

# Symmetric-key cryptography V

Example of block cipher

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(with lots of slides by Daniel J. Bernstein)

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2MMC10 – Cryptology

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Upcoming slides: mostly good cipher apart from too small  $n = 64$ .  
But: small variations can be quickly broken.

# TEA, a tiny encryption algorithm, $n = 64, |k| = 128$

1994 Wheeler and Needham

```
void encrypt(uint32 *b,uint32 *k)
{
    uint32 x = b[0], y = b[1];
    uint32 r, c = 0;
    for (r = 0;r < 32;r += 1) {
        c += 0x9e3779b9;
        x += y+c ^ (y<<4)+k[0]
                ^ (y>>5)+k[1];
        y += x+c ^ (x<<4)+k[2]
                ^ (x>>5)+k[3];
    }
    b[0] = x; b[1] = y;
}
```

uint32: 32 bits ( $b_{31}, b_{30}, \dots, b_1, b_0$ )  
representing integer  
 $2^{31}b_{31} + 2^{30}b_{30} + \dots + 2b_1 + b_0$ .

+: addition mod  $2^{32}$ .

c += d: same as  $c = c + d$ .

0x9e3779b9: hexadecimal  
for 2654435769.

^: xor;  $\oplus$ ; addition of  
each bit separately mod 2.  
Lower precedence than + in C  
(= first do + operation), so  
spacing is not misleading.

<<4: multiplication by 16, i.e.,  
( $b_{27}, \dots, b_1, b_0, b_0, 0, 0, 0, 0$ ).

>>5: division by 32, i.e.,  
( $0, 0, 0, 0, 0, b_{31}, \dots, b_6, b_5$ ).

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Right column: Diagram for one of the 32 rounds, without update of  $c$ .

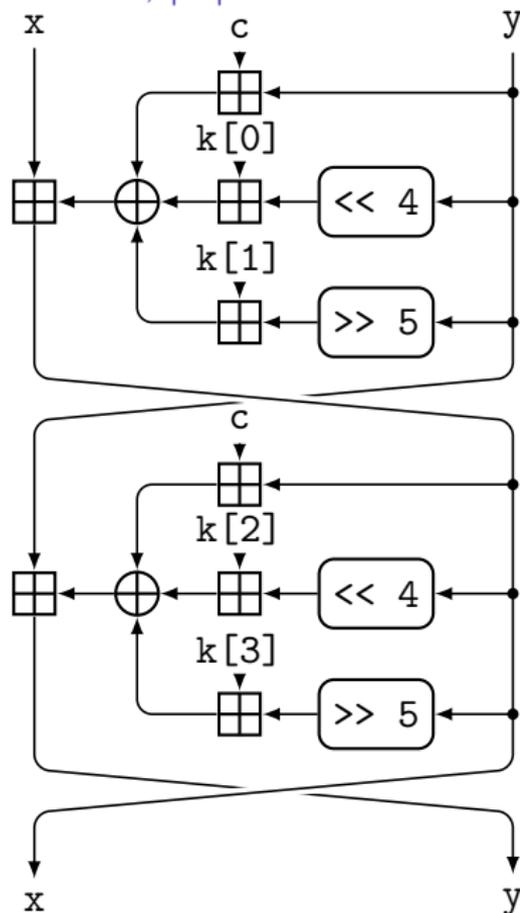


Image credit: adapted from [Roberto Avanzi](#)