MSR 3.0:

The Logical Meeting Point of Multiset Rewriting and Process Algebra

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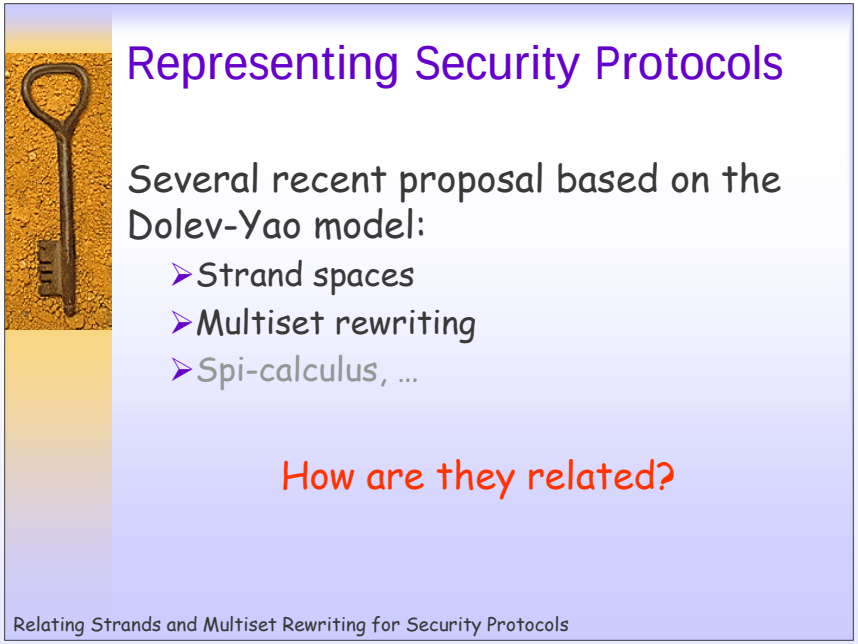
… 1st slide of my CSFW'00 talk …



- Since then
  - MSR ⇔ linear logic ⇔ strands
  - MSR 2.0
  - MSR ⇔ process algebra

MSR vs. PA

MSR

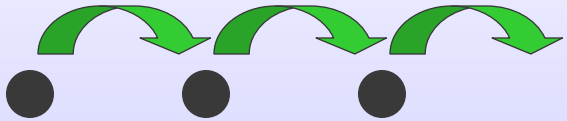
- NRL Prot. Analyzer, CAPSL/CIL, Paulson's approach, …

and Process Algebra

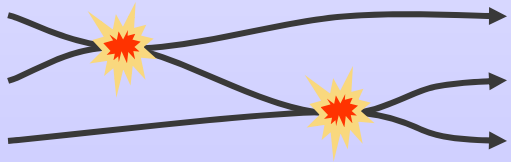
- Strand spaces, spi-calculus, other process-based lang.

operate in very different ways:

- State transitions



- Contact evolution



Representing Protocols

- MSR

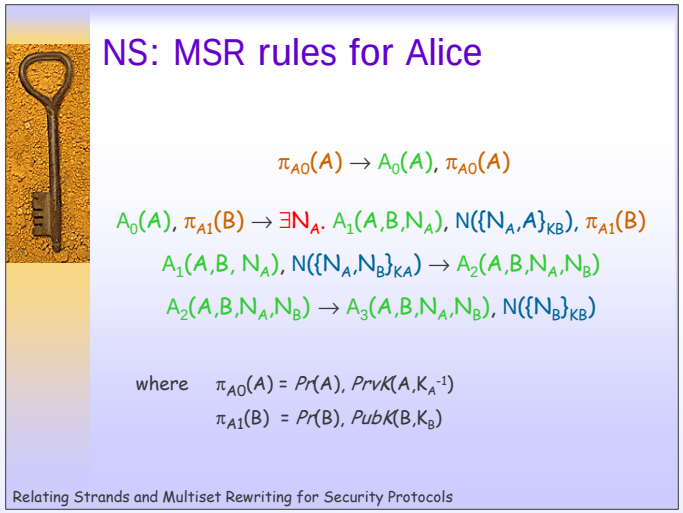
$$\left[\begin{array}{c} n \rightarrow a_1, n' \\ n'', a_1 \rightarrow a_2, n''' \\ \ldots \end{array}\right]$$

