PV181 Laboratory of security and applied cryptography

CryptoAPI

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CAPI

CryptoAPI (Cryptographic Application Programming Interface, Microsoft Cryptography API, MS-CAPI or simply CAPI) is an application programming interface included with Microsoft Windows operating systems that provides services to enable developers to secure Windows-based applications using cryptography. It is a set of dynamically linked libraries that provides an abstraction layer which isolates programmers from the code used to encrypt the data. (CryptoAPI supports both public-key and symmetric key cryptography)

CAPI provides:

1. Secure data storing
2. Ability to transfer data
3. Validation from 3rd party users
4. Work with cryptographic standards
5. Extension

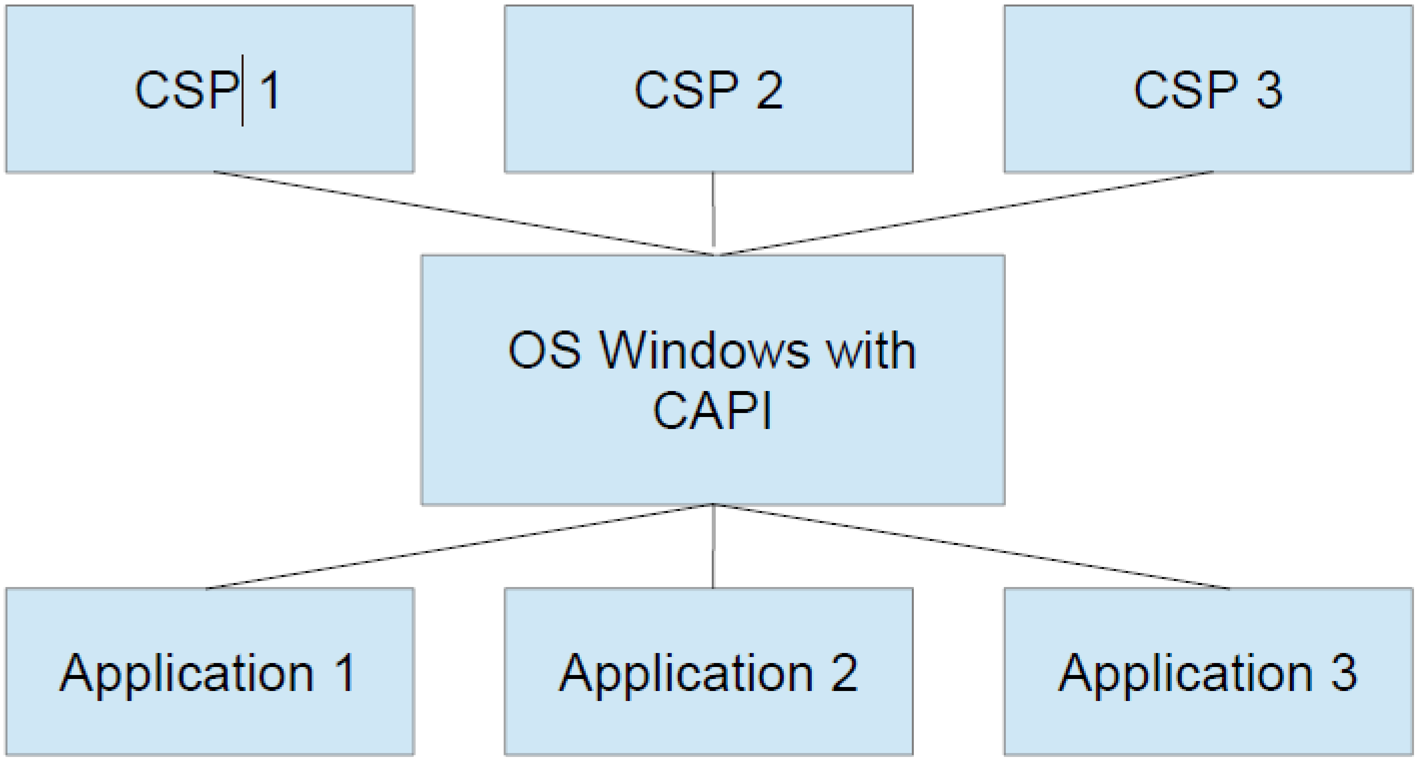
CAPI functionality groups:

