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Security and Composition

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Problem Statement

• Given a set of components with known properties, is there a way to assure and reason about a system composed of these components?

• Is it possible to design components that behave securely regardless of how they are composed?

• Added: can we develop secure systems in a modular manner, from trusted and untrusted components?
Reasoning About Composed Systems

- Yes, e.g., assume-guarantee
  - e.g. PCL for protocols
- But intruder/attacker model becomes complex
Refinement of These Compositions

- May always underestimate the intruder
- Especially as we move from abstract to detailed models... code
- But scientifically rich field... lots of progress
- Software model checking, type systems, etc.
Universally Composable Components

- Quite a lot of theory here
- Can do it sometimes (e.g., public key encryption)
- But also known impossibility results (e.g., zero knowledge)
Modular Construction

- Tactically essential: it's the only feasible approach
- Scientifically rich
  - Independence (via separation, diversity)
  - Variants of assume-guarantee
- But plenty to do
Why Composition Is Hard

- Trying to ensure a systemwide property... with components
- The system security argument may not decompose on architectural lines
  - So what is architecture?
  - A good one simplifies the assurance case