Breaking the Simple Authenticated Key Agreement (SAKA) protocol

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Abstract

An active attack against a key agreement protocol based on a shared password is described\(^1\). If poorly chosen, as passwords often are, the password can be compromised by a simple brute force search.

1 Introduction

A recent paper by Seo and Sweeney, [3], describes SAKA, a method for ‘authenticated key agreement’ based on a shared password. The scheme is presented as an alternative to the schemes of Bellovin and Merritt, [2], and Anderson and Lomas, [1]. These latter schemes also enable a key to be set up using a shared secret password and have been carefully designed to prevent exhaustive searches for poorly chosen passwords.

Unfortunately, unlike the protocols of [1, 2], the SAKA protocol does nothing to protect the password against an active guessing attack. A cryptanalyst can engage in the protocol, masquerading as a genuine party, and then guess the password by attempting to decrypt a message subsequently sent with the agreed key.

2 Details of attack

In the protocol as described, A and B generate a shared secret key as follows. A chooses a random \(a\) and sends \(B\) the value \(g^aQ \mod n\), where \(g\) is a public Diffie-Hellman ‘base’ modulo \(n\) (a public prime), and where \(Q\) is the shared password. B chooses a random \(b\) and sends A the value \(g^bQ \mod n\). A and B can then both compute \(g^{ab} \mod n\) (using knowledge of \(Q^{-1} \mod n - 1\)).

Suppose C impersonates A to B in the above protocol and sends \(X = g^c \mod n\) to B (for a random \(c\)). B then sends \(Y = g^bQ \mod n\) to C (thinking he is talking to A). B computes the shared secret key as \(K = X^{bQ^{-1}} \mod n = g^{bcQ^{-1}} \mod n\). C cannot compute the shared key but knows it will equal \(Y^{cQ^{-2}} \mod n\).

Now suppose B encrypts the message \(M\) using \(K\), and suppose also that \(C\) knows part of \(M\) (knowing \(M\) consists of a string of 8-bit ASCII characters will typically be sufficient). If \(C\) knows the password \(Q\) is poorly chosen, then \(C\) simply works though all possible passwords \(Q\), computes \(K^* = Y^{cQ^{-2}} \mod n\) for each candidate, and uses \(K^*\) to decrypt the encrypted message. If the

\(^1\)This report was originally written in July 1999
result has elements which match the parts of $M$ known by $C$, then $C$ has discovered the password $Q$.

3 Conclusion

Contrary to the main purpose of the SAKA protocol, we have shown that it is subject to a simple password search if the attacker can conduct an active attack.

References

