Fachhochschule Nordwestschweiz
Hochschule für Technik

Understanding Assemblies

and Reflecting on them

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Learning Target

- You
  - can explain the concept and format of .Net assemblies
  - can explain the content of a .Net assembly
  - can explain the concept of the global assembly cache
  - can develop a public assembly
  - understand and can explain the .Net Reflection concept
  - can apply the .Net reflection API to analyze assemblies
  - can apply the .Net reflection API to dynamically load assemblies and classes

Content

Assemblies

- Role and Format of .Net Assemblies
- The Global Assembly Cache
- Managing Private and Public Assemlies

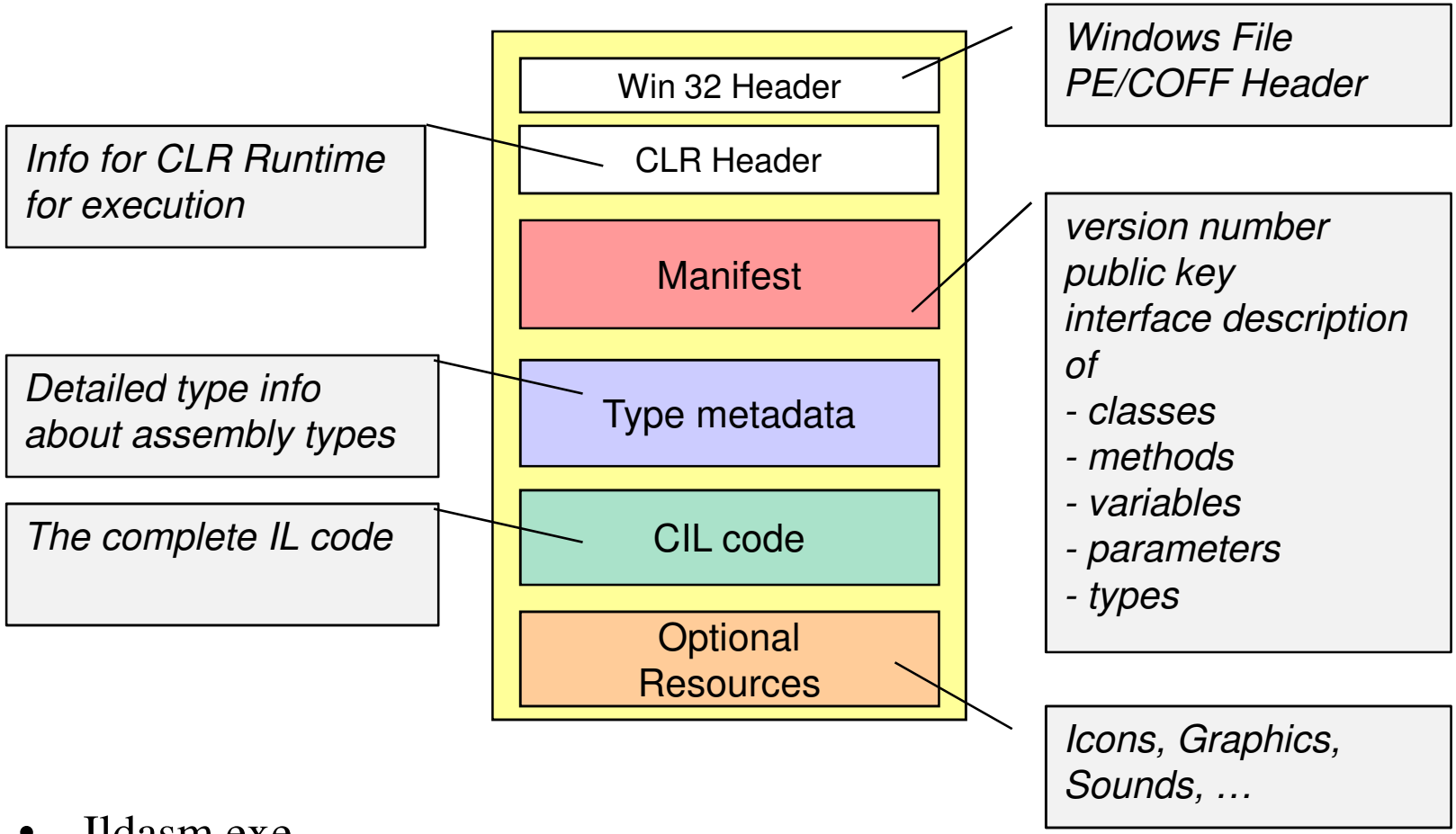
Reflection

- Type Information in .Net Assemblies
- Loading and Analyzing .Net Assembly

Role of .Net Assemblies

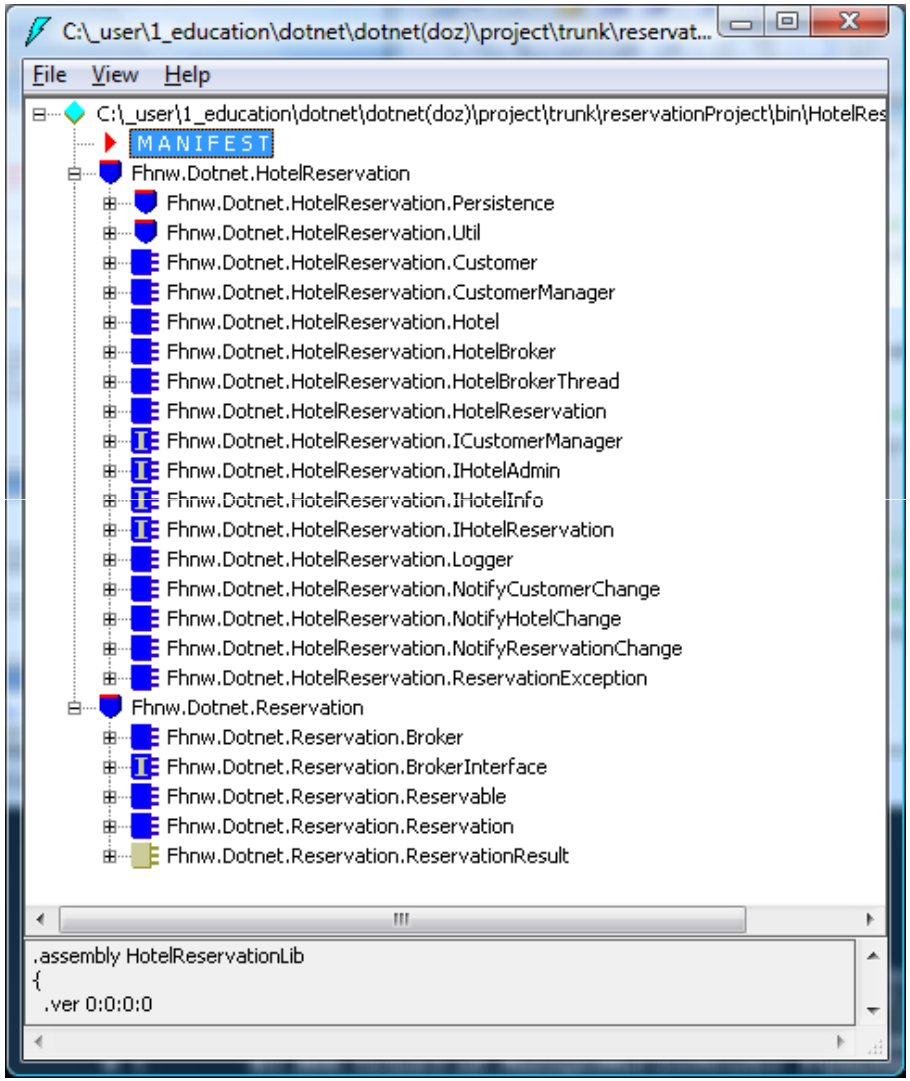
- Assemblies Promote Code Reuse
  - Are the smallest executable unit
- Assemblies Establish a Type Boundary
  - Types in a .Net assembly are considered to be unique
- Assemblies Are Versionable Units
  - Contain exact version info
- Assemblies Are Self-Describing
  - Contain all type info
- Assemblies Are Configurable
  - Can be stored anywhere

