Socio-Technical Trust: An Architectural Approach

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Outline

- Socio-technical systems (STS)
  - Specification
- Engineering STS for trust
  - Objectives and challenges
- Our approach
  - Socio-technical trust
  - Computational grounding
  - More trustworthy STS
- Case study: The Food Domain
- Conclusions and future work

Socio–Technical System

- An interplay of **humans**, **organizations** and their **technical systems**

STS Specification

- In terms of ***actors*** and their ***interactions***
  - Dependency captures social reliance
  - **But**, actors are mutually independent

- **Proposal**
  - ***Socio-technical trust***: fundamental social relationship among actors of an STS
    - ***STS*** are organized along trust relationships

Running example

Province of Trento

How can we engineer a healthcare STS that ensures this trust?

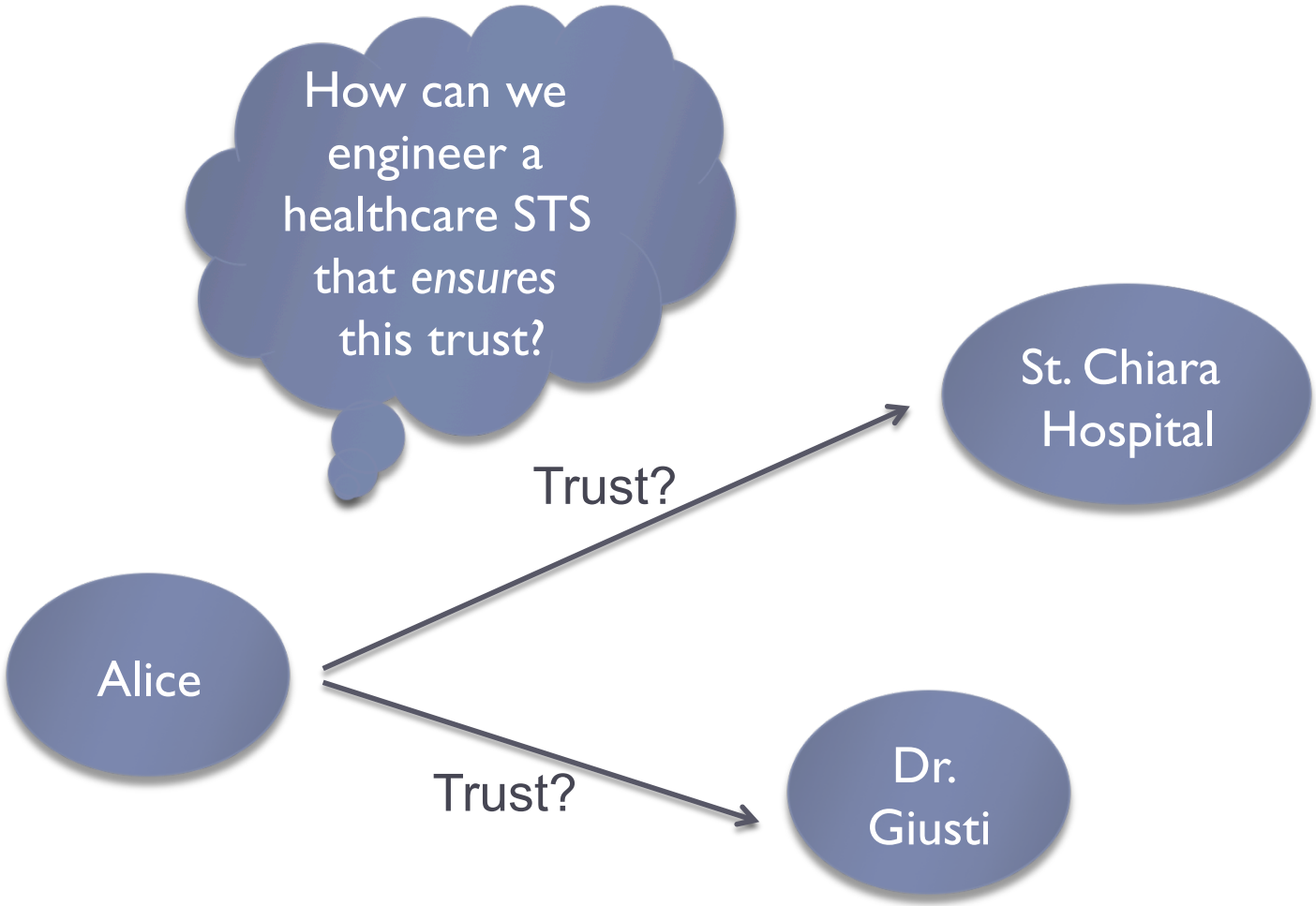
Trust?

