Protocol Derivation Assistant

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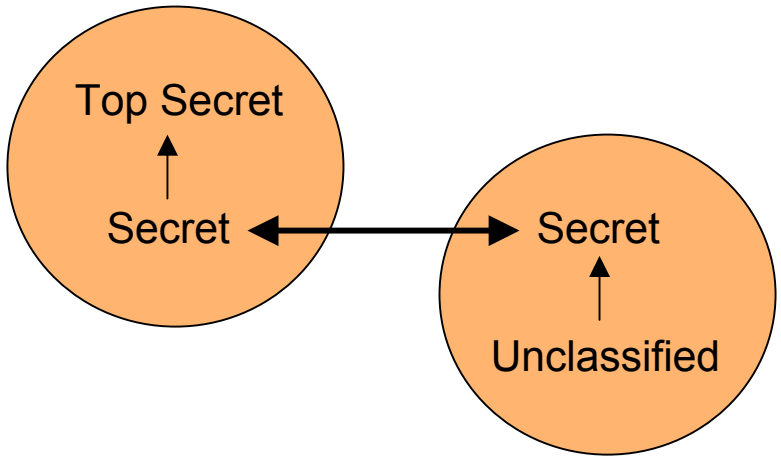
Problem

- networks are complex
  - regulated by protocols
- protocols are complex
  - require incremental approach

Problem

… but

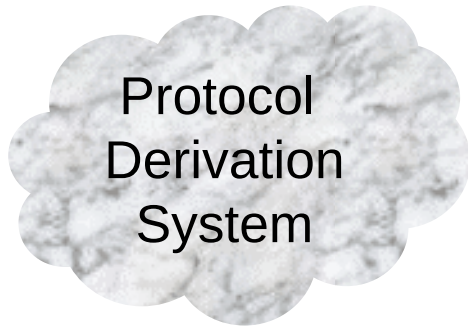
- security is not preserved under
  - refinement
  - composition



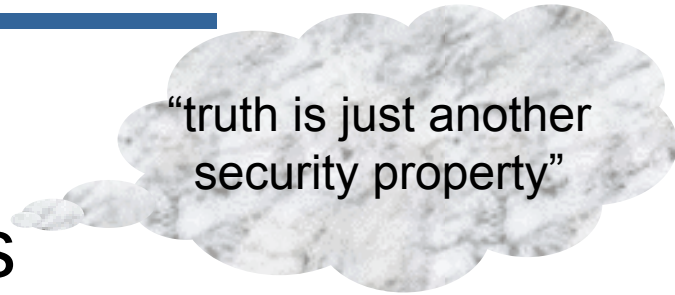
Solution

- annotate processes by properties
  - “distributed hoare logic”
- develop
  - processes and
  - properties

  in parallel



Protocol Derivation System



Protocols

- components
- refinements
- transformations

Proofs

- axioms
- proof rules
- proof transformations

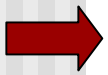
- **derivation patterns**

Protocol Derivation Assistant

- protocol development
- instance checking
- code generation
- property specification
- distributed reasoning
- certificate generation

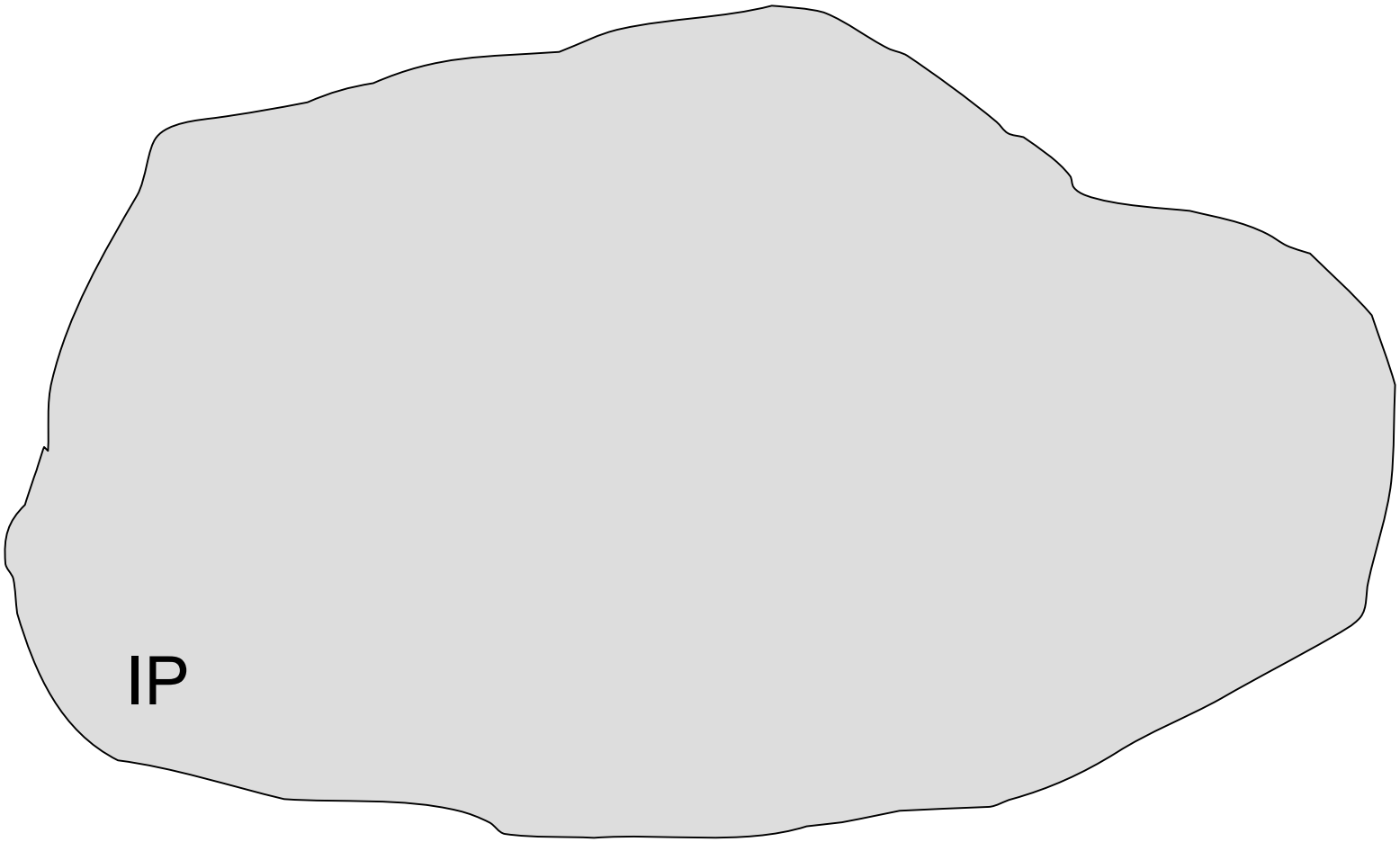
- **library, taxonomy**
- **peer-to-peer exchange**

