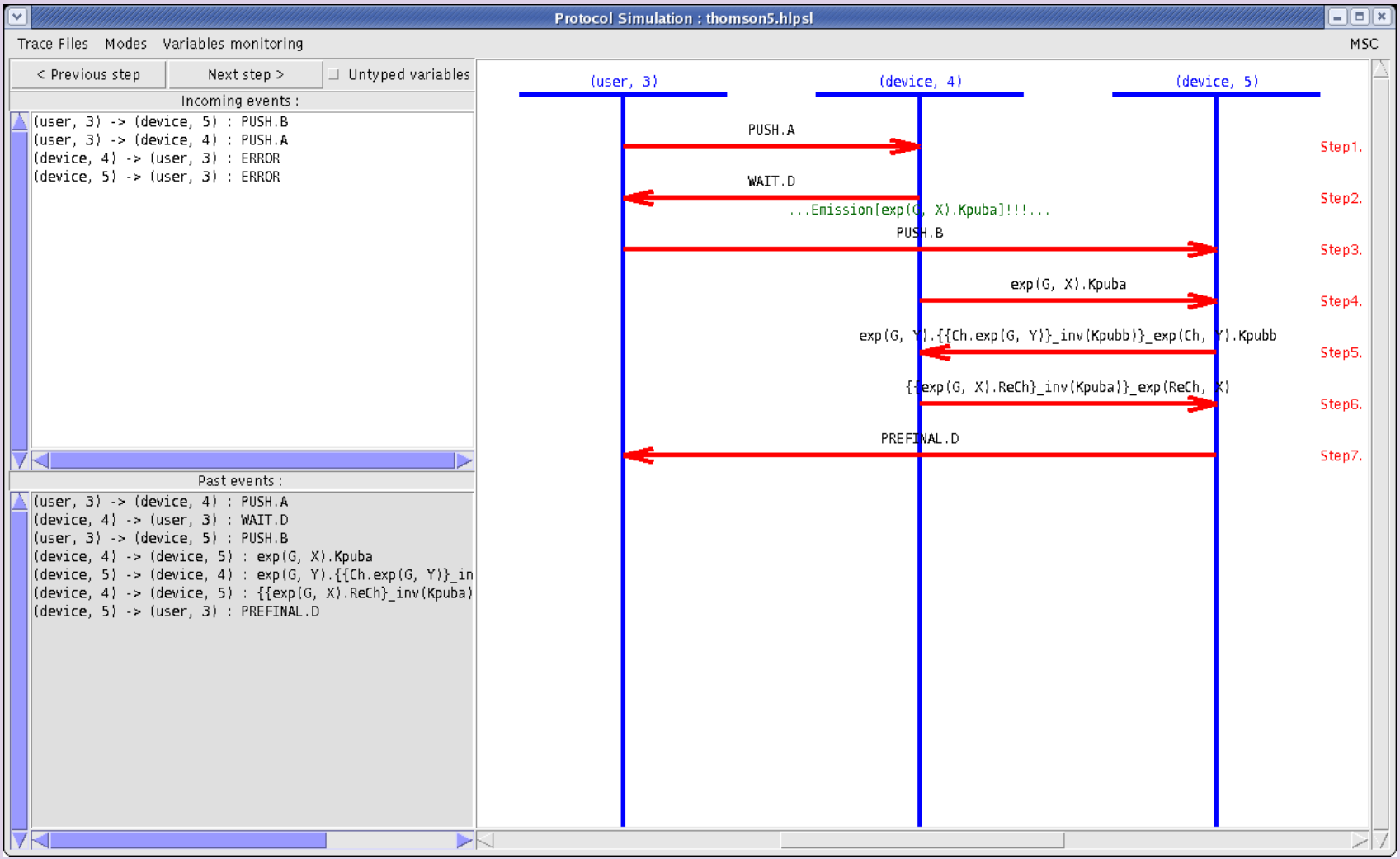

