A Verifiable Language for Cryptographic Protocols

We develop a formal language for specifying cryptographic protocols in a structured and clear manner, which allows verification of many interesting properties; in particular confidentiality and integrity. The study sheds new light on the problem of creating intuitive and human readable languages, that are analysable with respect to interesting properties. Furthermore it motivates and is an example of, a novel, more general methodology of language design by first verbosely describing the semantics in a mathematical language, e.g. a logic, then restricting the properties of interest to be computable, and finally systematically transforming it into a more intuitive specification language, maintaining this tractability.

Iterative Specialisation of Horn Clauses

We present a generic algorithm for solving Horn clauses through iterative specialisation. The algorithm is generic in the sense that it can be instantiated with any decidable fragment of Horn clauses, resulting in a solution scheme for general Horn clauses that guarantees soundness and termination, and furthermore, it presents sufficient criteria for completeness. We then demonstrate the use of the framework, by creating an instance of it, based on the decidable class \( \mathcal{H}_1 \), capable of solving a non-trivial protocol analysis problem based on the Yahalom protocol.
Relational Analysis for Delivery of Services
Many techniques exist for statically computing properties of the evolution of processes expressed in process algebras. Static analysis has shown how to obtain useful results that can both be checked and computed in polynomial time. In this paper we develop a static analysis in relational form which substantially improves the precision of the results obtained while being able to deal with the full generality of the syntax of processes. The analysis reveals a feasible complexity for practical examples and gives rise to a fast prototype. We use this prototype to automatically prove the correct delivery of messages for the implementation of an accident service, which is based on multiplexed communication, a crucial feature of global computing applications.

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A Secure Simplification of the PKMv2 Protocol in IEEE 802.16e-2005

Static analysis is successfully used for automatically validating security properties of classical cryptographic protocols. In this paper, we shall employ the same technique to a modern security protocol for wireless networks, namely the latest version of the Privacy and Key Management protocol for IEEE 802.16e, PKMv2. This protocol seems to have an exaggerated mixture of security features. Thus, we iteratively investigate which components are necessary for upholding the security properties and which can be omitted safely. This approach is based on the LySa process calculus and employs the corresponding automated analysis tool, the LySaTool.

Cryptographic Pattern Matching

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Static analysis for blinding

The classical key distribution protocols are based on symmetric and asymmetric encryption as well as digital signatures. Protocols with different purposes often require different cryptographic primitives, an example being electronic voting protocols which are often based on the cryptographic operation blinding. In this paper we study the theoretical foundations for one of the successful approaches to validating cryptographic protocols and extend it to handle the blinding primitive. Our static analysis approach is based on Flow Logic; this gives us a clean separation between the specification of the analysis and its realisation in an automatic tool. We concentrate on the former in the present paper and provide the semantic foundation for our analysis of protocols using blinding - also in the presence of malicious attackers.

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