Outline



1. Protocols
2. Protocol Derivations
3. Protocol Derivation Assistant

Running example: GDoI



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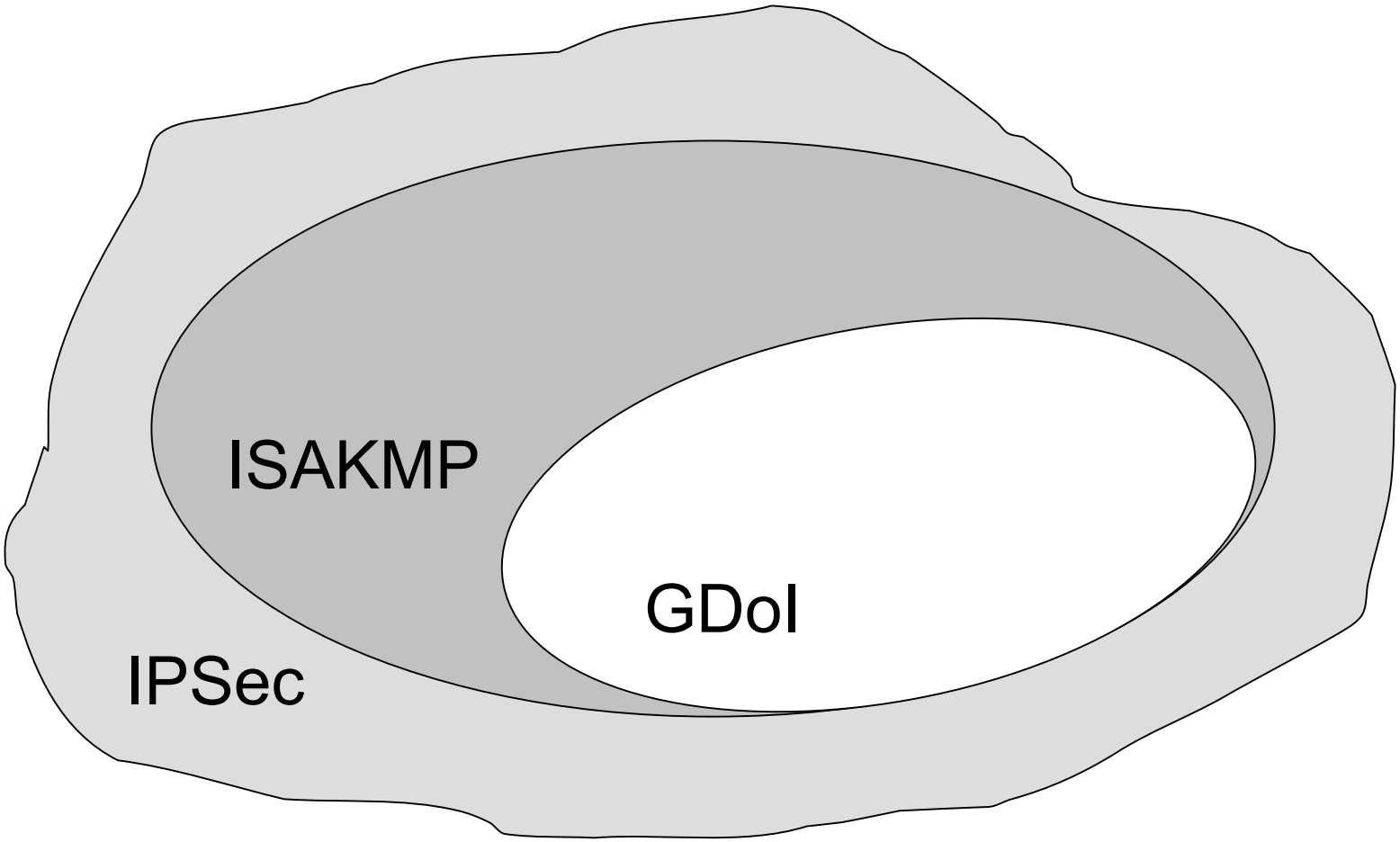

analyzed in joint work with Cathy Meadows

Running example: GDoI

- IPSec [IETF RFC 2400-2410]
  - charter: http://www.ietf.org/html.charters/ipsec-charter.html
- ISAKMP [IETF RFC 2408]
  - documents: http://web.mit.edu/tytso/www/ipsec/
  - distributions: http://web.mit.edu/network/isakmp/
  - implementations: DoD, Cisco
- GDoI [IETF RFC 3547, July 2003]
  - doc.: http://www.networksorcery.com/enp/protocol/gdoi.htm
  - carefully designed: seven internet drafts
  - formally verified and corrected

Group Domain of Interpretation

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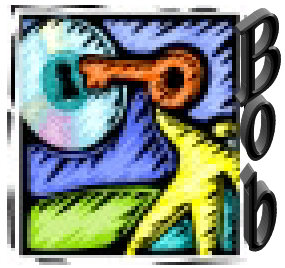

chal[A,B]

resp[A,B], chal[B,A]

resp[B,A]

k

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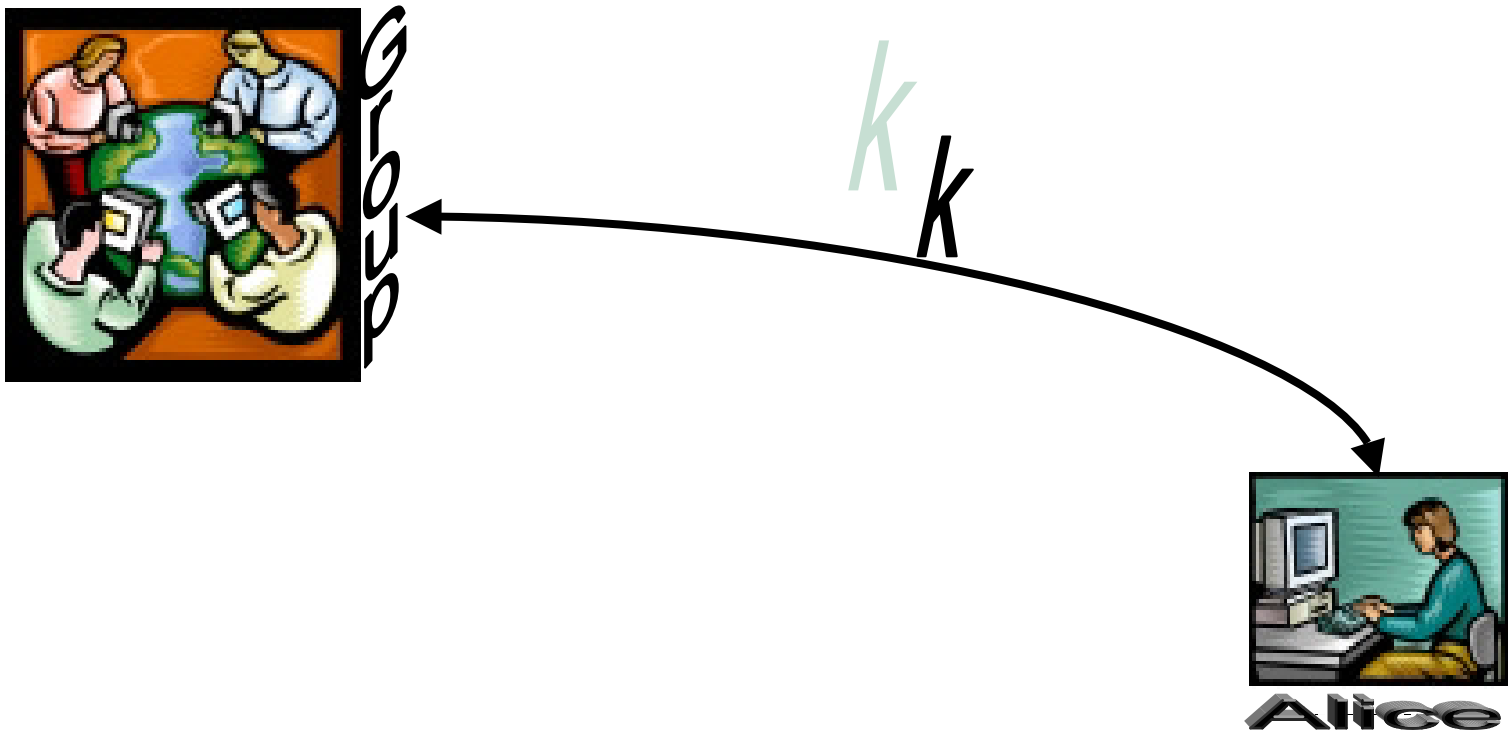

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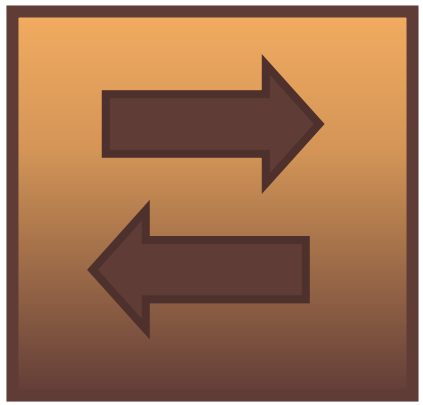