Trust?

doctors

- How can we specify an STS that is trustworthy?

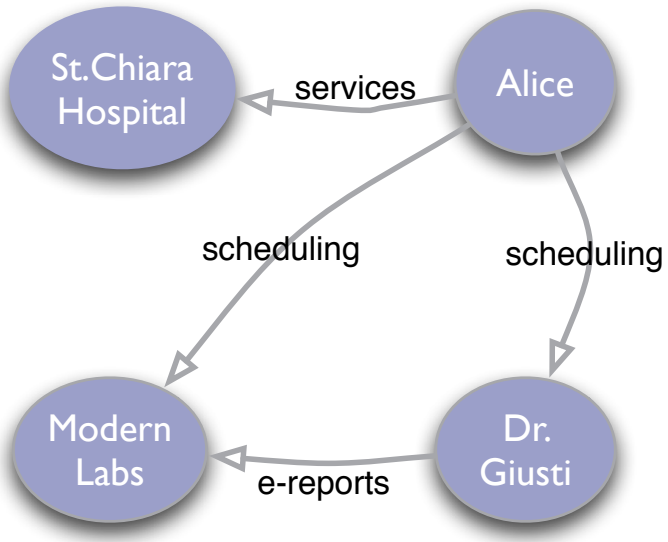
Running example



Existing Trust Approaches

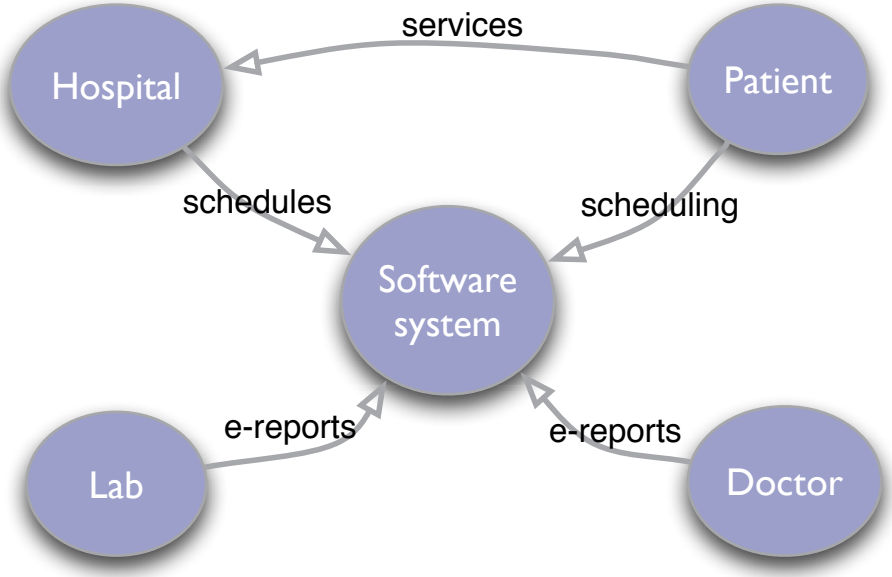
Cognitive Trust

- Each agent has its own mental model of others



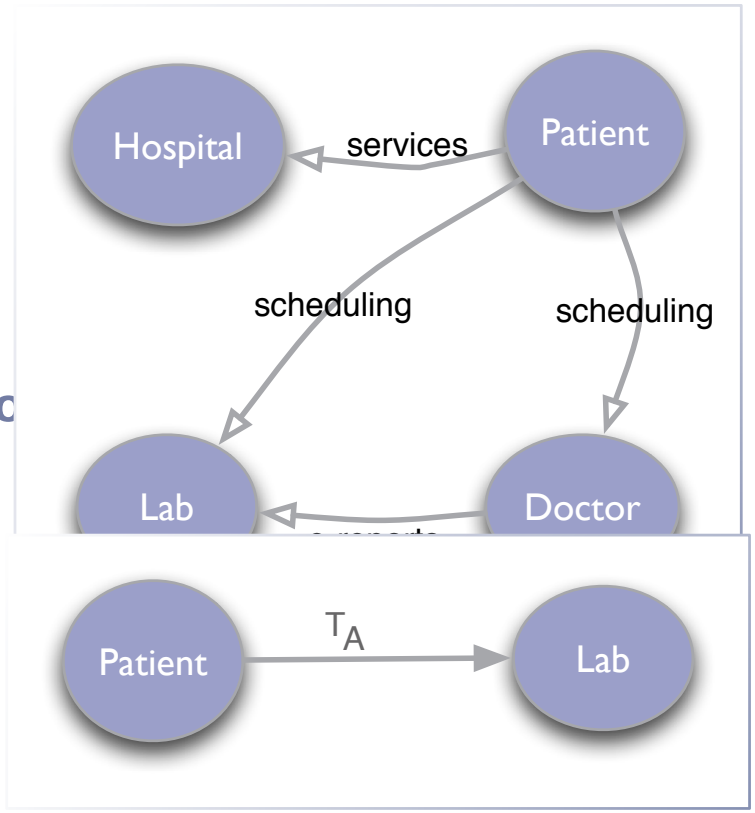
Technical Trust

- Assurance, or dependability



Socio-Technical Trust

- Encode **trust relationships** into the **architecture** of the STS
  - Irrespective of individual participants
  - Architectural trust ($\mathbf{T_A}$)



- Specification:
  - STS: a set of **roles** and the **trust relatic**
  - Formally: $S \subseteq R \times R \times P \times P$
  - We say: $T_A(x,y,p,q)$ iff $(x,y,p,q) \in S$
- Example: HealthcareSystem
  - roles: Hospital, Lab, Doctor, Patient
  - T_A(Patient,Hospital,takeTest,receiveAccurateResults)

Objectives and challenges

- ***Engineer STS for trust***
  - ***Ensure robust interaction:*** provide means to guarantee a purposeful and effective interaction between actors, to ensure the overall objectives are achieved

  - ***Compare STS***: What is the most appropriate STS for me?
    - ***Role-oriented perspective***

Computational Grounding

- Commitment-based approach
  - Commitments model interactions between participants in terms of a contractual relation