1. Basic cryptographic functions:
   1. encoding / decoding
   2. hash function
   3. initializing CSP, working with context
   4. key generation
   5. key exchanging
2. Functions for working with certificates
3. High-level functions
4. Low-level functions

CSP

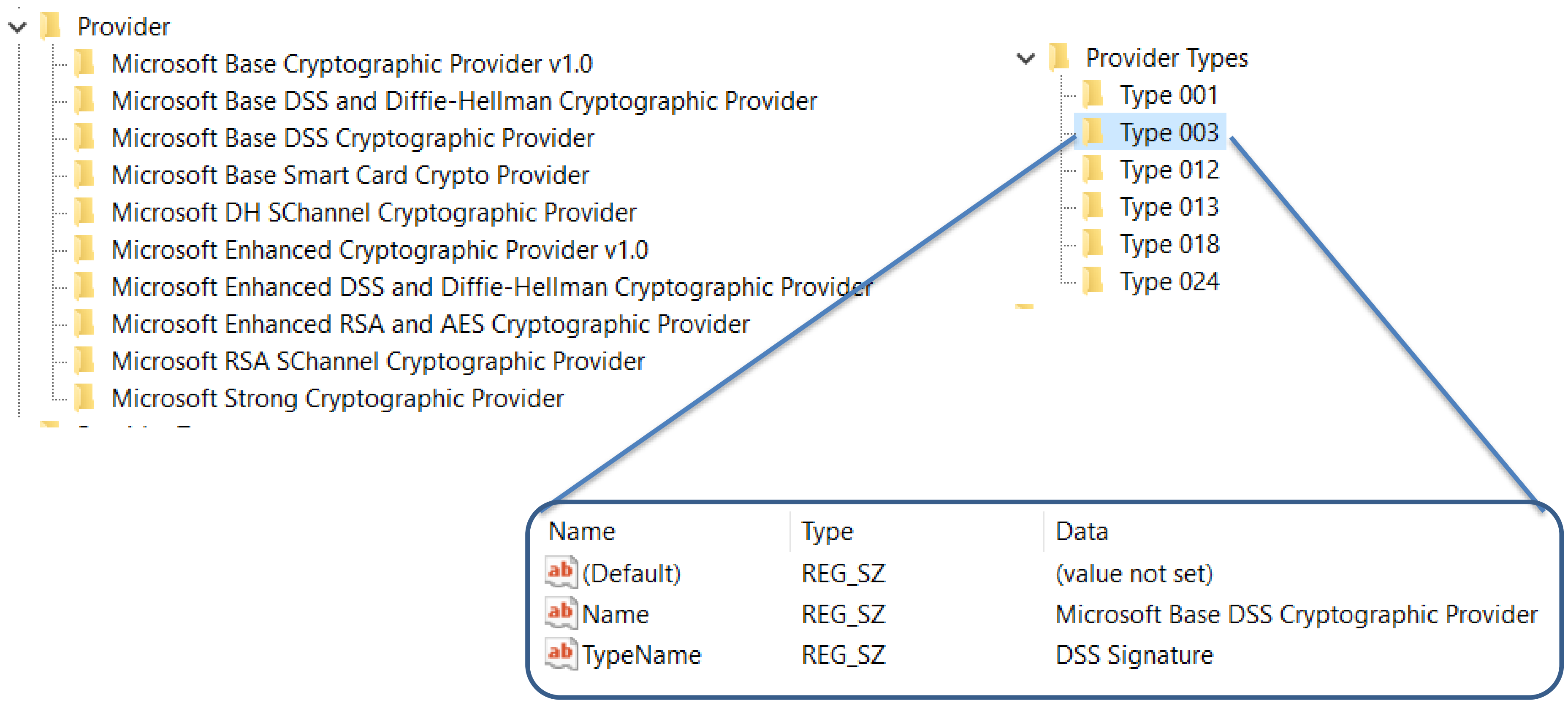
- CSP (Cryptography Service Provider) - is a software library that implements the Microsoft CryptoAPI (CAPI). CSPs implement **encoding** and **decoding** functions, which computer application programs may use.
- CSP provides:
  - implementation of the standard interface
  - work with encode / decode keys
  - inability to interference from third parties
- 2 function groups for working with CSP:
  - initialization of the context and getting CSP parameters
  - Key generation and function for work with them
  - encode / decode functions
  - Hash functions