GDoI[A,B](H,S)

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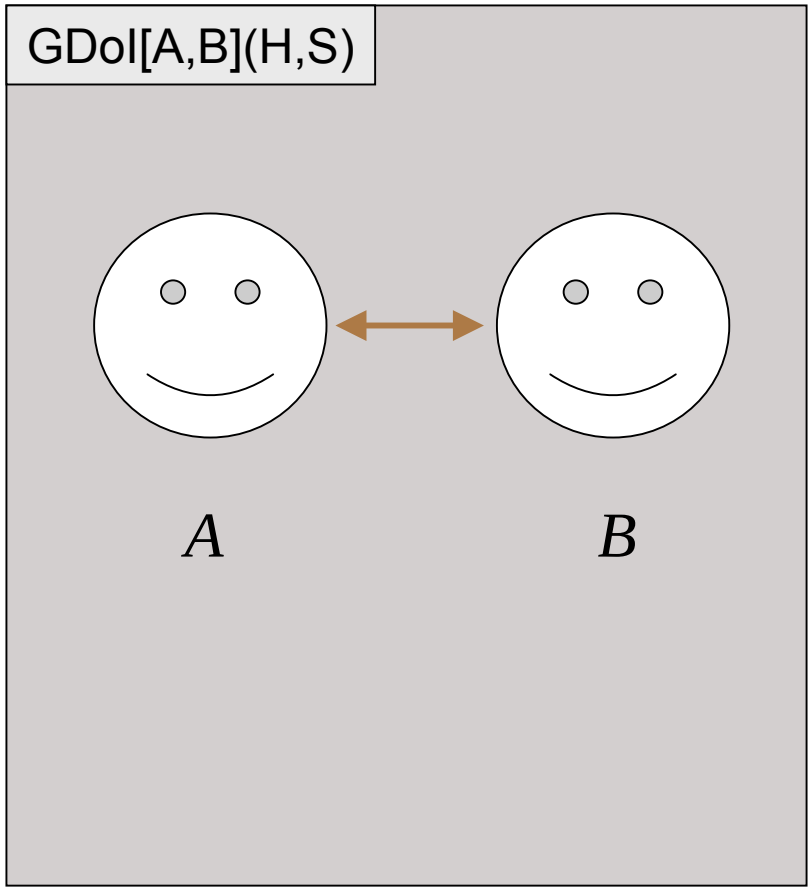

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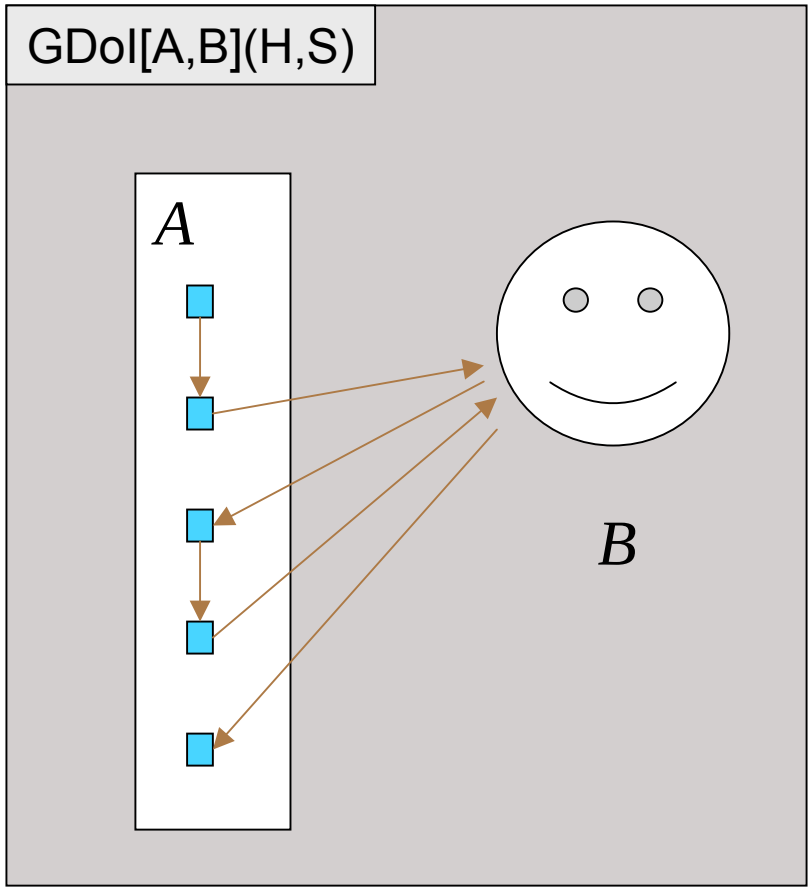

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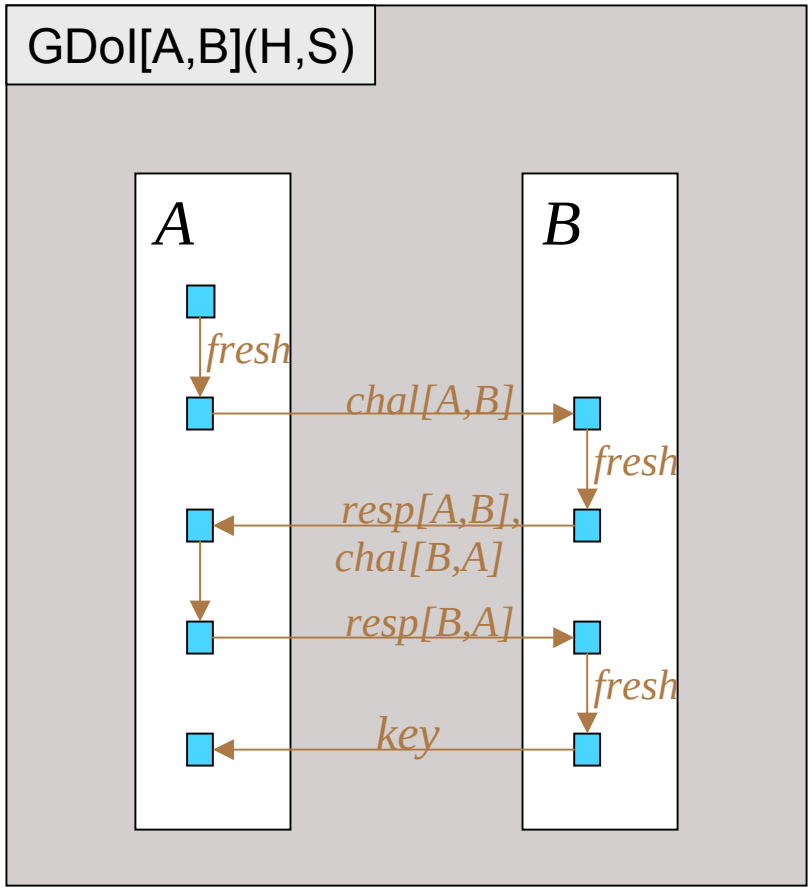

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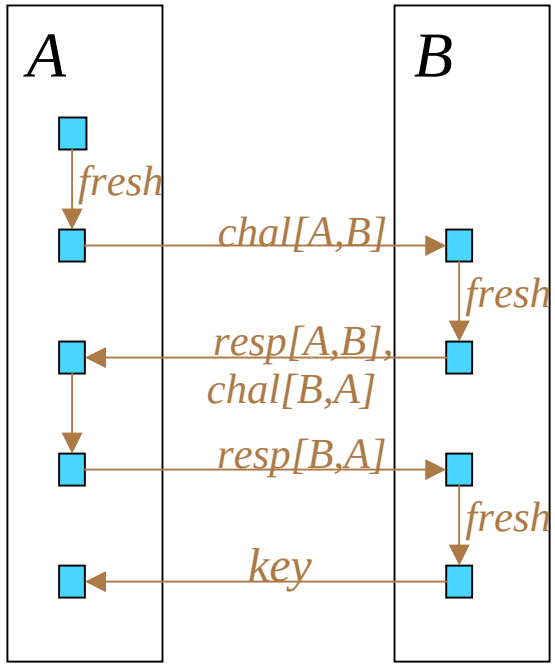

