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On the Soundness of Infrastructure Adversaries

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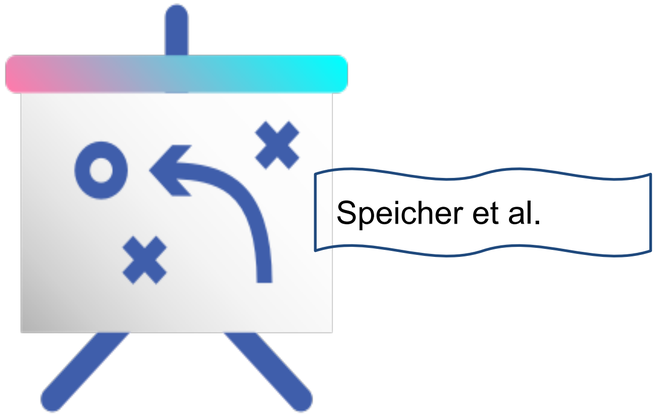
Motivation

Infrastructure Model



Quantitative Security Risk Assessment

Examples:

- Do we need DNSSEC?
- Biggest security risk?
- Best deployment strategy?

Administrators

Plan investments; secure infrastructure

Standardization bodies & Policy Makers

Focus efforts

Evaluate impact of policies; improve self-reliance

Protocol designers

Assess deployment issues with regard to status quo

Infrastructure Model

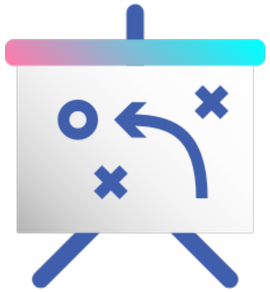
Infrastructure Model

Symbolic Soundess

Symbolic Model

- quantitative
- analyse IT-infrastructures
- building blocks: security protocols
- rule-based, infrastructure adversary (IA)

?



- possibilistic
- analyse security protocols
- building blocks: cryptographic primitives
- rule-based, Dolev-Yao threat model

Established

ProVerif

DEEPSEC

Outline

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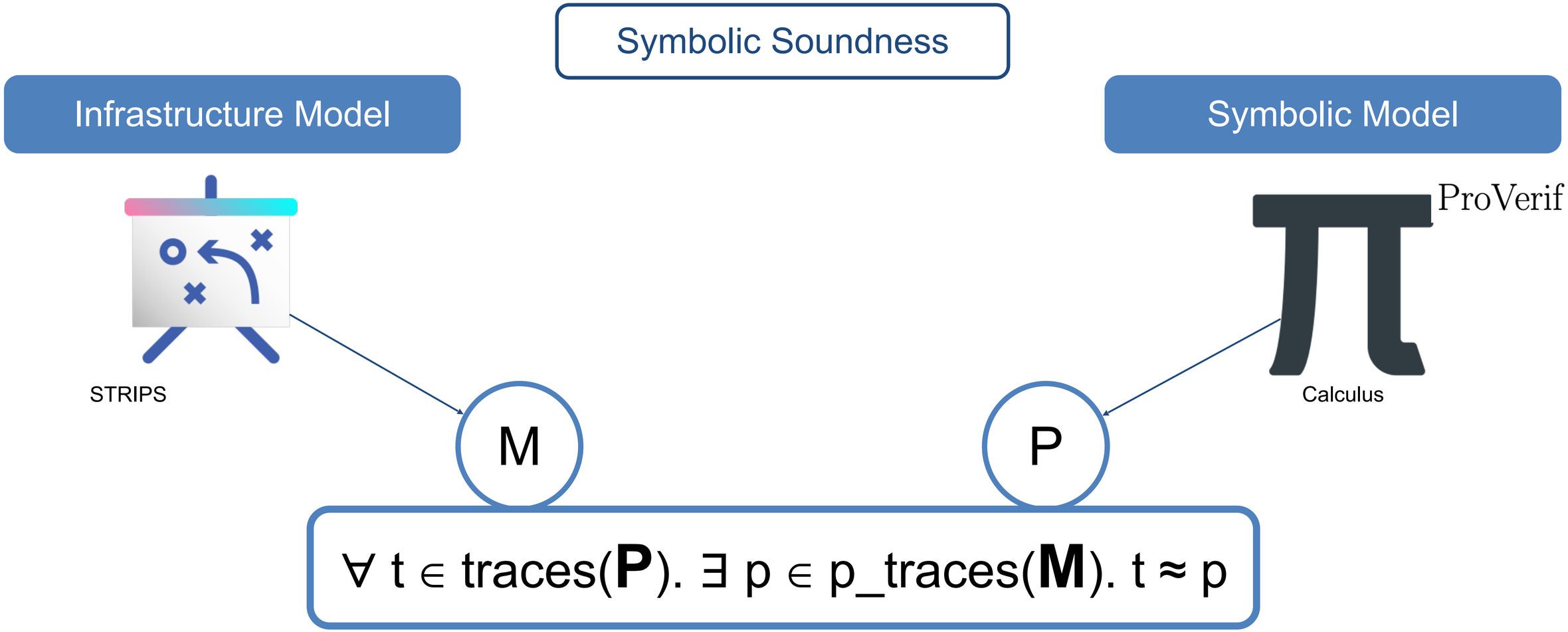
Symbolic Soundness - Definition

