CACE WP5 Meeting

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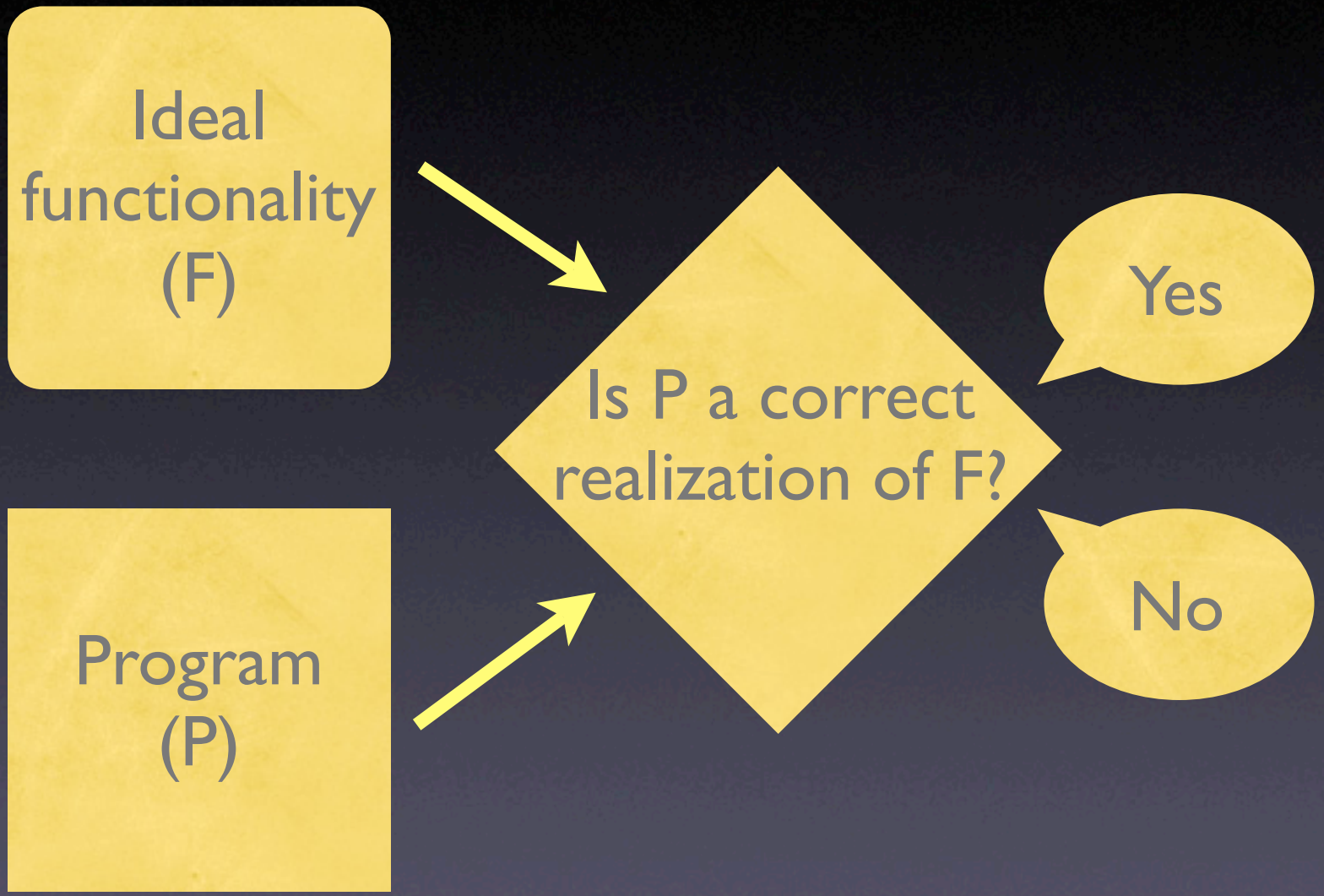
Security Policies in MPC

Janus Dam Nielsen
University of Aarhus

Overview

- A Grand Challenge
  - and the design-space it spans
- Examples of relevant security guaranties
- Examples of SMC applications