The Format of a .Net Assembly

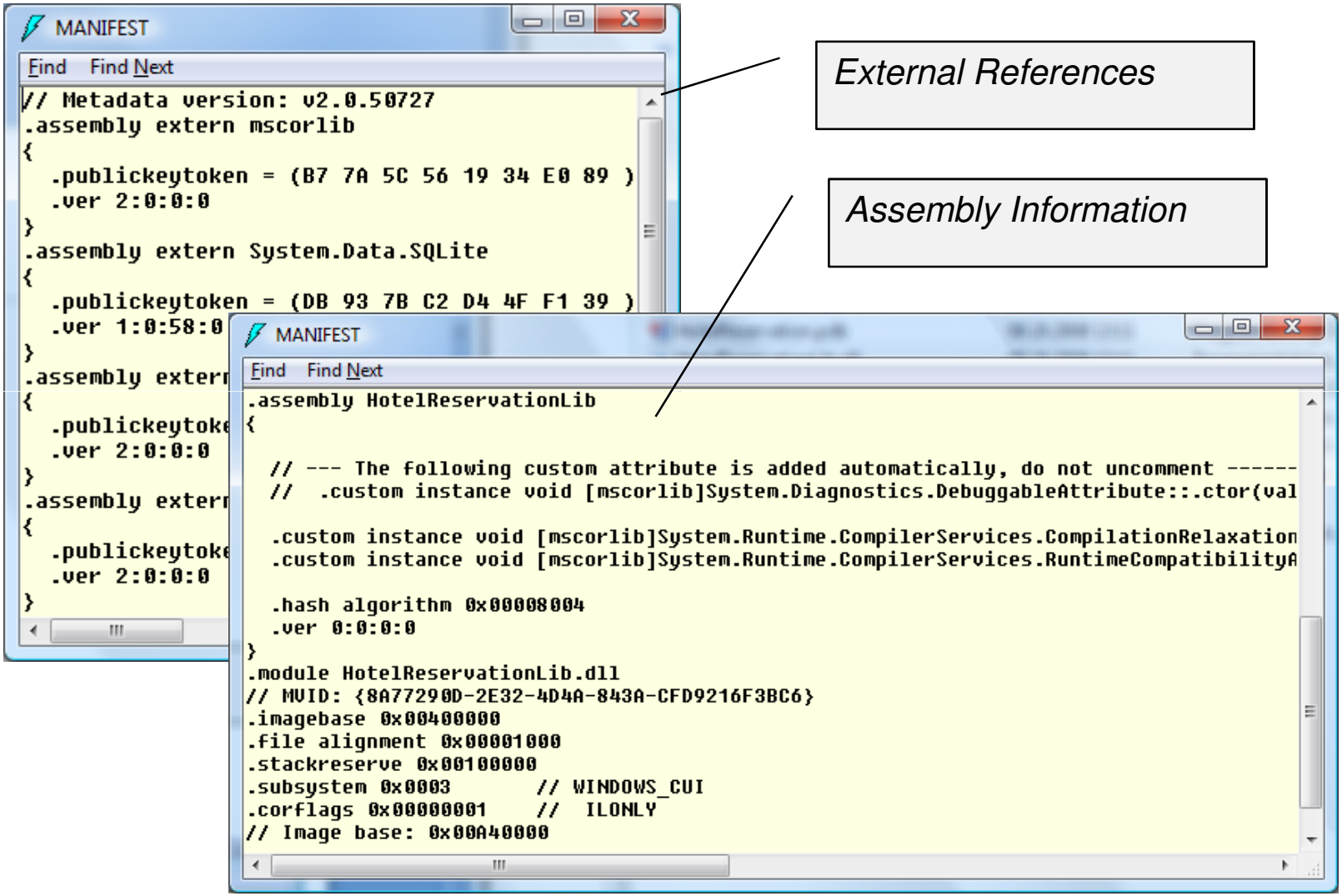


- Ildasm.exe
- dumpbin.exe [/headers | /clrheader]