  - Formally: C(debtor,creditor,antecendet,consequent)

- Why commitments?
  - Obtain a more **robust** system: *Robust Interaction*
  - Whenever C(Lab,Patient,paid $\wedge$ tookTest,resultsDelivered)
    - T_A(Patient,Lab,paid $\wedge$ tookTest,resultsDelivered)

More trustworthy

- Intuition: more robust
  - Commitments alone are not enough: we need mechanisms to support them

- **Trust supporting mechanisms**
  - Some trust relationships influence positively other trust relationships with respect to a given role's perspective

- Formally: $T(x,y,p,q) \succ_x T(x,y,r,s)$
  - **Supports** relation: Handle exceptions that might arise from existing trust relations

Trust supporting mechanisms

- **Examples**
  - If results are not delivered, provide a coupon for redoing/repeating the tests without paying again
    - Compensate

T(patient,lab,violated(patient,lab,paid,delivered),refund∧discountCoupon)

  - If results are not delivered, money is reimbursed (payment is undone)
    - Undo

T(patient,lab,undo(delivered),T(patient,lab,undelivered,undo(paid))

  - If the hospital cannot prepare test results, can transfer the responsibility to a lab
    - Delegate

T(patient,hospital,threatened(patient,hospital,paid,delivered),
T(patient,lab,paid,delivered))