A Grand Challenge

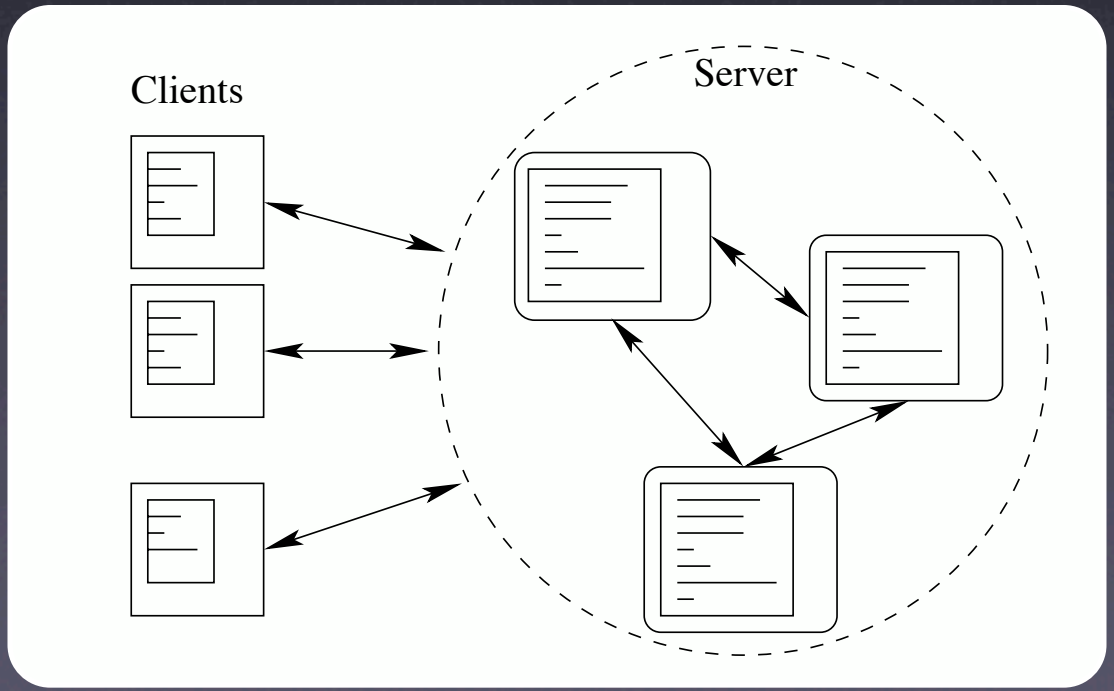


The Design-space

1. Security against all attacks in the UC sense
2. Formal verification of a program against a specific security model
3. Security against classes of attacks (insider/outsider attacks, intentional/unintentional, covert channels, etc.)
4. Security against individual attacks

SMCL
a place in space

- A domain-specific language for SMC
- Target audience is not crypto-people
- Provides some security guaranties



SMCL

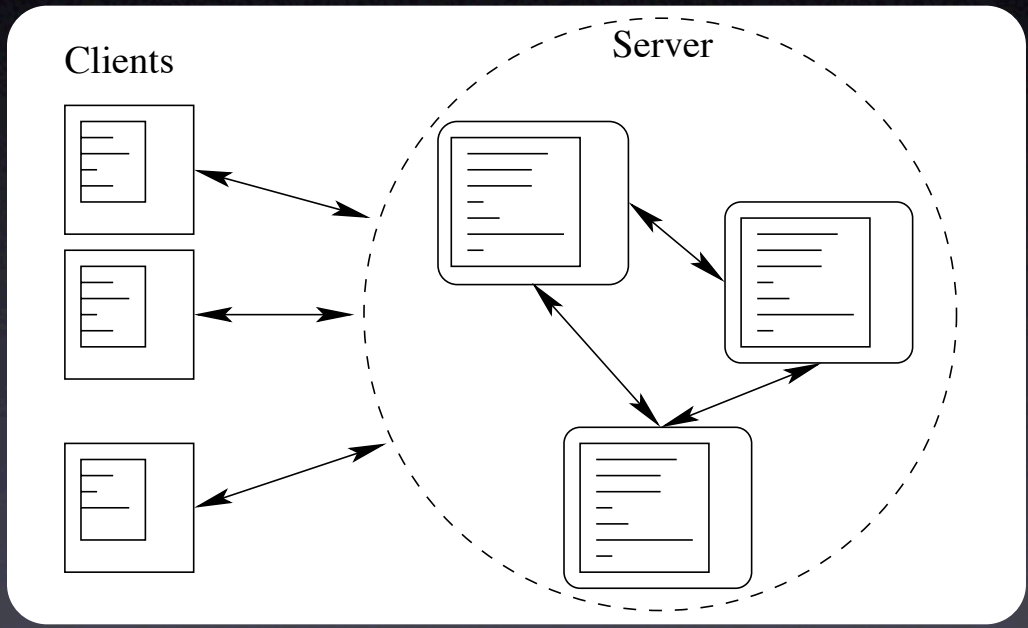
The Millionaire's Example

```
declare client Millionaires:
  tunnel of sint netWorth;

  function void main(int[] args) {
    ask();
  }
  function void ask() {
    netWorth.put(readInt());
  }

  function void tell(bool b) {
    if (b) {
      display("You are the richest!");
    } else {
      display("Make more money!");
    }
  }
```

```
declare server Max:
  group of Millionaires mills;

  function void main(int[] args) {
    sint max = 0;
    sclient rich;
    foreach (client c in mills) {
      sint netWorth = c.netWorth.take();
      if (netWorth >= max) {
        max = netWorth;
        rich = c;
      }
    }
    foreach (client c in mills) {
      c.tell(open(c==rich|rich));
    }
  }
```