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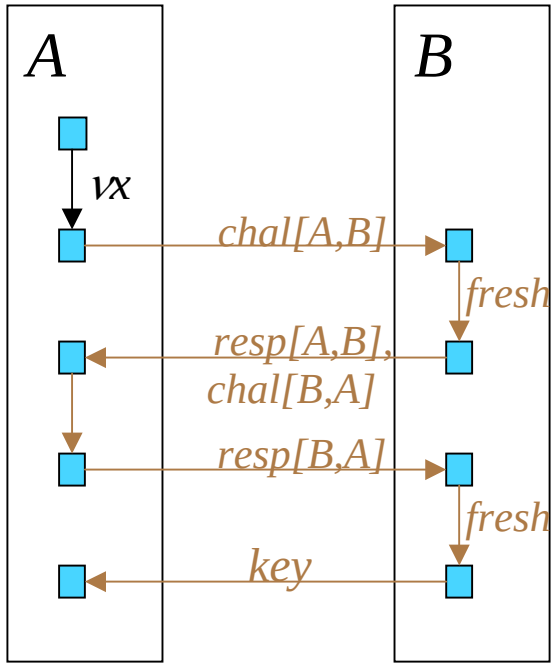

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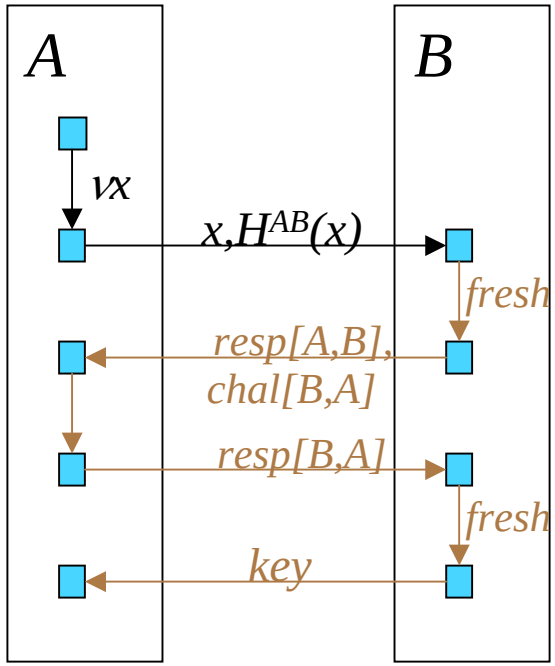

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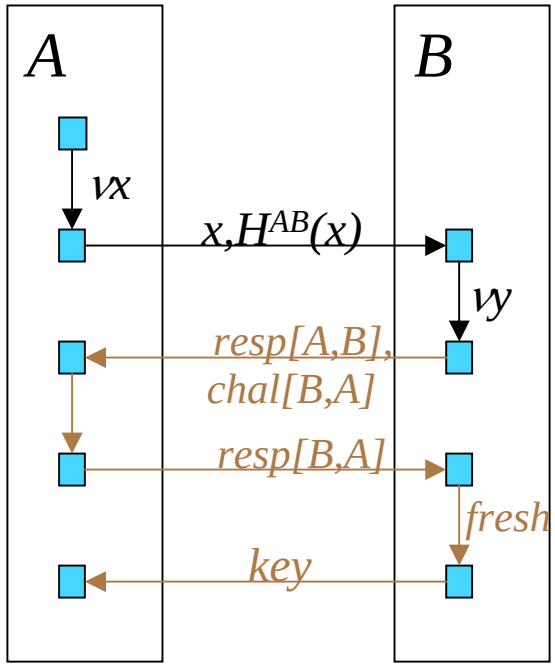

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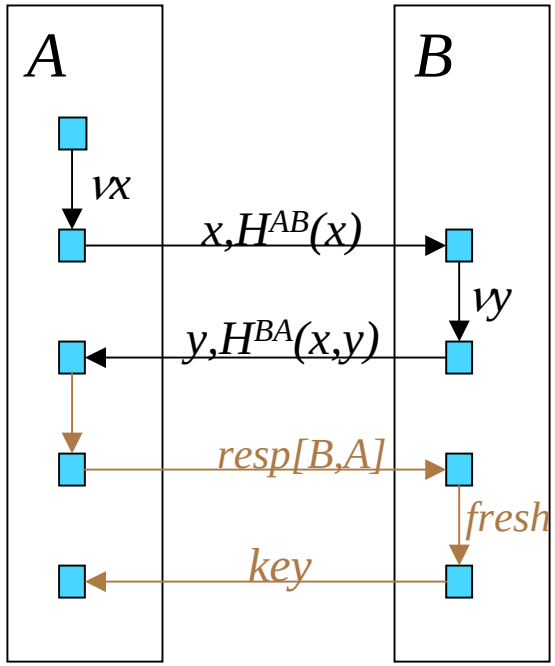

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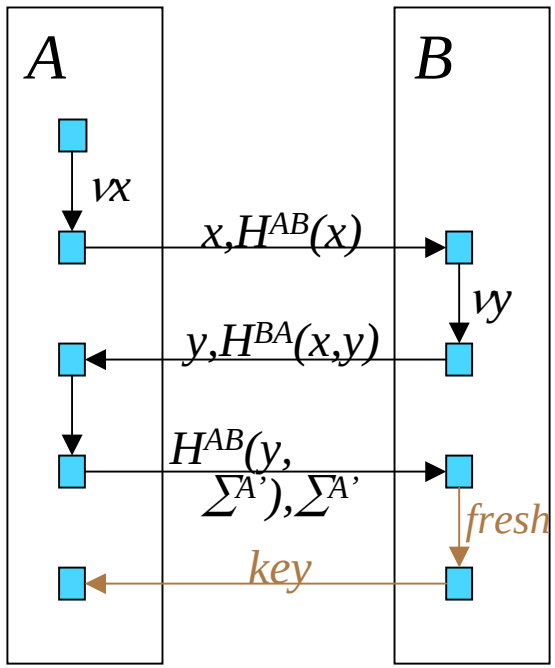

$$\Sigma^Z = C^Z, S^Z(x,y)$$

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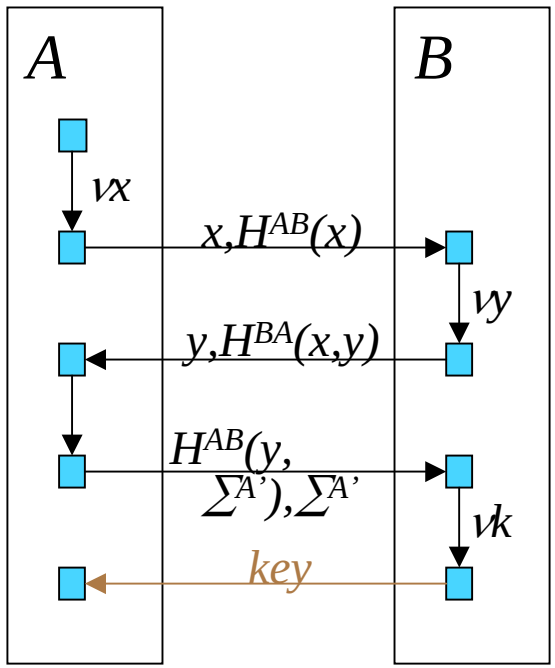