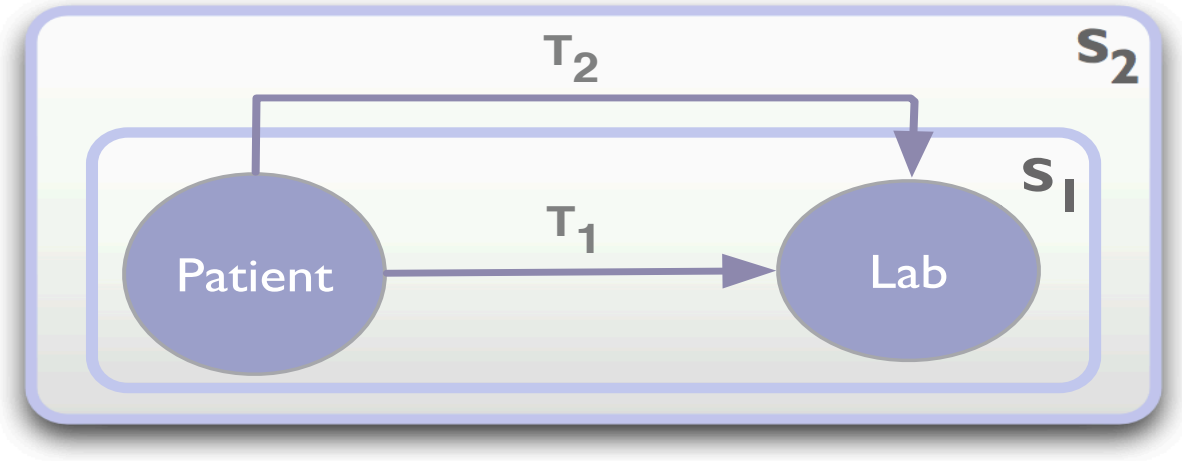
Trust supporting mechanisms

Name	Trust Encoding
Compensate(x,y,p,q,r,s)	T(x,y,violated(x,y,p,q),T(x,y,r,s))
Delegation(x,y,z,p,q)	T(x,y,threatened(x,y,p,q),T(x,z,p,q))
Undo(x,y,p,q,r)	T(x,y,undo(q),T(x,y,r,undo(p)))

- Abstracted from the basic operations performed on commitments

More trustworthy: compare STSs

- T_1=T(Patient, Lab, paid $\wedge$ tookTest, resultsDelivered)
- T_2=T(Patient, Lab, threatened(T_1), T(Patient, Hospital, paid $\wedge$ tookTest, resultsDelivered))



- $S_1 = \{T_1\}, S_2 = \{T_1, T_2\}$
- $T_2 \succ_{Patient} T_1 \Rightarrow S_2 \rangle\rangle_{Patient} S_1$

