

Instructions for Authors of SBC Conferences

Papers and Abstracts

Giovani Ferreira¹, Rafael Marconi¹

¹CEUB - Centro Universitário de Brasília
Caixa Postal 4488 – 70.904-970 – Brasília – DF – Brazil

Abstract. adhaskjdhaksjd [Tanenbaum and Van Steen 2002]

1. Introduction

Collision search is an important tool in cryptanalysis. A broad range of cryptanalytic problems such as computing discrete logarithms, finding hash function collisions, and meet-in-the-middle attacks can be reduced to the problem of finding two distinct inputs, a and b , to a function f such that $f(a) = f(b)$ [Van Oorschot and Wiener 1999].

2. Related Concepts

2.1. Message Integrity

Message integrity is normally maintained via the protocol called “MAC” or Message Authentication Code. To briefly explain its mechanism,

In the digital world, the techniques for transmission and integrity assurance of messages are in constant evolution, aiming more efficient and secure protocols. A protocol’s security can be threatened by innumerable different ways, some possibly unknown yet, and requires a reasonable time of study, tests and attacks to be considered for use in real applications.

O protocolo de autenticação HMAC pode ser entendido em detalhes em [Krawczyk et al. 1997], mas como uma breve introdução, consideremos o seguinte exemplo: Alice deseja se comunicar com Bob, a integridade deve ser mantida, ou seja, the message should not be tampered with or changed to contain false or modified information:

1. Alice gera uma signing tag $S(k, m)$, for m = message and k = secret key between Alice and Bob
2. Bob ao receber a mensagem, runs a verification algorithm, defined by $V(k, m, tag) = V(k, m, S(k, m))$
3. Using the same key, the algorithm will return *yes* which shows that message integrity has been maintained

In that way, Bob is able to identify that the message sent by Alice was not compromised and its content is exactly what Alice had written.

2.2. Hash Collision

Hash functions are designed to take a message of arbitrary bitlength and map it to a fixed size output called a hash result. Let $H : M \rightarrow R$ be such a hash function. Typically, hash functions are constructed from a function $h : B \times R \rightarrow R$ which takes a fixed

size block of message bits together with an intermediate hash result and produces a new intermediate hash result. A given message $m \in \mathbb{M}$ is typically padded to a multiple of the block size and split into blocks $m_1, m_2, \dots, m_l \in B$. The padding often includes a field which indicates the number of bits in the original message. Beginning with some constant $r_0 \in \mathbb{R}$, the sequence $r_i = h(m_i, r_{i-1})$ is computed for $i = 1, 2, \dots, l$, and r_l is the hash result for message m [Van Oorschot and Wiener 1999].

2.3. Birthday Attack

The birthday paradox is the counter-intuitive principle that for groups of as few as 23 persons there is already a chance of about one half of finding two persons with the same birthday (assuming all birthdays are equally likely and disregarding leap years). Compared to finding someone in this group with your birthday where you have 23 independent chances and thus a success probability of $\frac{23}{365} \approx 0.06$, this principle is based on the fact that there are $\frac{23 \cdot 22}{2} = 253$ distinct pairs of persons. This leads to a success probability of about 0.5 (note that this does not equal $\frac{253}{365} \approx 0.7$ since these pairs are not independently distributed) [Stevens et al. 2012].

The following is the general algorithm for the Birthday Attack and in the next section I will discuss the Birthday Paradox, which is a problem that gave birth to the Birthday Attack algorithm.

1. Let $H : M \rightarrow \{0, 1\}^n$ be a hash function. From this we know that the size of the tag space is $\approx 2^n$ bits and that $|M| \gg 2^n$
2. We choose $2^{\frac{n}{2}}$ random messages in \mathbb{M} , i.e. $m_1, m_2, \dots, m_{2^{\frac{n}{2}}} \in \mathbb{M}$.
3. For $i = 1, 2, \dots, 2^{\frac{n}{2}}$ compute $t_i = H(m_i)$, where t_i is the hash value in the tag space.
4. We then search for any collisions, i.e. $t_i = t_j$ for $i, j \in 1, 2, \dots, 2^{\frac{n}{2}}$. If this is not found we go back to step 1 and repeat with different message samples.

2.4. Se pa - Distributed System

A distributed system is a collection of independent computers that appears to its users as a single coherent system [Tanenbaum and Van Steen 2002].

3. Experiments and Evaluation

Foram aplicados tecnicas de paralelismo (openmp) e distribuicao (mpi) visando uma melhoria na performance da busca por colisao. A funcao hash usada nos testes foi a MD5.

4. Conclusions and Future work

Referências

- Krawczyk, H., Canetti, R., and Bellare, M. (1997). Hmac: Keyed-hashing for message authentication.
- Stevens, M. M. J. et al. (2012). *Attacks on hash functions and applications*. Mathematical Institute, Faculty of Science, Leiden University.
- Tanenbaum, A. S. and Van Steen, M. (2002). *Distributed systems: principles and paradigms*, volume 2. Prentice hall Englewood Cliffs.
- Van Oorschot, P. C. and Wiener, M. J. (1999). Parallel collision search with cryptanalytic applications. *Journal of cryptology*, 12(1):1–28.