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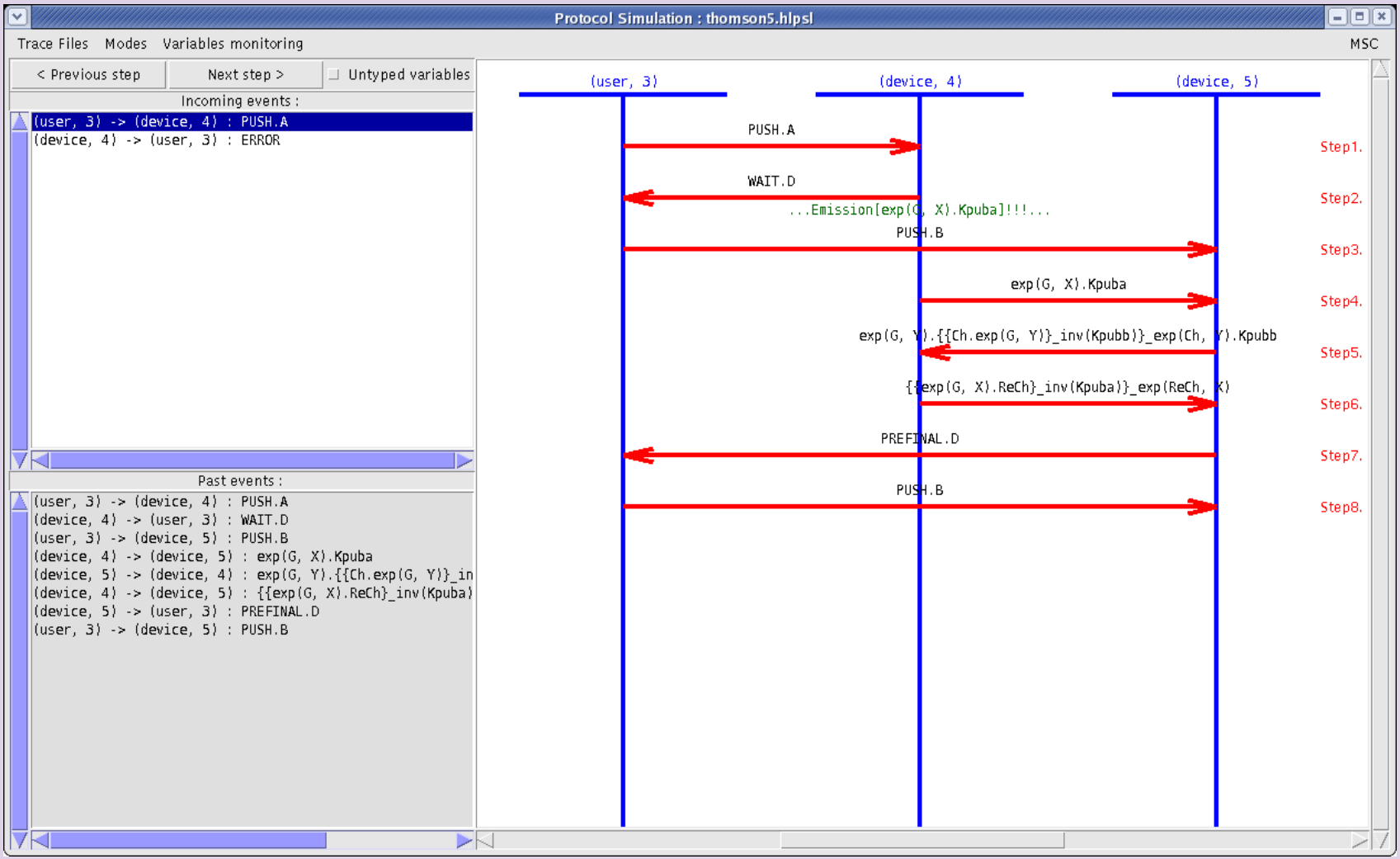