S_2 more trustworthy than S_1

Case Study: The Food Domain

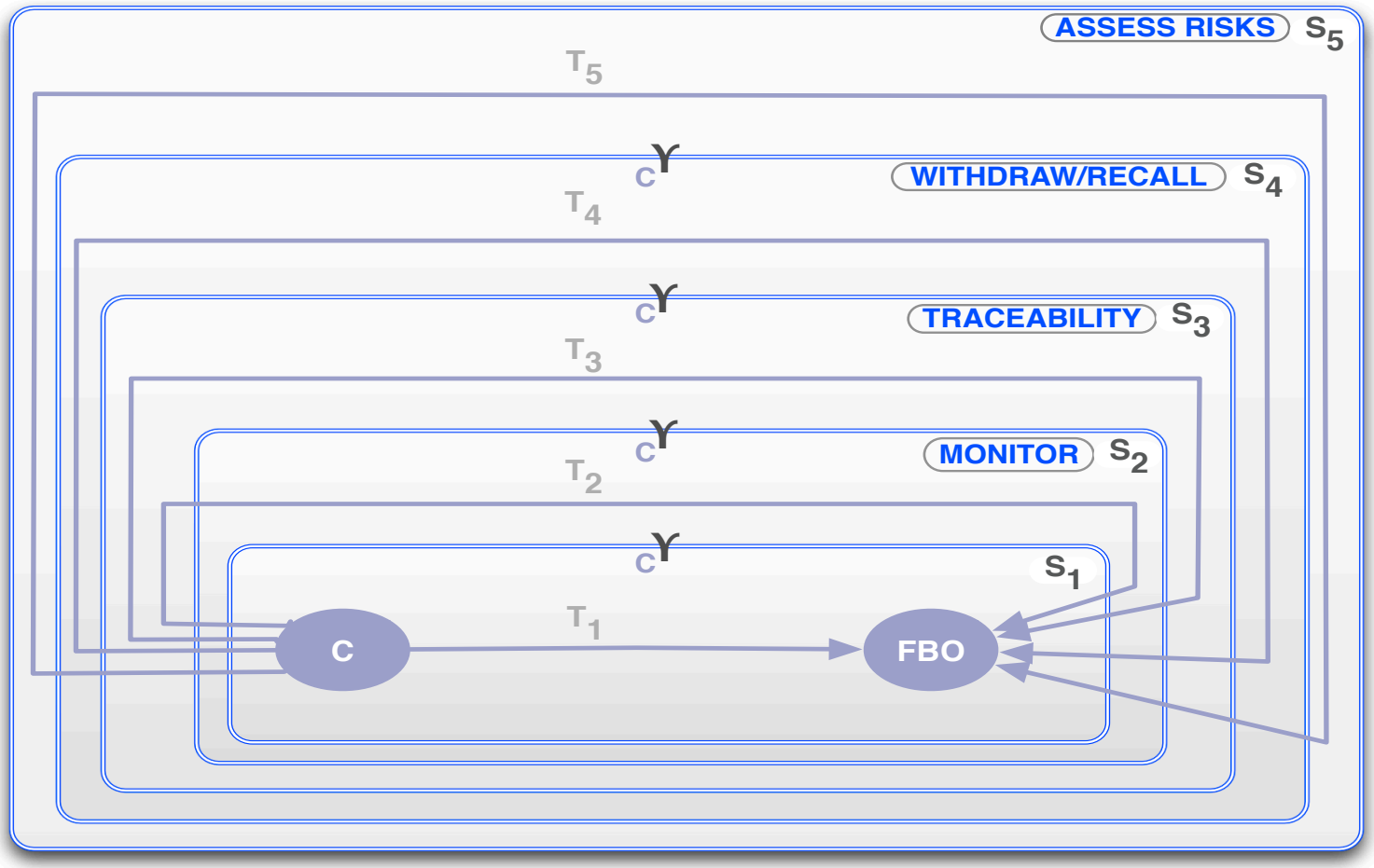
- Information on food, food safety, and nutrition
- Information for consumers
  - Information about food and nutrition
- Information for food business operators
  - Producers, manufacturers, regulators, retailers, etc.
  - Information about regulations and law
    - Guidance to regulatory requirements

Food chain: from farms to our tables

Case Study: The Food Domain

- Domain analysis
  - Identify domain specific information
  - New domain-specific supports relations
- Identify roles
  - Producers, manufacturers, regulators, and consumers
  - Grouped into: Food business operator (FBO), Consumer (C)
- Identify trust relationships
- Apply trust supporting mechanisms
  - Domain-specific trust supporting mechanisms

Case study: Food Safety



- $T_5 \succ_C T_4 \succ_C T_3 \succ_C T_2 \succ_C T_1$ → $S_5 \gg_C S_4 \gg_C S_3 \gg_C S_2 \gg_C S_1$
- Enhance consumers' trust about food safety in the food domain

Discussion

Conclusions

- Socio-technical trust is grounded in architecture
- Key feature: the role-oriented perspective
- It is different from cognitive and technical trust
- Understanding the structure of a system proved valuable for prospective participants

Future Work

- Extend the list of trust supporting mechanisms and explore their formal semantics
- Better understand STSs and analyze them
- Evaluate with other Case Studies

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Thank you!

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