Format of .Net Assembly – ILDASM - View

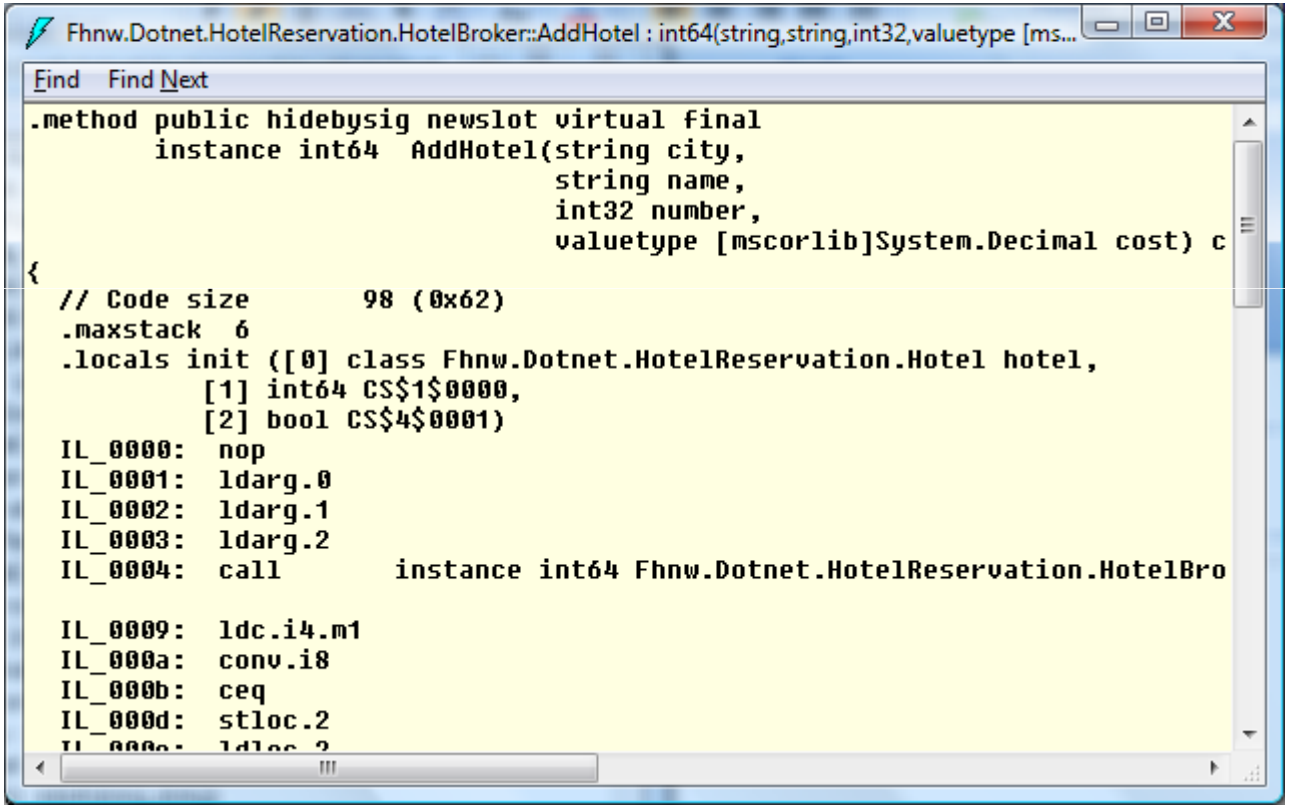


Assembly Manifest



… and the IL Code

- HotelBroker.AddHotel



Managing Private Assemblies

- Usually located in the executable's directory

- .Net Probing Process
  - The process how the runtime resolves the location of private external assemblies
  - 1. Look for DLL in clients assembly location
  - 2. Look for EXE in clients assembly location
  - 3. Look for either DLL or EXE in a subdirectory with same name as the assembly in clients assembly location
  - If not found "FileNot Found Exception"
  - Usually stored in the local directory
  - Can also be stored in any other location using the applications config file

Configuring Private Assemblies

- Can also be stored in any other location using the applications config file (*AppName.exe.config*)

```
<configuration>
  <runtime>
    <assemblyBinding xmlns="urn:schemas-microsoft-com:asm.v1">
       <probing privatePath="MyLibraries"/>
    </assemblyBinding>
  </runtime>
</configuration>
```