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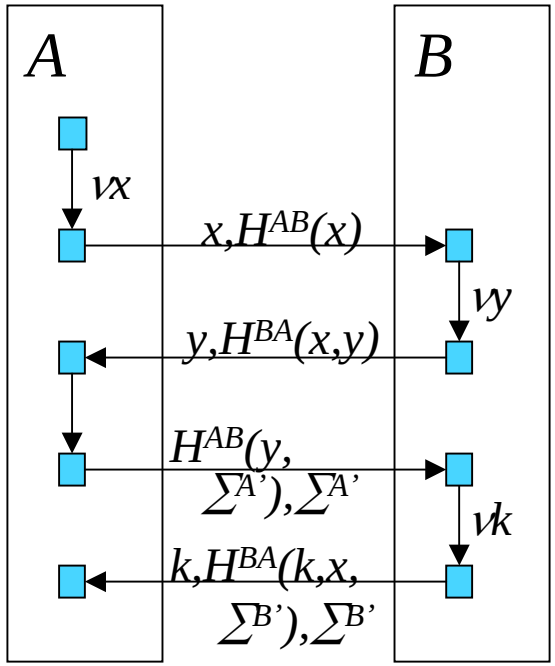

$$\sum^{Z} = C^{Z},S^{Z}(x,y)$$

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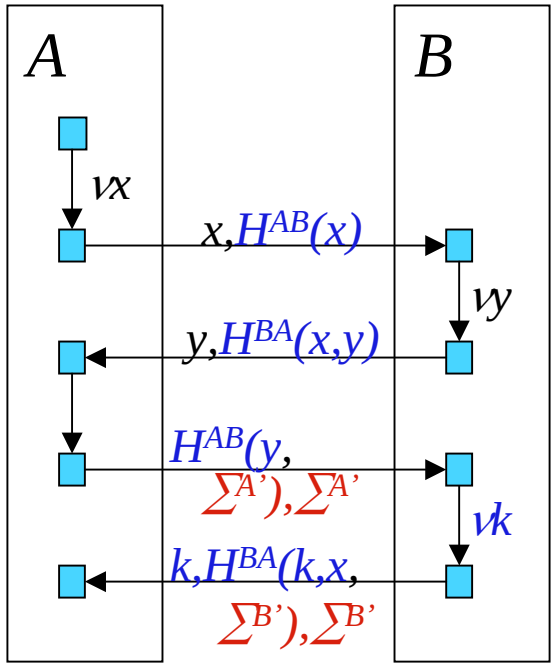

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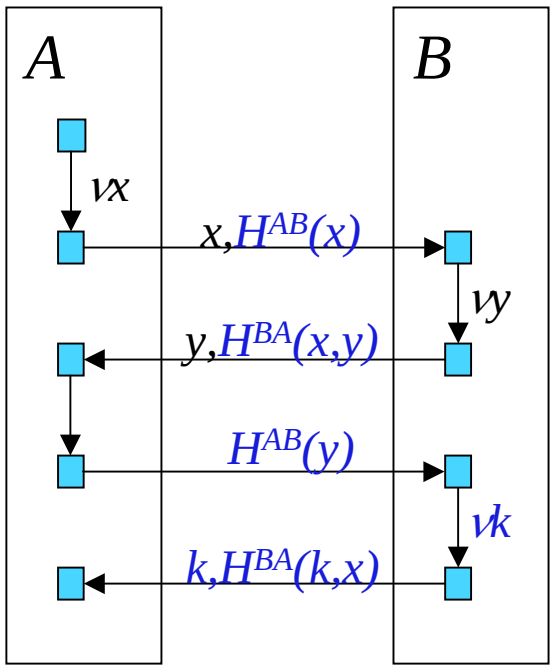

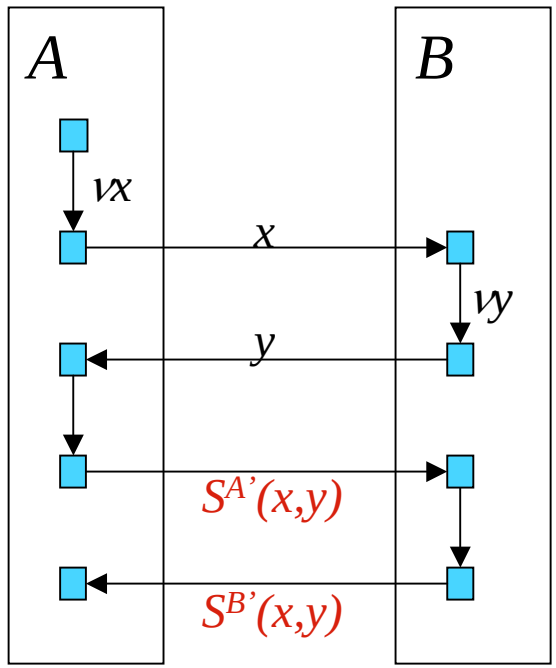

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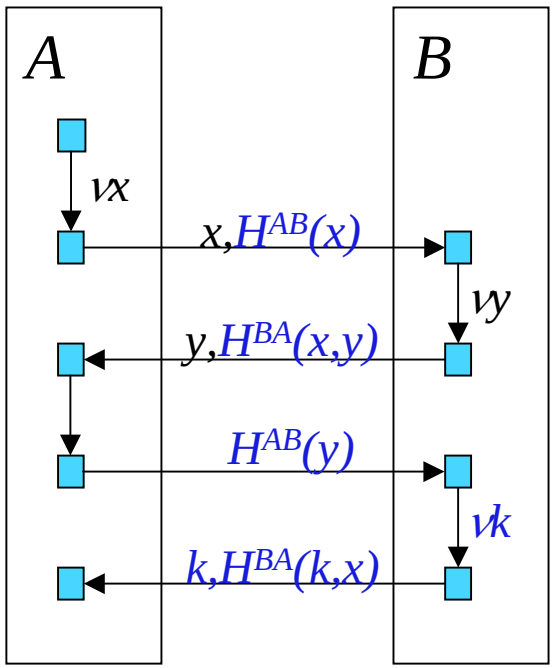

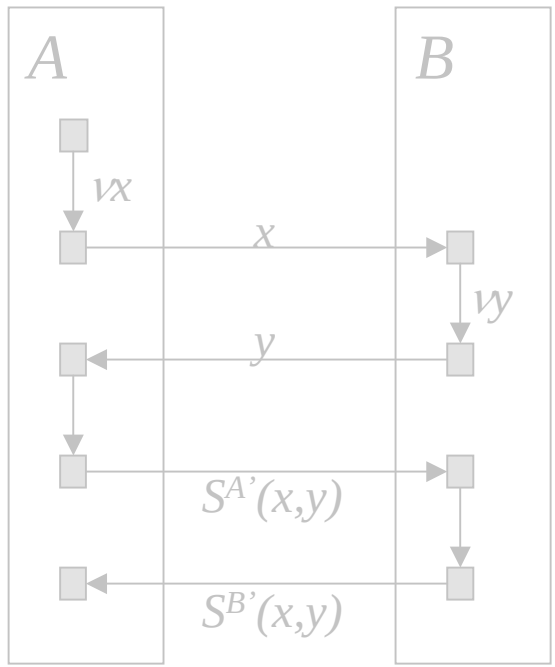

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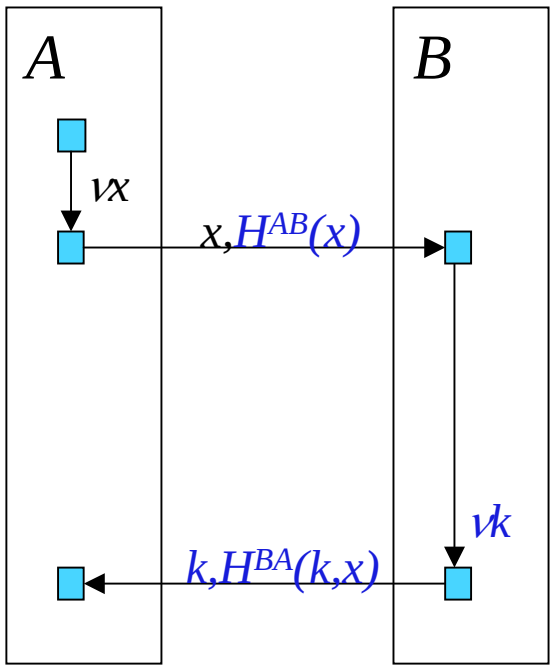

