Neumann Stubblebine

Author(s): B. Clifford Neumann and Stuart G. Stubblebine April 1993
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Summary: Session key exchange inspired by the Yahalom protocol with the addition of timestamps, and mutual authentication. Symmetric key cryptography with server.

Protocol specification (in common syntax)

```
A, B, S :          principal
Na, Ma, Nb, Mb :   number
Kas, Kbs, Kab :    key
Ta, Tb :           time

1.   A  ->  B  :   A, Na
2.   B  ->  S  :   B, {A, Na, Tb}Kbs, Nb
3.   S  ->  A  :   {B, Na, Kab, Tb}Kas, {A, Kab, Tb}Kbs, Nb
4.   A  ->  B  :   {A, Kab, Tb}Kbs, {Nb}Kab
5.   A  ->  B  :   Ma, {A, Kab, Tb}Kbs
6.   B  ->  A  :   Mb, {Ma}Kab
7.   A  ->  B  :   {Mb}Kab
```

Description of the protocol rules

The messages `1-4` are the part concerning the generation and exchange of the session key `Kab`. The messages `5-7` are the mutual authentification, this second part of the protocol can be repeated alone several times, until the ticket `{A, Kab, Tb}Kbs` expires (it is called *repeated authentication*).

Requirements

The protocol must guaranty the secrecy of `Kab`: in every session, the value of `Kab` must be known only by the participants playing the roles of `A`, `B` and `S` in that session.

The protocol must also ensures mutual authentication of `A` and `B`.

References

[NS93]

Claimed attacks

1. From [HLL+95], see also BAN simplified version of Yahalom for the first 4 messages, where B accepts the nonce Na has the fresh shared key Kab.

```
 1.   I(A)  ->   B    :   A, Na
 2.    B    ->  I(S)  :   B, {A, Na, Tb}Kbs, Nb
 3.                       omitted
 4.   I(A)  ->   B    :   {A, Na, Tb}Kbs, {Nb}Na
 5.   I(A)  ->   B    :   Ma, {A, Na, Tb}Kbs
 6.    B    ->  I(A)  :   Mb, {Ma}Na
 7.   I(A)  ->   B    :   {Mb}Na
```

See Hwang modified version of Neumann Stubblebine for a modified version preventing this attack.

2. From [HLL+95]. This attack concerns the repeated authentication part, assuming Kab has been recorded in a previous legitimate run of the protocol.

```
 i.5.    I(A)  ->   B    :   Ma, { A, Kab, Tb }Kbs
 i.6.     B    ->  I(A)  :   Mb, {Ma}Kab
 ii.5.   I(A)  ->   B    :   Mb, {A, Kab, Tb}Kbs
 ii.6.    B    ->  I(A)  :   Mb', {Mb}Kab
 i.7.    I(A)  ->   B    :   {Mb}Kab
```

3. From [Wei99]. In this attack, the intruder I can get as many ciphers {A, Kiab, Tb}Kbs as needed to start a known plaintext attack in order to break Kbs.

```
 a.2.   I(B)  ->   S    :   B, {A, K0ab, Tb}Kbs, Nb
 a.3.    S    ->  I(A)  :   {B, Na, K1ab, Tb}Kas, {A, K1ab, Tb}Kbs, Nb
 b.2.   I(B)  ->   S    :   B, {A, K1ab, Tb}Kbs, Nb
 b.3.    S    ->  I(A)  :   {B, Na, K2ab, Tb}Kas, {A, K2ab, Tb}Kbs, Nb
                            etc
```

See also

Yahalom

Citations

[HLL+95] Tzonelih Hwang, Narn-Yoh Lee, Chuang-Ming Li, Ming-Yung Ko, and Yung-Hsiang Chen. Two attacks on neumann-stubblebine authentication protocols. *Information Processing Letters*, 53:103 – 107, 1995.

[NS93] B. Clifford Neumann and Stuart G. Stubblebine. A note on the use of timestamps as nonces. *Operating Systems Review*, 27(2):10–14, april 1993.

[Wei99] Christoph Weidenbach. Towards an automatic analysis of security protocols. In Harald Ganzinger, editor, *Proceedings of the 16th International Conference on Automated Deduction*, volume 1632 of *LNAI*, pages 378–382. Springer, 1999.