CAPI & CSP & Apps



CSP on current machine

HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Cryptography\Defaults\Provider\



- Provider
  - Microsoft Base Cryptographic Provider v1.0
  - Microsoft Base DSS and Diffie-Hellman Cryptographic Provider
  - Microsoft Base DSS Cryptographic Provider
  - Microsoft Base Smart Card Crypto Provider
  - Microsoft DH SChannel Cryptographic Provider
  - Microsoft Enhanced Cryptographic Provider v1.0
  - Microsoft Enhanced DSS and Diffie-Hellman Cryptographic Provider
  - Microsoft Enhanced RSA and AES Cryptographic Provider
  - Microsoft RSA SChannel Cryptographic Provider
  - Microsoft Strong Cryptographic Provider

- Provider Types
  - Type 001
  - Type 003
  - Type 012
  - Type 013
  - Type 018
  - Type 024

Name	Type	Data
(Default)	REG_SZ	(value not set)
Name	REG_SZ	Microsoft Base DSS Cryptographic Provider
TypeName	REG_SZ	DSS Signature

CAPI and terminology

- Work with: CSPs + keys
- Key containers
  - store keys (symmetric, private or public)
  - associated to CSP

- Context - session between CAPI and client App
- Session key – volatile objects **never** leave CSP
  - import, export functions
- Key BLOB - contain an encrypted private key

CAPI programming

1. Call **CryptAcquireContext** function (returns handle)
2. work with handle – potentially other objects should be created (e.g. hash objects)

```
BOOL CryptAcquireContext(
  HCRYPTPROV *phProv,          // pointer to a handle of a CSP
  LPCSTR     szContainer,      // key container name
  LPCSTR     szProvider,       // name of the CSP
  DWORD      dwProvType,       // type of provider to acquire
  DWORD      dwFlags           // Flags)
```

See manual with examples:

https://docs.microsoft.com/en-us/windows/win32/seccrypto/cryptography-portal

CNG

- Cryptography API: Next Generation(CNG)
  - since Vista
- Two modes: kernel, user (same API)
  - user mode – CNG provider in Bcrypt.dll
  - kernel mode - *Ksecdd.sys*
- Functions: key funcs, crypto primitives
- Crypto agility:
  - easy to add functions

CAPI vs CNG

- CAPI
  - algs (**numeric constants**) defined in *wincrypt.h*
  - hard to add new algorithm
- CNG
  - algs are **strings**
  - new CSP can be created – no need to sign it by MS
  - possible to query CNG for supported algs
  - Newer algs – NSA Suite B and several others

CNG programming

Most of the CNG APIs require a provider or an object created by a provider.

1. Opening the Algorithm Provider
2. Getting or Setting Algorithm Properties
3. Creating or Importing a Key
4. Performing Cryptographic Operations
5. Closing the Algorithm Provider

CNG: Example

```
BCryptOpenAlgorithmProvider(&hAlg...)
BCryptGetProperty(hAlg,  BCRYPT_BLOCK_LENGTH,  &dwBlockSize...)
//allocate buffer, rounding up to next block size

BCryptGetProperty(hAlg,  BCRYPT_OBJECT_LENGTH, &cbKeyObjectLen...)
//allocate buffer for key object

BCryptGenerateSymmetricKey(hAlg, &hKey...)
BCryptEncrypt(hKey,...)                         //data is now encrypted

BCryptDestroyKey(hKey)
BCryptCloseAlgorithmProvider(hAlg,0)            //deallocate buffers
```