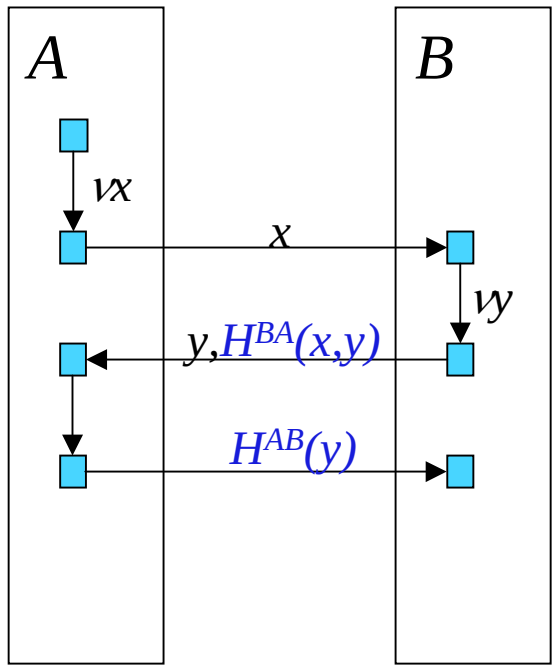

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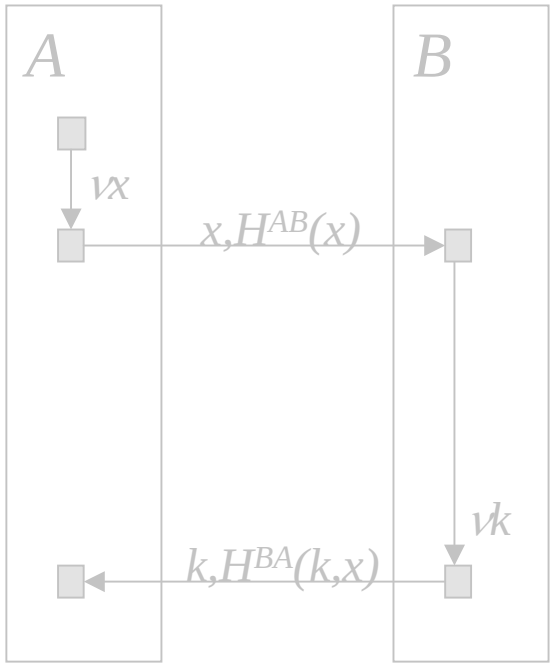

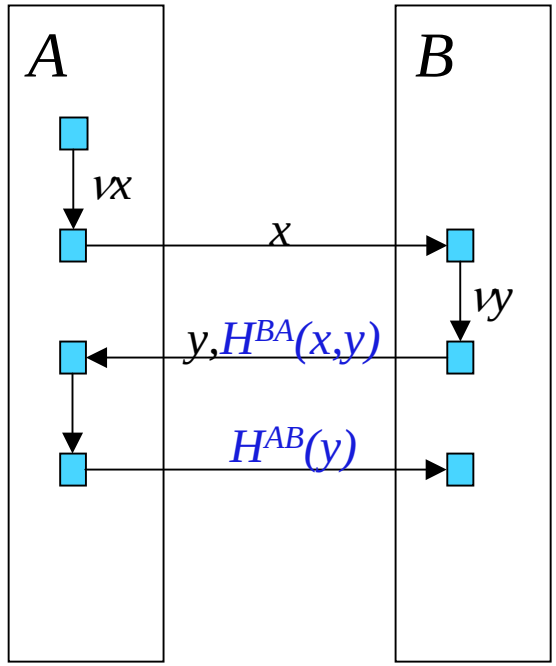

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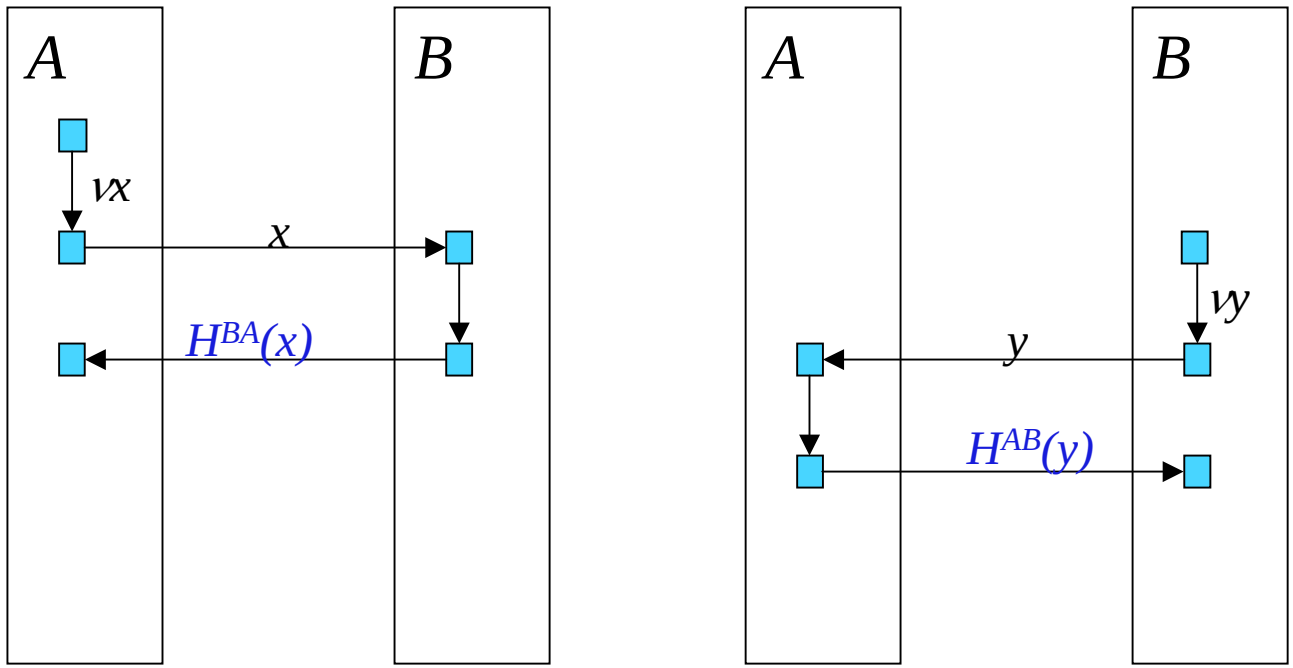

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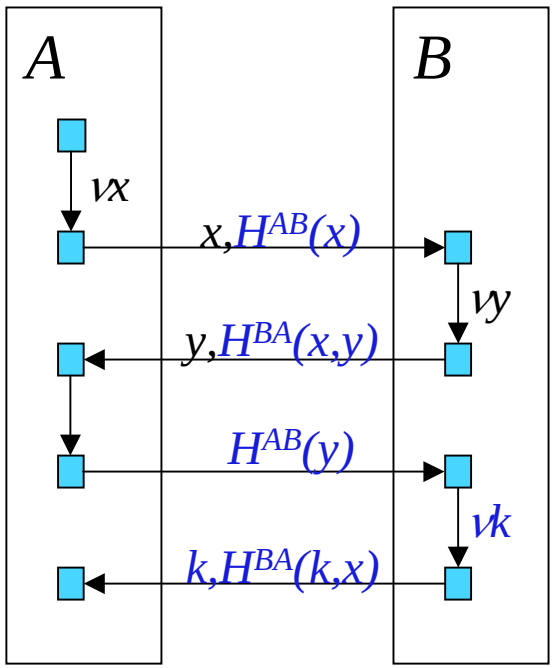

