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Application Security Cryprography in .NET

Agenda

- Classes hierarchy
- Random numbers generation
- Hash functions
- Symmetric and asymmetric encryption
- Slow functions
- Recommendations
- DPAPI

Cryptography in .NET

- Main namespace
  - System.Security.Cryptography
- Classes hierarchy
  - SymmetricAlgorithm, AsymmetricAlgorithm, HashAlgorithm, RandomNumberGenerator (abstract)
  - Aes, Rsa, RC2 (abstract)
  - Implementations
    - *CryptoServiceProvider (e.g. AesCryptoServiceProvider)
      - Based on Windows Cryptography API (CAPI)
      - Certified by FIPS (Federal Information Processing Standards)
    - *Managed (e.g. AesManaged)
      - Based fully on manager code
      - Not certified by FIPS
    - *Cng (e.g. ECDsaCng) (CNG = cryptography next generation)
      - Available since Windows 2008/Vista
      - Only several algorithms supported nowadays

Cryptography in .NET

- Random numbers generation
  - RNGCryptoServiceProvider (better)
  - System.Random (faster)

Cryptography in .NET

- Hash functions
  - Classic hash functions
  - Message Authentication Codes (with password)
    - Based on hash functions: HMAC
    - Based block cipher algorithm: CBC-MAC
  - What is .NET?
    - HashAlgorithm
      - MD5, MD160 (RIPEMD160), SHA1, SHA26, SHA384, SHA512
    - KeyedHashAlgorithm
      - HMACMD5, MACRIPEMD160, HMACSHA1, HMACSHA256, HMACSHA384, HMACSHA512
      - MACTripleDES

Cryptography in .NET

- Symmetric encryption and decryption
  - Base class for symmetric algorithms
    - System.Security.Cryptography.SymmetricAlgorithm
  - Algorithms
    - Rijndael
      - Block sizes supported: 128, 160, 192, 224, and 256
    - Aes
      - Chosen by NIST to become a standard
      - Rijndael with limit set of block (128) and key sizes (128, 192, 256)
    - DES, TripleDes, RC2

Cryptography in .NET

- Asymmetric encryption and decryption
  - Base class for symmetric algorithms
    - System.Security.Cryptography.AsymmetricAlgorithm
  - Algorithms
    - DSA
    - ECDiffieHellman
    - ECDsa
    - RSA

Cryptography in .NET

- Asymmetric encryption and decryption
  - In this type of encryption, keys are stored in keys containers
  - Class CspParameters
    - Identified by KeyContainerName
  - Keys can be stored in a
    - Machine-Level RSA Key Container (available to everyone)
    - User-Level RSA Key Container (available to user)
      - Files in: %APPDATA%\Microsoft\Crypto\RSA

Cryptography in .NET

- Slow functions
  - PBKDF2 (Rfc2898DeriveBytes class)
    - Example of PBKDF2
      - DK=PBKDF2(HMAC–SHA1, passphrase, ssid, 4096, 256)
        - 4096 – number of iterations
        - 256 – key length
  - BCrypt,SCrypt (no direct implementations)
- Applications:
  - Generating keys and initialize vectors
  - Slow functions can be used for storing passwords

Cryptography in .NET

- Useful helper classes
  - BitConverter
    - ToInt32()
    - ToString()
  - Encoding.UTF8
    - GetString(byte[])
    - GetBytes(string)
  - System.Security.SecureString

Cryptography in .NET

- Summary what to use:
  - Data privacy: Aes
  - Data integrity: HMACSHA256, HMACSHA512
  - Digital signature: ECDsa, RSA
  - Key exchange: ECDiffieHellman, RSA
  - Random number generation:
    - RNGCryptoServiceProvider
  - Generating a key from a password:
    - Rfc2898DeriveBytes

Source: http://msdn.microsoft.com/en-us/library/0ss79b2x(v=vs.110).aspx

Cryptography in .NET

- Windows Data Protection API (DPAPI)
  - Another way for symmetric encryption of data
  - One advantage: you don't care about keys
    - Windows take care
    - It can be: machine-level or user-level
  - ProtectedData class
  - File:
    - %APPDATA%\Microsoft\Protect\{SID}

Cryptography in .NET

- Example
  - RandomNumbers
  - SymmetricEncryptionDecryption
  - AsymmetricEncryptionDecryption
  - DPAPI

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