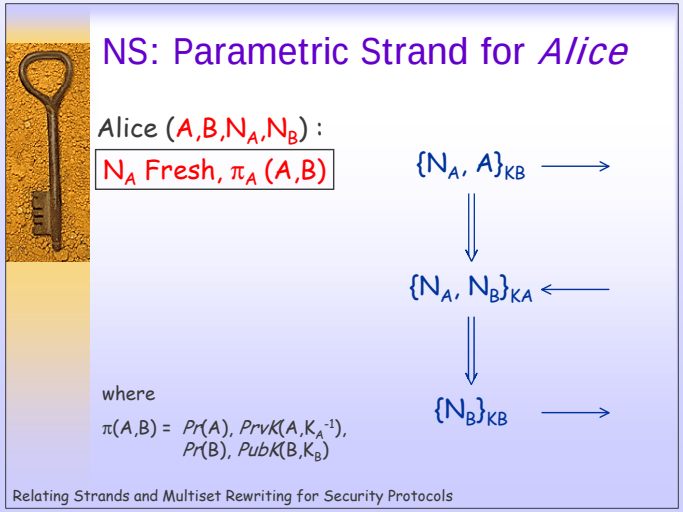
  - a_i pass control/data to the next rule

- PA

$$\underline{n}.n'.\underline{n''}.n'''.\ \ldots\ .0$$

  - Control is implicit





During Translation

- MSR → PA
  - Use a_i to piece process together
  - Besides that, very easy
- PA → MSR
  - Synthesize a_i
    - Not trivial for parameters
  - Come up with state

What Makes Encoding Hard?

Two activities

- Move between formalisms
- Move between paradigms

Analogy: translate Lisp to C

- Turn S-Expressions to structures
- Turn recursion into iteration

… but C supports recursion …

Extending MSR

Idea: devise an extension of MSR that brings it closer to PA

Benefits

- Simplifies translation (a lot)
- Internalizes paradigm shift
  - Independent from target formalism
  - Easier to understand
  - In-house optimizations

MSR 3.0

- … or higher-order MSR
- ω-multisets

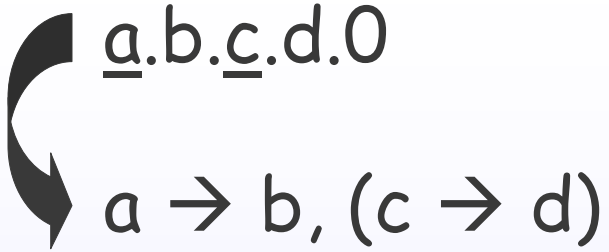
$$w ::= . \mid a,w \mid w \to w$$

- Computation

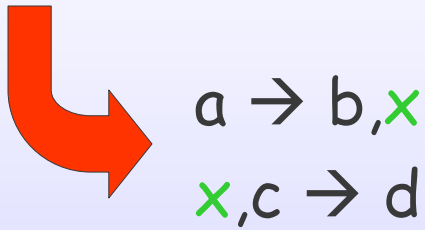
$$\frac{}{u,v,(u \to w) \;\Rightarrow\; v,w}$$

PA to MSR 1

- PA to MSR 3



- MSR 3 to MSR 1



  - Done completely within MSR
  - Done once and for all
  - Opportunity for optimization (FO setting)
    - Study of memory denial-of-service

MSR 3 to PA

- Easy but not as trivial
- Care is required
  - If we want a somewhat invertible translation

The Rest of the Story

… but there is more to PA

- ||, !, +, ν, …

- There is more to MSR 3
  - MSR 3 is linear logic in disguise
  - … more radically so than MSR 1