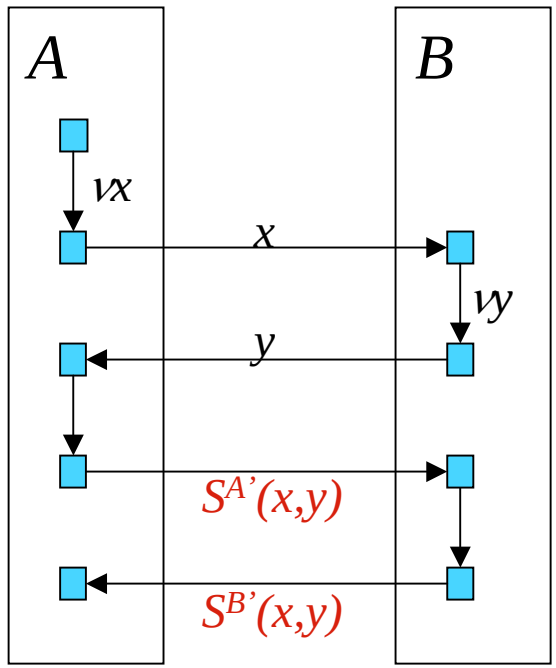

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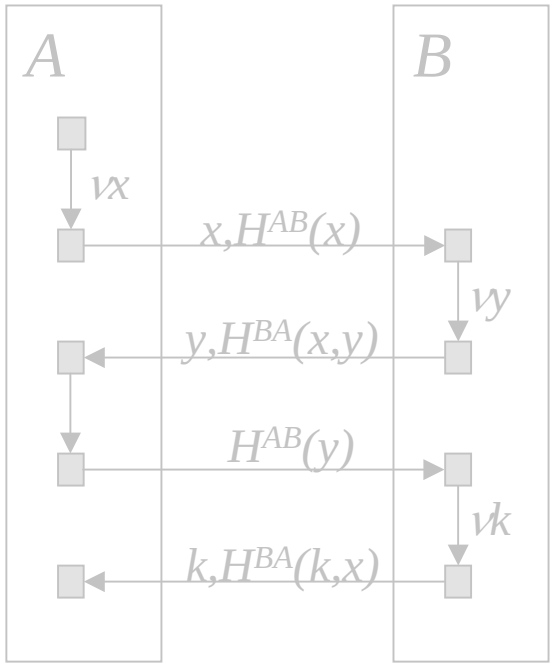

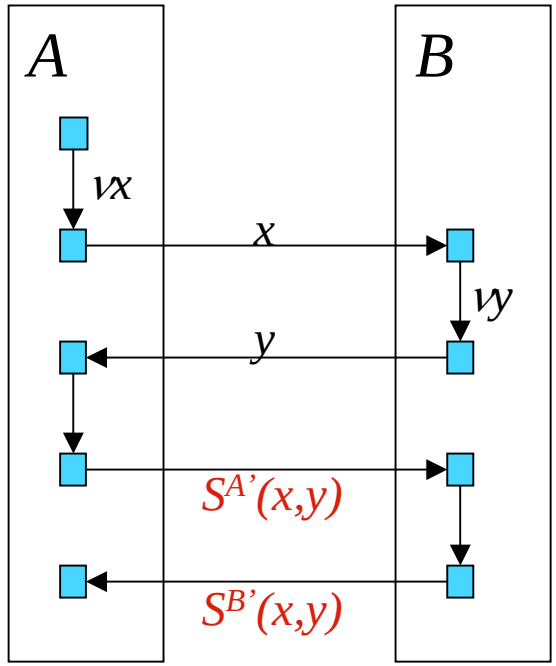

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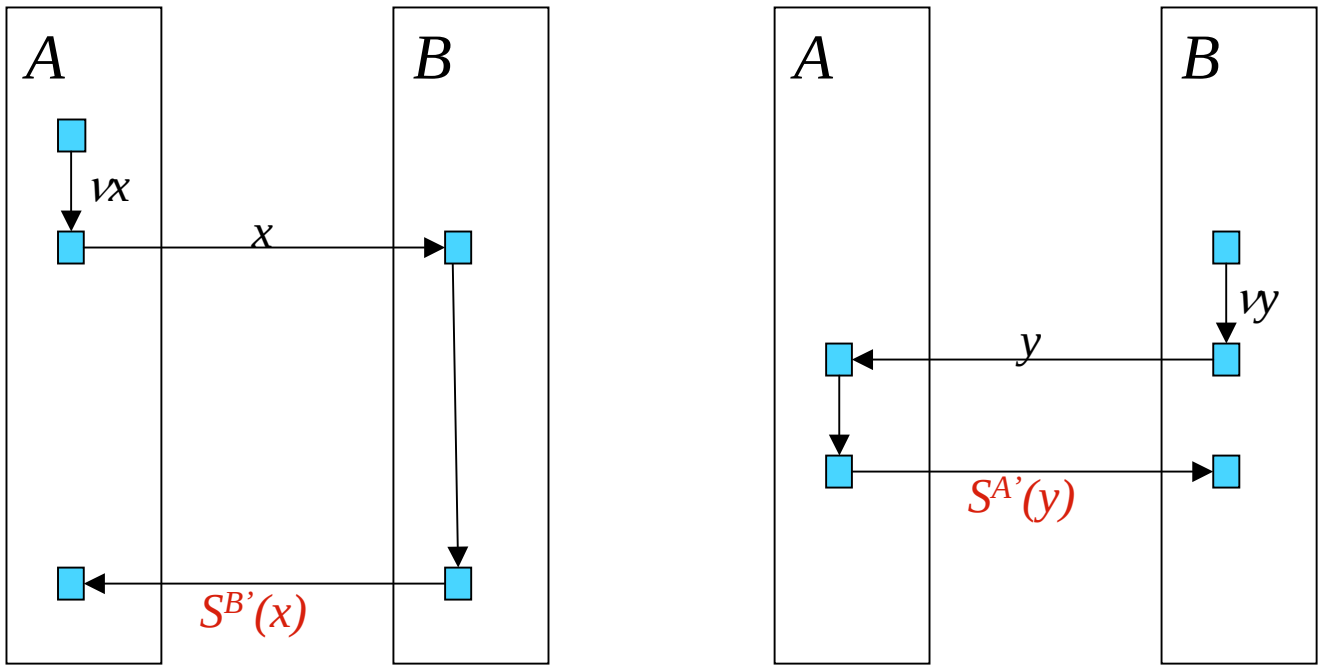