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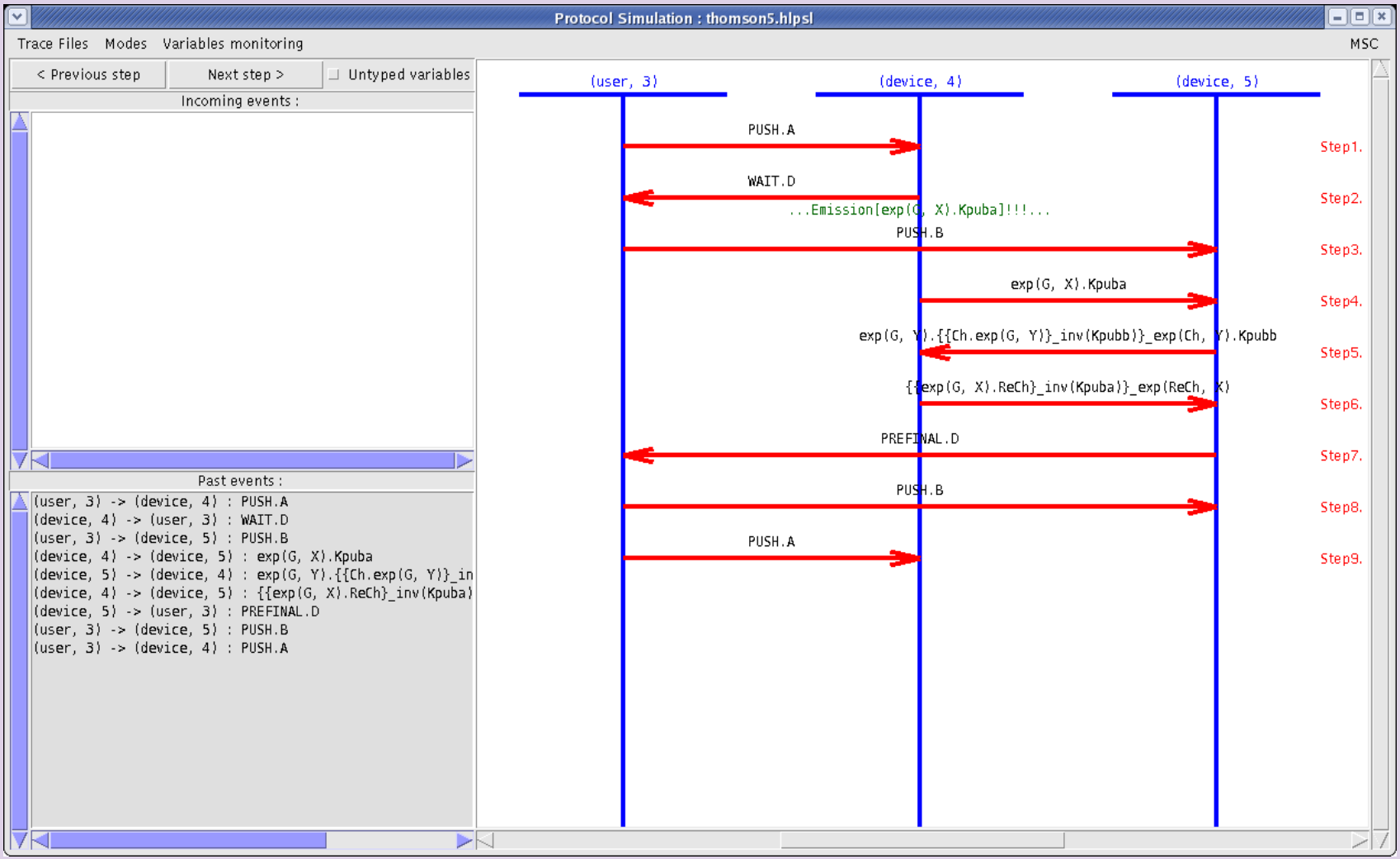

Futher Work

A correct treatment of mathematical functions

- This is not yet fully functional when messages include *exp*, *xor*.

Integration of a mode to replay interactively the attacks

- Execute an intruder role who receive, replay, and treat all messages sent by an agent.

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