Sekuritas Jaringan

Pertemuan 4

Baskoro Adi P.

Double DES & Triple Des

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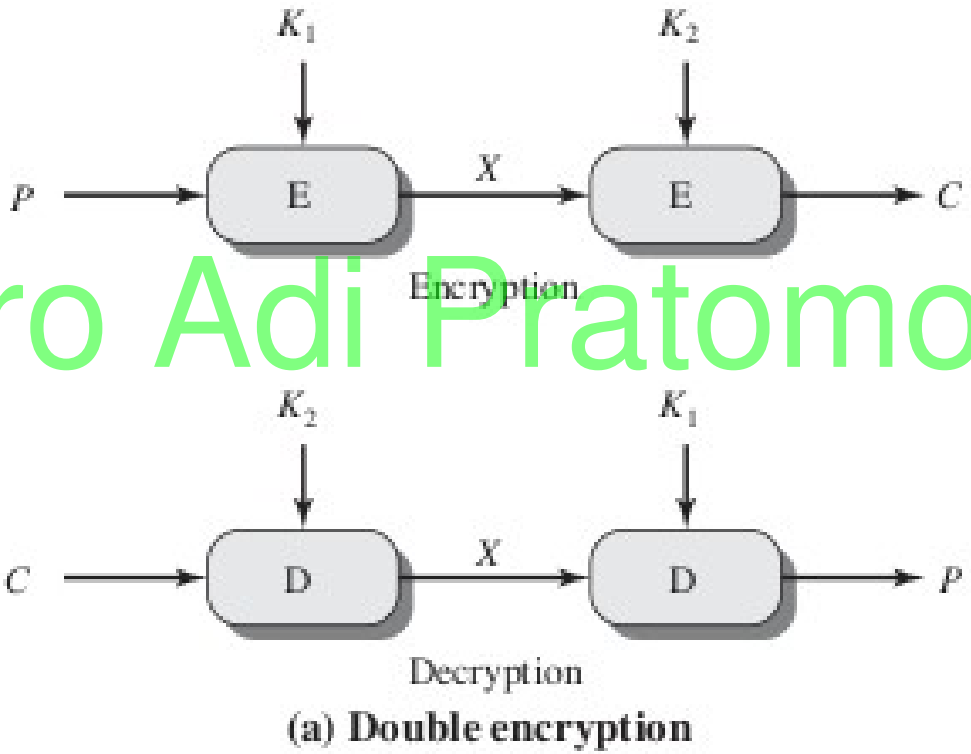
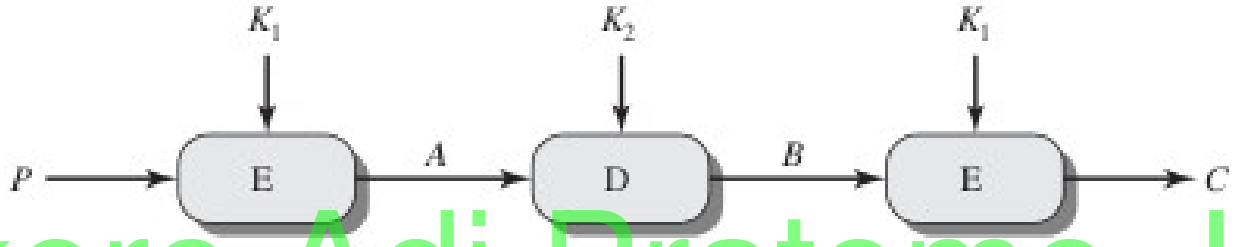
Double DES



(a) **Double encryption**

Triple DES



(b) Triple encryption

Pseudorandom Number Generator

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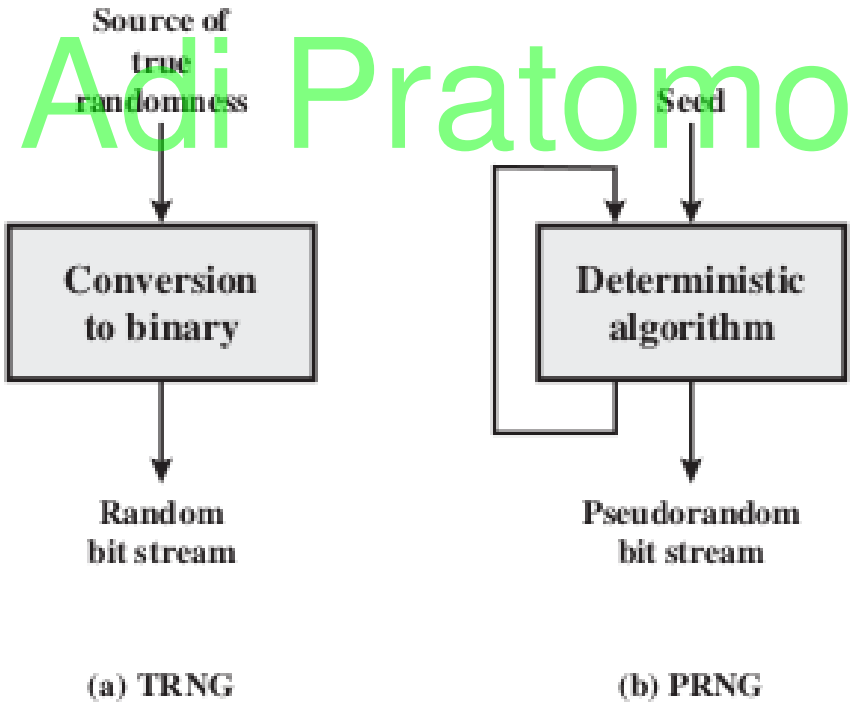
One Time Pad