Outline

1. Protocols
2. Protocol Derivations
3. Protocol Derivation Assistant

but for derivations we need…

Outline

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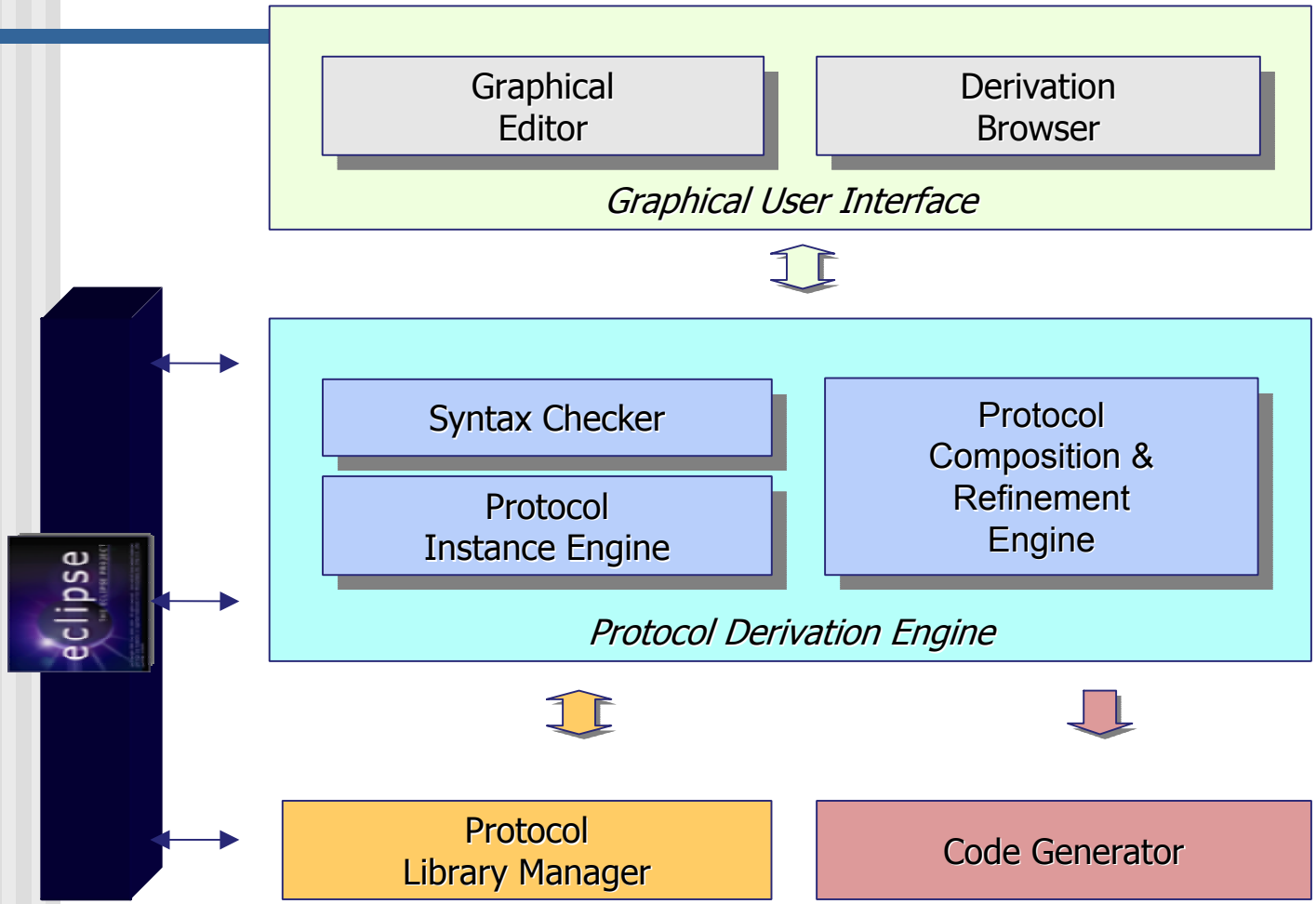
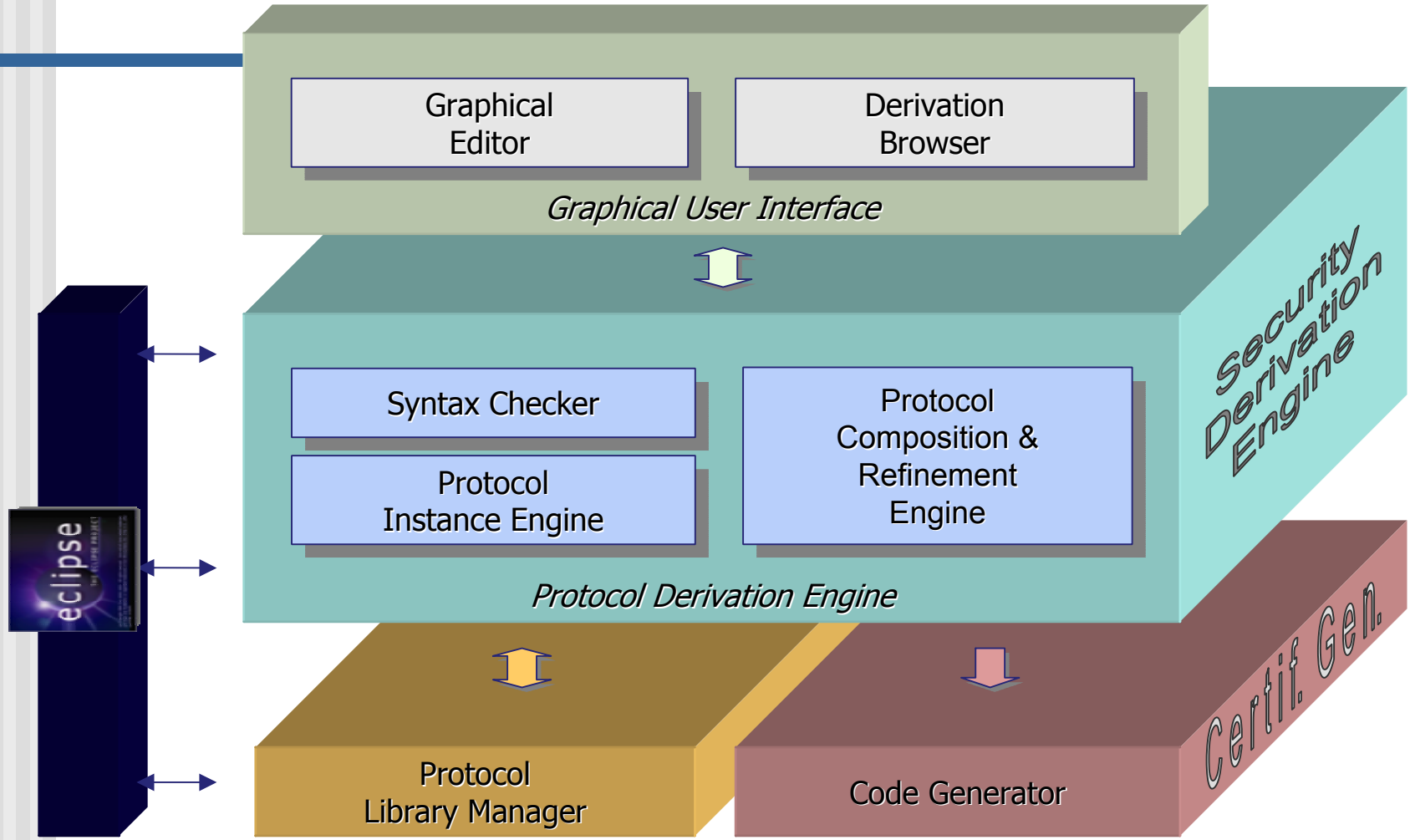
PDA Architecture



PDA Architecture



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PDA DEMO

Deriving attacks on GDoI.

GDoIv2 proposal.

Summary

- PDA supports:
  - protocol specifications
    - process representations
    - property axioms
    - distributed reasoning
  - composition and refinement of distributed processes
  - evolving taxonomies of protocols and properties
  - rudimentary code generation
- to do:
  - automate property derivations
  - code and certificate generation
  - integrate other tools
  - add crypto

Papers

- An encapsulated authentication logic for reasoning about key distribution protocols
  - with I. Cervesato and C. Meadows, *submitted*
- Deriving, attacking and defending GDOI
  - with C. Meadows, *Proceedings of ESORICS 2004* (Springer LNCS)
- A derivational system and compositional logic for security protocols
  - with A. Datta, A. Derek and J. Mitchell, *J. of Comp. Security* 2004
- Abstraction and refinement in protocol derivation
  - with A. Datta, A. Derek and J. Mitchell, *Proceedings of CSFW 2004* (IEEE)

Papers

- Secure protocol composition
  - with A. Datta and A. Derek and J. Mitchell, *Proceedings of MFPS 2003* (ELNCS); ext. abstract in *FMCS 2003* (ACM)
- Derivation system for security protocols and its logical formalization
  - with A. Datta, A. Derek and J. Mitchell, *Proceedings of CSFW 2003* (IEEE)
- Compositional logic for protocol correctness
  - with N. Durgin and J. Mitchell, *J. of Comp. Security* 2003; eariler version in *CSFW 2001* (IEEE)
- Composition and refinement of behavioral specifications
  - with D. Smith, *ASE 2002* (IEEE)

www.kestrel.edu/users/pavlovic/

PDA web site

www.kestrel.edu/software/pda/