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2021 年 3 月 31 日

Abstract

A user identity anonymity is an important property for roaming services. In 2011, Kang et al. proposed an improved user authentication scheme that guarantees user anonymity in wireless communications. This letter shows that Kang et al.'s improved scheme still cannot provide user anonymity as they claimed.

Keywords: *cryptanalysis, authentication, anonymity, wireless communications, security*

1 Introduction

In 2004, Zhu and Ma [1] proposed an authentication scheme with anonymity for wireless communication environments. Later, Lee et al. [2] showed several security flaws of Zhu-Ma' s scheme and then improved it. However, in 2008, Wu et al. [3] showed that both Zhu-Ma' s scheme and Lee et al.' s scheme still cannot provide anonymity and then proposed an improvement to preserve anonymity. Nevertheless, Zeng et al. [4] and Lee et al. [5] showed that Wu et al.' s scheme also cannot provide anonymity, respectively.

In 2011, Kang et al. [7] proposed an improved user authentication scheme based on both Wu et al.' s and Wei et al.' s schemes [3], [6] that guarantees strong user anonymity in wireless communications. However, this letter shows that the Kang et al.' s improved scheme also cannot provide user anonymity as they claimed.

2 Review of Kang et al.s Scheme

2.1 Initial Phase

Where an MU registers with his/her HA, the MU's identity ID_{MU} is submitted to the HA. After receiving ID_{MU} from MU, HA generates PW_{MU}, r_1 and r_2 as follows.

$$PW_{MU} = h(N||ID_{MU}) \tag{1}$$

$$r_1 = h(N||ID_{HA}) \tag{2}$$

$$r_2 = h(N||ID_{MU}) \oplus ID_{MU} \tag{3}$$

where N is a secret value kept by *HA*.*HA* stores ID_{HA}, r_1, r_2 and $h(\cdot)$ in the smart card of MU and then sends it with PW_{MU} to MU through a secure channel.

2.2 First Phase

$$n = h(T_{MU}||r_1) \oplus r_2 \oplus PW_{MU} \tag{4}$$

$$L = h(T_{MU} \oplus PW_{MU}) \tag{5}$$

$$ID_{MU} = h(T_{MU}||h(N||ID_{HA})) \oplus n \oplus ID_{HA} \tag{6}$$

$$\begin{aligned} k &= h(h(h(N||ID_{MU}))||x||x_0) \\ &= h(h(PW_{MU}))||x||x_0 \end{aligned} \tag{7}$$

2.3 Second Phrase

$$k = h\left(h\left(h\left(N\|ID_{MU}\right)\right)\|x\|x_{i-1}\right) \tag{8}$$

3 Anonymity Problem of Kang et al.s Scheme

$$\begin{aligned} n' =& h\left(T'_{MU}\|r_1\right) \oplus r'_2 \oplus PW'_{MU} \\ =& h\left(T'_{MU}\|r_1\right) \oplus h\left(N\|ID'_{MU}\right) \oplus ID_{HA} \\ & \oplus ID'_{MU} \oplus PW'_{MU} \\ =& h\left(T'_{MU}\|r_1\right) \oplus h\left(N\|ID'_{MU}\right) \oplus ID_{HA} \\ & \oplus ID'_{MU} \oplus h\left(N\|ID'_{MU}\right) \\ =& h\left(T'_{MU}\|r_1\right) \oplus ID_{HA} \oplus ID_{MU} \end{aligned} \tag{9}$$

$$\begin{aligned} ID'_{MU} =& n' \oplus h\left(T'_{MU}\|r_1\right) \\ =& h\left(T'_{MU}\|r_1\right) \oplus ID_{HA} \oplus ID'_{MU} \\ & \oplus ID_{HA} \oplus h\left(T'_{MU}\|r_1\right) \\ =& ID'_{MU} \end{aligned} \tag{10}$$

4 Conlusions

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