Symbolic Soundness - Proof Concept

Symbolic Model - Construction

Summary and Results

Symbolic Soundness



Symbolic Soundness - Conditions

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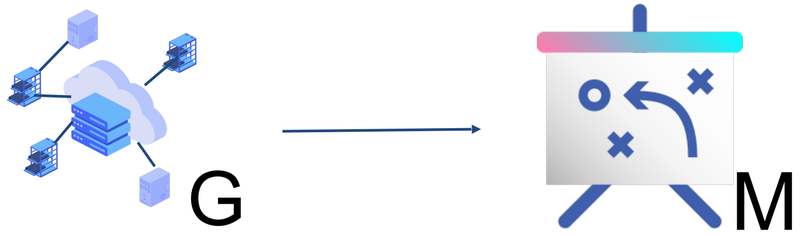
C 1	C 2	C 3	C 4	C 5
Depended on Formalism	Syntactic check on IA	Depended on Formalism	Syntactic check on IA	Prove in the symbolic model

Conditions for

Symbolic Soundness

π

Symbolic Model - Construction



$$F(G) = P$$

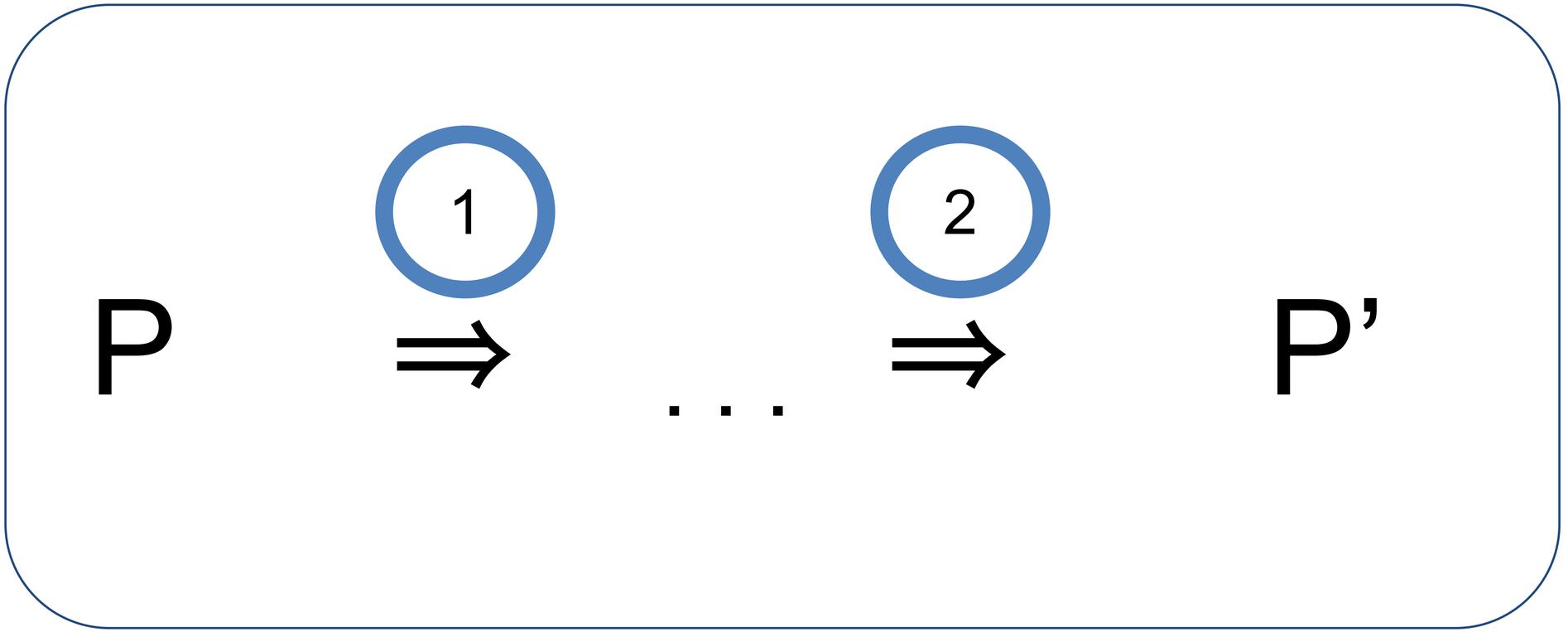
G
=
Graph presentation
of analysed infrastructure