Managing Shared Assemblies

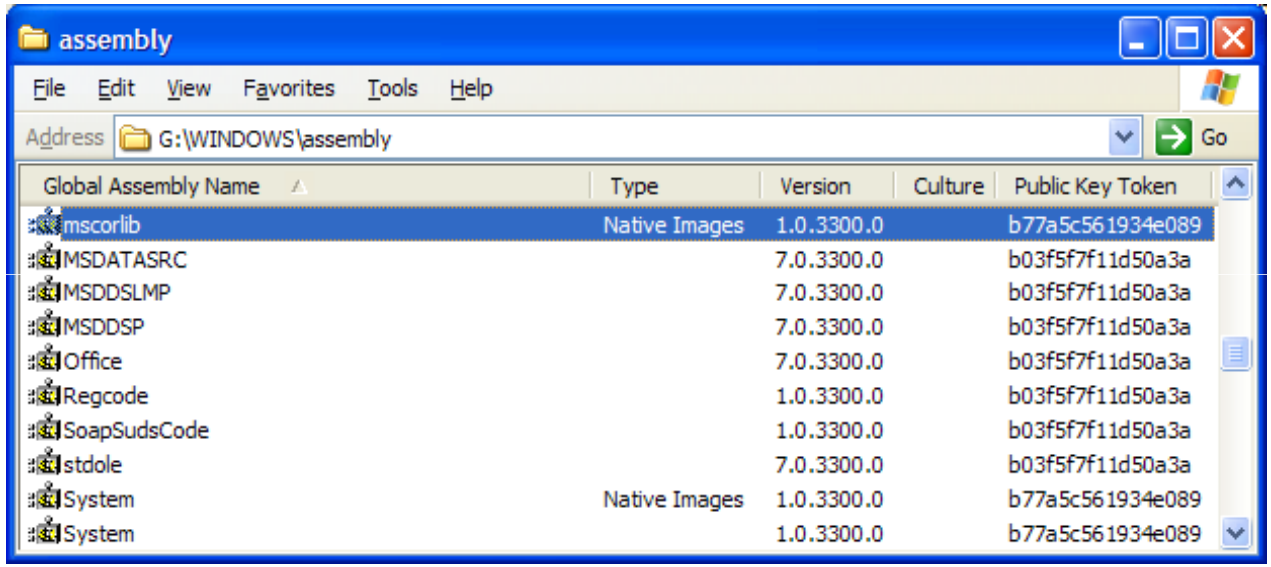
- Share the Assembly with other applications
  - Can be used several applications
  - Only one copy stored

- The Global Assembly Cache (GAC)
  - A safe Win\System32 repository ☺
  - Can store different versions of the same assembly
  - Only limited and controlled access

- Various GACs
  - GAC – .net 1.x
  - GAC_32 / GAC_64
  - GAC_MSIL

The Global Assembly Cache

- A *View* on the GAC
  - (using Explorer plugin “Assembly Cache Viewer“ (shfushion.dll)



- The Actual path

```
C:\Windows\assembly\NativeImages1_v1.1.4322\mscorlib\1
.0.5000.0__b77a5c561934e089_1dc9747c\mscorlib.dll
```

Installing Assemblies into the GAC

- No direct Access
- Installing with the GACUtil (gacutil.exe)

  > gacutil **-i** GlobalLib.dll

- Removing assemblies from the GAC

  > gacutil **-u** GlobalLib

- Only **signed** assemblies can be stored
  - Assembly is signed with a **strong name**

Strong Name for Assemblies

- "strong" assembly name consists of:
  - name
  - version number (major.minor.build.revision)
  - culture attribute (usually neutral)
  - hash value of a public key