- Penggunaan kunci dengan isi yang acak dan sepanjang pesan, serta digunakan untuk sekali enkripsi

```
      H       E       L       L       O  message
   7 (H)   4 (E)  11 (L)  11 (L)  14 (O) message
+ 23 (X)  12 (M)   2 (C)  10 (K)  11 (L) key
= 30      16      13      21      25     message + key
=  4 (E)  16 (Q)  13 (N)  21 (V)  25 (Z) message + key (mod 26)
      E       Q       N       V       Z  → ciphertext
```

Generate Random Number

- True Random Number Generator (TRNG)
- Pseudorandom Number Generator (PRNG)



PRNG Requirements

- Randomness
  - Uniformity
  - Scalability
  - Consistency
- Unpredictability
  - Forward unpredictability
  - Backward unpredictability
- Seed Requirement

PRNG Algorithm

- Purpose Built Algorithm
  - Linear Congruential Generator
  - Blum Blum Shub Generator
- Algorithm based on existing cryptographic algorithm
  - Symmetric Cipher
  - Asymmetric Cipher
  - Hash Function & MAC

Linear Congruential Generators

- $X_{n+1} = (aX_n + c) \bmod m$
- Dimana :
  - m : modulus : m > 0
  - a : multiplier : 0 < a < m
  - c : increment : 0 <= c < m
  - X_0 : Seed / nilai awal : 0 <= X_0 < m

Linear Congruential Generators (2)

- Jika :
  - A = C = 1
  - A = 7, C = 0, M = 32, X_0 = 1
  - A = 5, C = 0, M = 32, X_0 = 1
  - A = 7^5, C = 0, M = 2^{31}, X_0 = 1
- Bagaimana random number yang dihasilkan?

Blum Blum Shub

- Cari dua bilangan p dan q, dimana :
  - p mod 4 = q mod 4 = 3
- n = p x q
- Pilih random number s, dimana :
  - n dan s adalah relatively prime
    - GCD (n, s) = 1
- Generator :

$$X_0 = s^2 \bmod n$$

$$\textbf{for}\ i = 1\ \textbf{to}\ \infty$$

$$X_i = (X_{i-1})^2 \bmod n$$

$$B_i = X_i \bmod 2$$

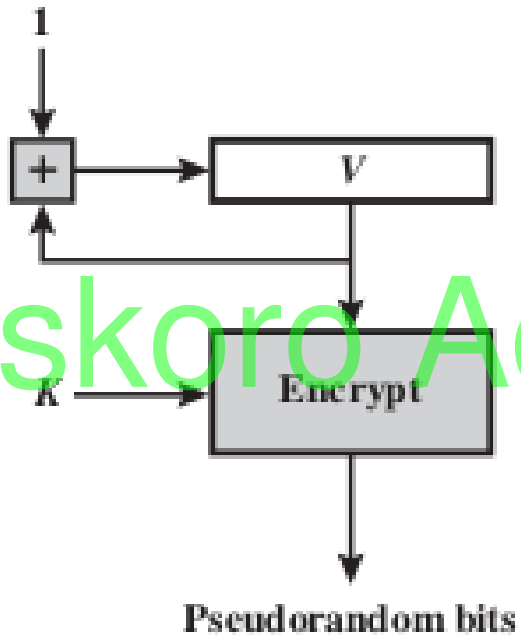
Blum Blum Shub (2)

