



Why Random Numbers for Cryptography?

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Short Answer:

Because we need to improve the overall quality of our RBGs and how we implement them.

Historical: Key and IV Generation

- “A DES key consists of 64 binary digits (“0”s or “1”s) of which 56 bits are randomly generated and used directly by the algorithm.” (FIPS 46, 1977)
- DES Modes of Operation (FIPS 81, 1980) uses IVs as “randomizing” blocks for CBC, CFB, and OFB modes
- Financial Institution Message Authentication (ANSI X9.9-1982) makes use of keyed DEA
- Message or Data Authentication Codes using DES (FIPS 113, 1985) points to ANSI X9.17 for key generation of keys
- Idea: Use block cipher to generate pseudo-random blocks

Historical: RNG for Financial Institution Key Management (ANSI X9.17-1985)

$K^* = (K1, K2)$ = secret key pair

$TDEA_{K^*}(X)$ = TDES encryption of X

S = secret seed

1. DT = date time

2. $I = TDEA_{K^*}(DT)$

3. $R = TDEA_{K^*}(I \text{ XOR } S)$ = Deterministic Random Output

4. $S = TDEA_{K^*}(R \text{ XOR } I)$

5. Go to step 1.

Asymmetric Key Generation

- The Digital Signature Standard (FIPS 186) provides several DRNGs to generate pseudorandom values
 - Private key x such that $0 < x < q$ where q is a prime divisor of $p-1$.
 - Secret internal value k such that $0 < k < q$
- Idea: Can use a hash function to generate pseudorandom values
- These RNGs were intended for generating integers modulo q rather than blocks
- These functions are used as general non-deterministic RNGs
- Little or no advice about seed generation was provided

Other Uses

- **PIN and Password Generation**
 - PIN Protection Principles, ANSI X9.8:1
 - Password Generation, FIPS 181-1993
- **Generation of Primes**
 - DSA, ANSI X9.30
 - RSA, ANSI X9.31
 - Prime Number Generation, ANSI X9.80
- **Random Challenges for Authentication**
 - Entity Authentication using PKC, FIPS 196
- **Key Confirmation**
 - ECC Key Agreement and Transport, ANSI X9.63
 - NIST Key Schemes Recommendation
- **Nonces**

FIPS 140-1&2 RNG Requirements

- Use of an approved RNG for key generation
- Continuous RNG Test
- Statistical Tests
 - Laboratory validation tests
 - Self tests
- Idea: “Compromising the RNG shall require at least as many operations as determining the value of the generated key.”

Why ANSI X9.82?

- Need for general guidance on RBGs for cryptographic applications
- Need for application independent RBGs
- Need for guidance on seed generation
- Need for best guidance on development of non-deterministic RBGs
- Need for more comprehensive validation tests (without going overboard)
- Need for in depth consideration that is provided by standards development
- Need to improve overall quality of cryptographic RBGs



Related Efforts

- U.S. Government development and use of X9.82 techniques and methods
- ANSI X9.82 Concepts submitted as input to ISO/IEC CD 18031. (See Debby Wallner)



*And Now,
DANSI X9.82*