F
=
Mapping from infrastructure
graph to pi calculus process

G is hardcoded ⇒ Changes in analysed infrastructure invalidate assessment

G can have millions of nodes ⇒ Verifiers do not scale well with model size

Process transformations



1 Allow adversary to choose concrete infrastructure.

$Q(s_1) \mid \ldots \mid Q(s_n) \Rightarrow !in(s).Q(s)$

2 Technical transformation: move message inputs deeper into the process.

Results

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Summary

Symbolic soundness: Definition and Conditions

Construction of Symbolic Model

Case Study

‘Formally Reasoning about the Cost and Efficacy of Securing the Email Infrastructure’ - EuroS&P, (Speicher et al. 2018)

Detection of flaws in their adversary model

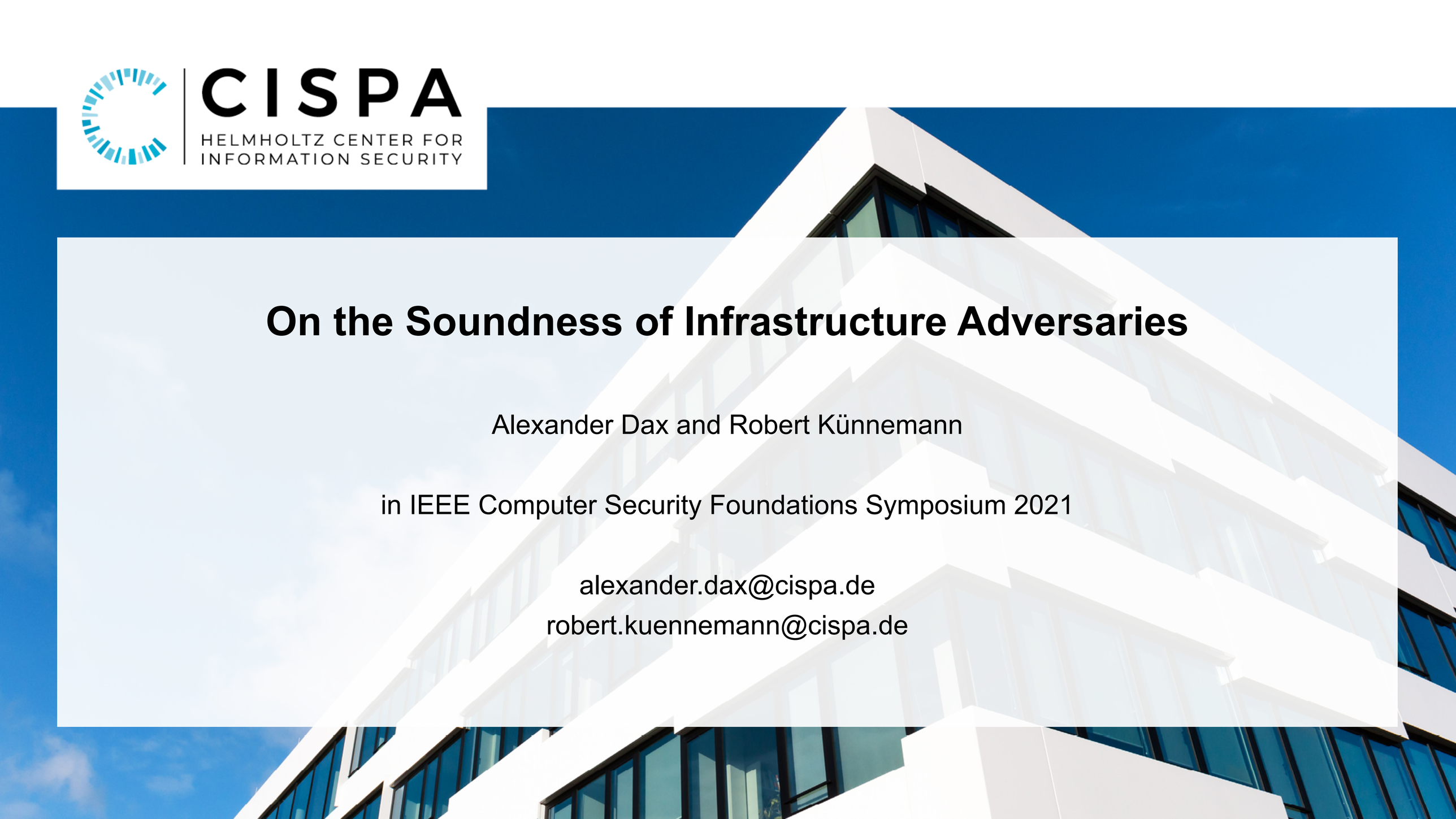
Includes PKI,SMTP, DNS, DNSSEC and inter-AS routing

(Github repository)

Symbolic Completeness

Corresponding notion to soundness

Conditions contain liveness properties



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