- Contoh :
  - Jika p = 383, q = 503, s = 101355, hitung B_1

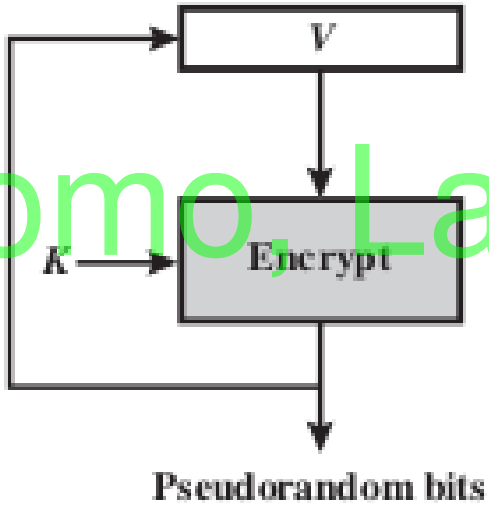
Table 7.1 Example Operation of BBS Generator

i	X_i	B_i
0	20749	
1	143135	1
2	177671	1
3	97048	0
4	89992	0
5	174051	1
6	80649	1
7	45663	1
8	69442	0
9	186894	0
10	177046	0
11	137922	0
12	123175	1
13	8630	0
14	114386	0
15	14863	1
16	133015	1
17	106065	1
18	45870	0
19	137171	1
20	48060	0

