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Tutorial 7

Friday, December 7, 2018

Problem 1. *(Lamports protocol)* Discuss the following properties of Lamport's protocol:

a) Show that the one-way function is not required to be secret.

b) Which properties must a hash function fulfill to be usable as a one-way function in the protocol?

c) Propose a function that could be used as the one-way function, assuming that the discrete logarithm is hard to solve in $\mathbb{Z}_p^*$ for a usable p. Describe Lamport's protocol for this special case.

d) How can an attacker get access to a one-time password using an active attack?

Problem 2. *(Attacks on identification schemes)* Alice and Bob want to use the following identification schemes. Amongst others they are using a hash function h, some symmetric encryption E_k and some digital signatures S_A and S_B.

a) Alice and Bob use the following fixed password identification scheme.

1) $A \to B : pwd$
2) B verifies that $h(pwd)$ is equal to a stored version of the hashed password pwd.

Describe a replay attack for a fixed password identification. Can this replay attack be prevented by encrypting the password, i.e., Alice sends $E_k(pwd)$ to Bob?

b) The following challenge-response mutual authentication protocol is given.

1) $A \to B : r_A$
2) $A \leftarrow B : E_K(r_A, r_B)$
3) $A \to B : r_B$

Explain how an eavesdropper E can authenticate to A without knowing the symmetric key K by a reflection attack. How can such a reflection attack be avoided? Propose an improved protocol, where r_B is not revealed to an eavesdropper E.

c) The following challenge-response protocol based on digital signatures is given.

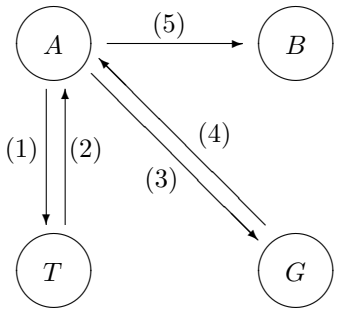
1) $A \to B : r_A$
2) $A \leftarrow B : r_B, S_B(r_B, r_A, A)$
3) $A \to B : r'_A, S_A(r'_A, r_B, B)$

Explain how an eavesdropper E can authenticate to B without signing any message with his own identity by an interleaving attack. How can this attack be avoided?

Problem 3. *(Kerberos with ticket granting server)* We introduce a ticket granting server for the simplified Kerberos protocol.
To establish secure *unilateral* authentication from A (Alice) to B (Bob) with a trusted authority server T (Trent) and a ticket granting server G (Grant), we use the following parameters:

- k_{AT} is a shared key between A and T.
- k_{AG} is a session key for secure communication between A and G.
- TGT is a ticket granting ticket to authenticate A to G.
- k_{TG} is a shared key between T and G.
- a_{AG} is an authenticator between A and G.
- k_{AB} is a session key for secure communication between A and B.
- k_{BG} is a shared key between G and B.
- ST is a service ticket to authenticate A to B.
- a_{AB} is an authenticator between A and B.
- Time stamps t_i and validity periods l_i, for $i = 1, 2, ...$

The sequence of messages to be exchanged by the protocol is provided in the figure below.



Formulate[1] the corresponding protocol and describe it with the parameters as given above.

[1] Feel free to use textbooks, www, etc.