Security Model

- Adversary may:
  - Observe physical state of the server
  - Not observe private and secret values



Security Guaranties

- Security against attacks that are a function of the program trace
  - Timing, information flow, etc.
- Enforced by:
  - Carefully crafted semantics
  - Static analysis of well-typed SMCL programs

If an adversary corrupts more than the threshold of servers then all guaranties are off

Semantics

- Conditionals are a source of differences in the trace
  - Execute both branches
  - Termination
  - Public side-effects

```
if (b) {
  x = y;
}
else {
  x = z;
}
```

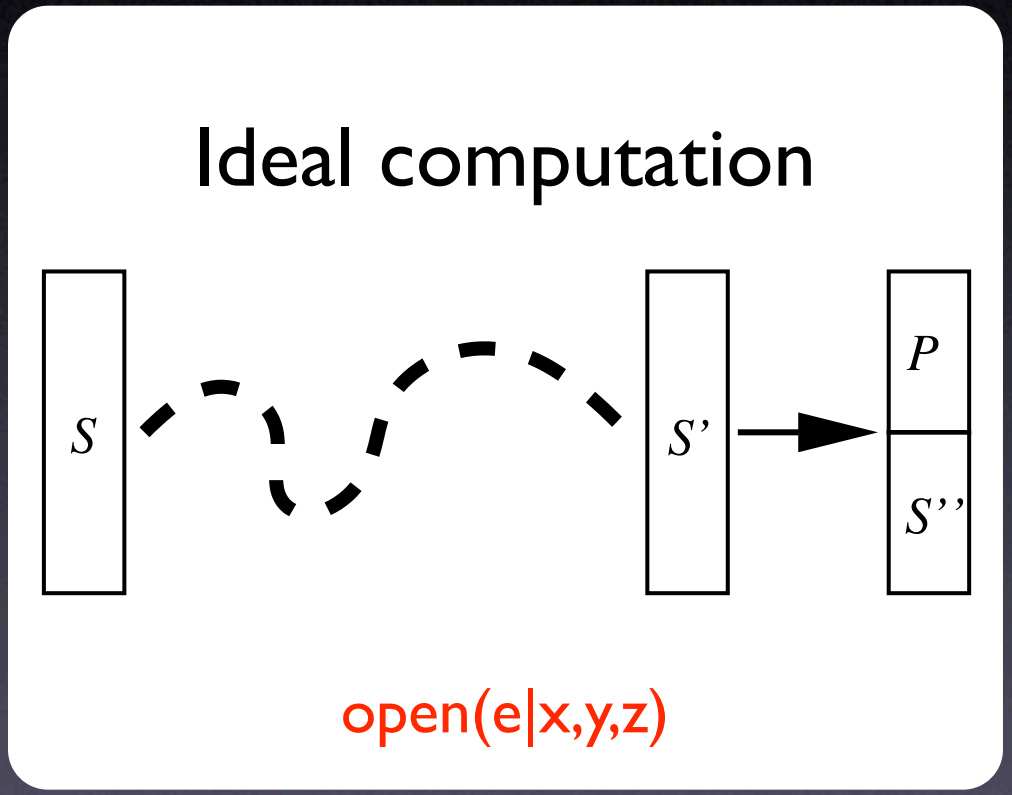
```
x = b*y + (1-b)*z
```

Hoistability

- Branches must agree on public side-effects
  - Assignment to public variables
  - Communication
  - Function calls
- While loops and recursion with secret condition are not allowed

Semantic Information Leak

- Ideal computations are inefficient
- Prove that a pragmatic version reveals same information as the ideal version
- Assist the programmer



SMC Applications

- Auctions
- Negotiations
- Benchmarking
- Datamining
- Voting
- Survey
- Etc. (See WP4 d.1)

Sugarbeet auction

- Developed as a partnership with a private company
- Approx. 3 years of work
- Security model changed during development
- How security is achieved is not important for users - only that it is “secure”

Questions?