PRNG Using Block Cipher



(a) CTR mode



(b) OFB mode

ANSI X9.17 PRNG

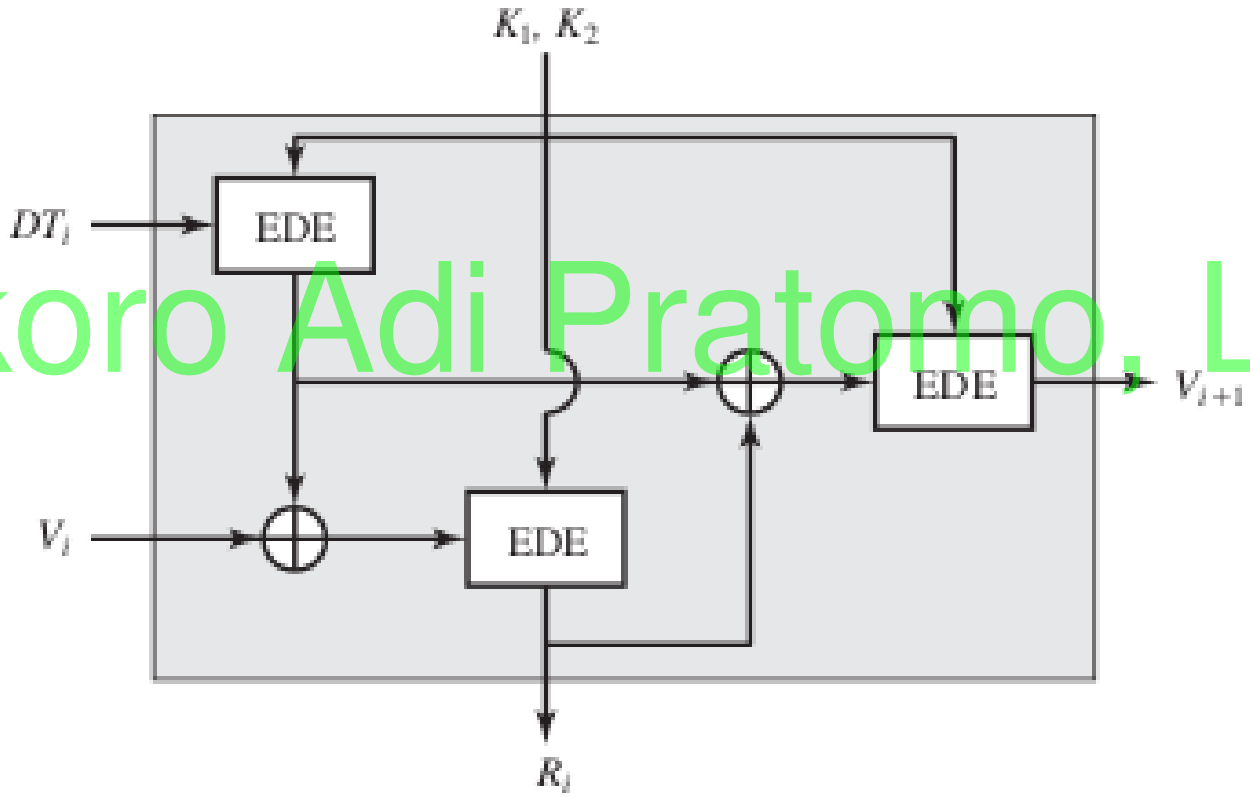


Figure 7.4 ANSI X9.17 Pseudorandom Number Generator

Stream Cipher

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Stream Cipher

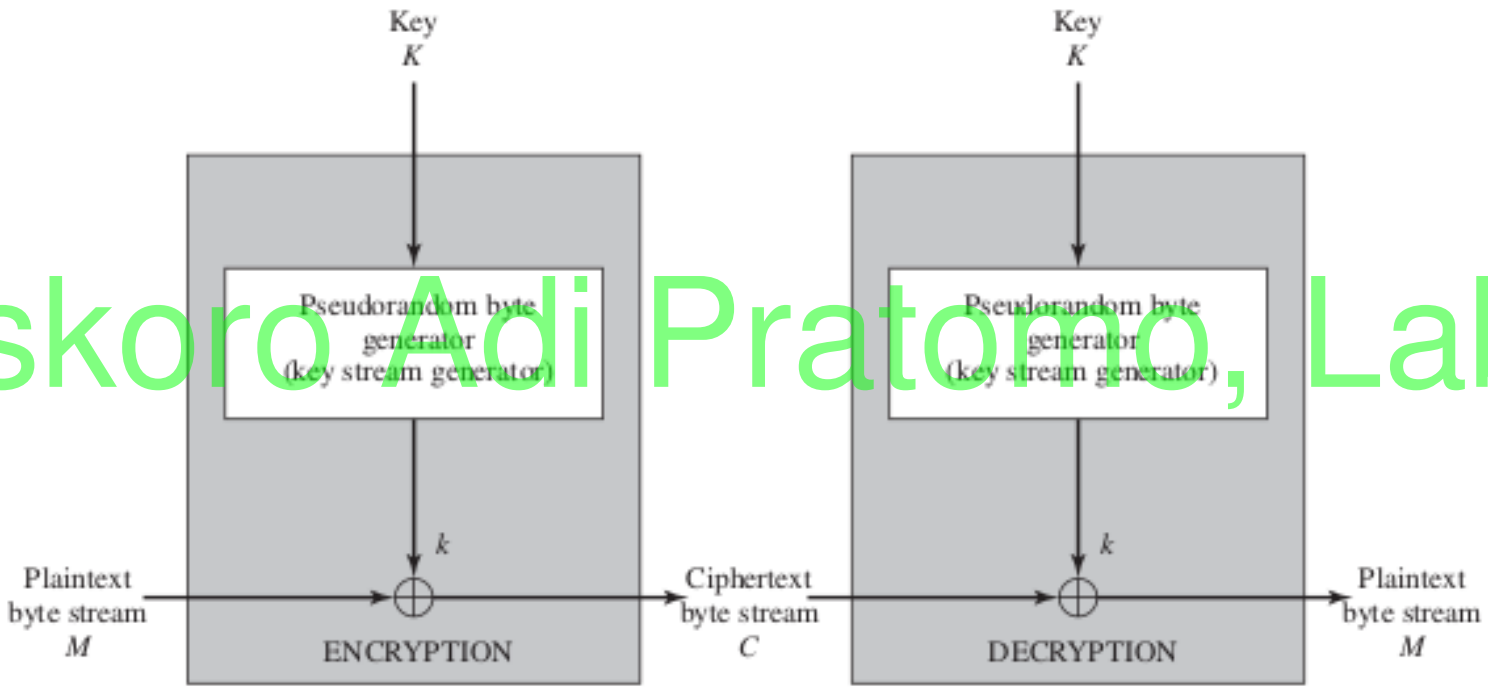

Figure 7.5 Stream Cipher Diagram

Perbandingan Kecepatan

Table 7.4 Speed Comparisons of Symmetric Ciphers on a Pentium II

Cipher	Key Length	Speed (Mbps)
DES	56	9
3DES	168	3
RC2	Variable	0.9
RC4	Variable	45

RC4

- Dibuat pada 1987
- Key size : 1-256 bytes
- Operasi : per-byte
- Digunakan di :
  - Secure Socket Layer
  - WEP
  - WPA

RC4 Algorithm

- Siapkan 256 byte state vector S
  - S[0]=0,S[1]=1,S[2]=2,...,S[255]=255
- Inisialisasi :
  - ```
    for i = 0 to 255 do
        S[i] = i;
        T[i] = K[i mod keylen];
    ```
- Permutasi Awal untuk S :
  - ```
    j = 0;
    for i = 0 to 255 do
        j = (j + S[i] + T[i]) mod 256;
        Swap (S[i], S[j]);
    ```

RC4 Algorithm (2)

- Keystream Generation
  - ```
    i, j = 0;
    while (true)
        i = (i + 1) mod 256;
        j = (j + S[i]) mod 256;
        Swap (S[i], S[j]);
        t = (S[i] + S[j]) mod 256;
        k = S[t];
    ```
- Enkripsi :
  - k XOR data
    ```

TUGAS PROGRAMMING
&
DISKUSI