StreamHash2 Hash Function

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Outline

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History of StreamHash Family

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- Multicollision Attack (Antoine Joux: Multicollisions in Iterated Hash Functions, CRYPTO 2004)
  - Complexity of $\frac{n}{2} \cdot 2^{n/4}$ for finding collisions
  - Complexity of $\frac{n}{2} \cdot 2^{n/2}$ for finding preimages
- Issue addressed in StreamHash2 by introducing a counter

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- Internal state cycles
- The $\oplus$ operation of StreamHash did not propagate changes between the four bytes of the 32-byte state word
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Functional Requirements

Hash function $h(m)$ is expected to meet the following requirements

- Input m can be of any length
- Output of $h(m)$ has a predefined, fixed length
- $h(m)$ is fast to compute for any given m

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Security Requirements

- **Preimage resistance**
  Practically infeasible for any given $h(m)$ to compute m
- **Second preimage resistance**
  Practically infeasible for any given m_1 message it is infeasible to find another m_2 such that $h(m_1) = h(m_2)$
- **Collision resistance**
  Practically infeasible to find two different messages m_1 and m_2 such that $h(m_1) = h(m_2)$

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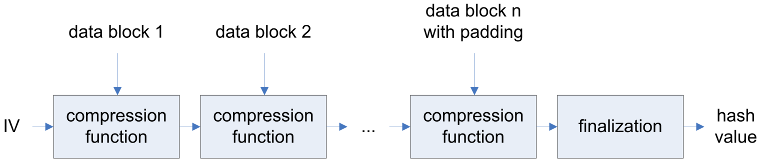
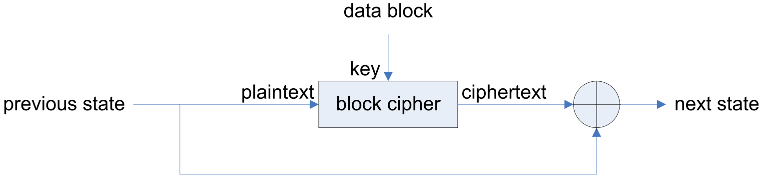
Merkle-Damgård Construction



Davies-Meyer Compression Function



$$H_i \leftarrow E_{m_i}(H_{i-1}) \oplus H_{i-1}$$

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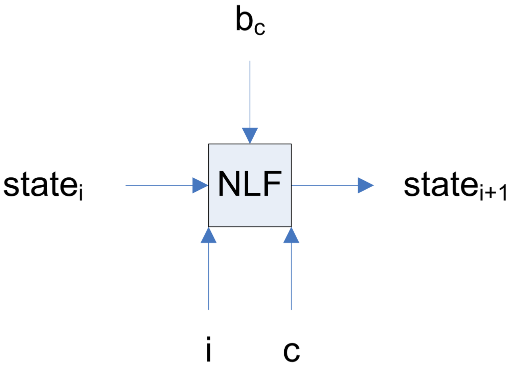
State Vector

State vector consists of 32-bit words

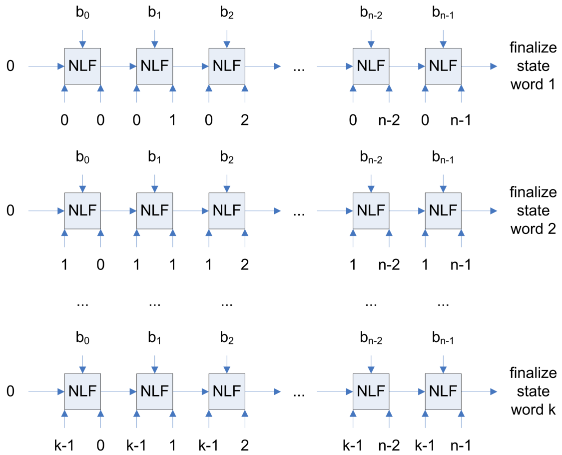
- $7 \times 32 = 224$ bits
- $8 \times 32 = 256$ bits
- $12 \times 32 = 384$ bits
- $16 \times 32 = 512$ bits

NLF Transformation

NLF is a non-linear transformation based on an S-BOX



StreamHash Family Structure



NLF Implementation of StreamHash2 Function

$$state_{i+1} \leftarrow state_i \boxplus S\text{-}BOX[LSB(state_i) \oplus b \oplus i] \boxplus c$$

, where:

- b processed byte value
- c processed byte index
- i state vector index
- $S\text{-}BOX$ S-BOX table
- $state$ state vector

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- Clear and easy to analyze design
- Minimal size of code
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- High performance on 8-bit and 16-bit architectures
- Low latency
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- Expensive hardware implementation
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