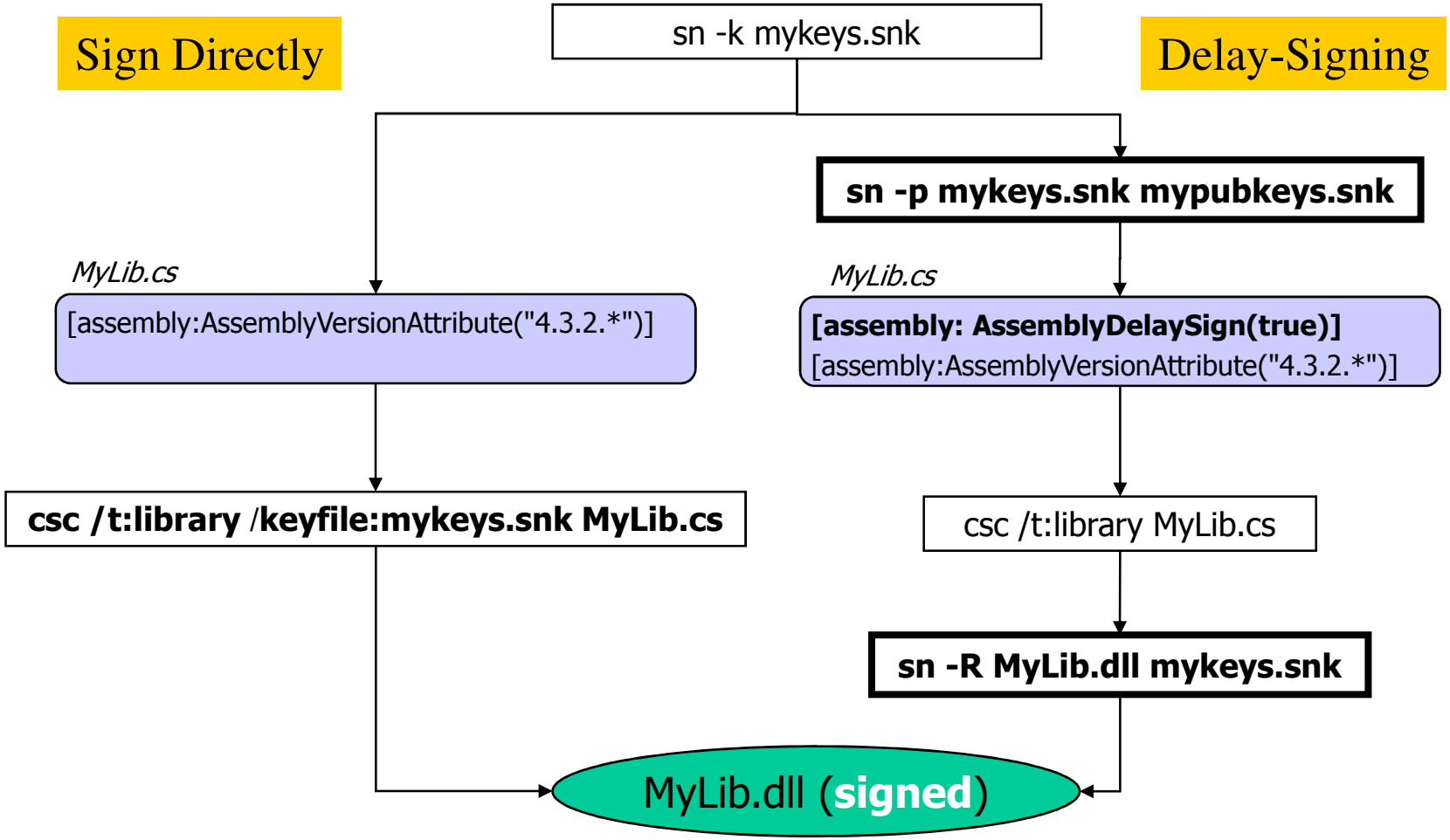
e.g. MyLib,
Version=1.2.745.18000,
Culture=en-US,
PublicKeyToken=13a3f300fff94cef

Strong Name Tool (sn.exe)

Command line tool for

- generating pairs of private & public keys
  > sn **-k** mykeys.snk
- extracting the public key from a key pair
  > sn **-p** mykeys.snk mypubkey.snk
- delayed signing of assemblies
  > sn **-R** MyLib.dll mykeys.snk

Signing an Assembly

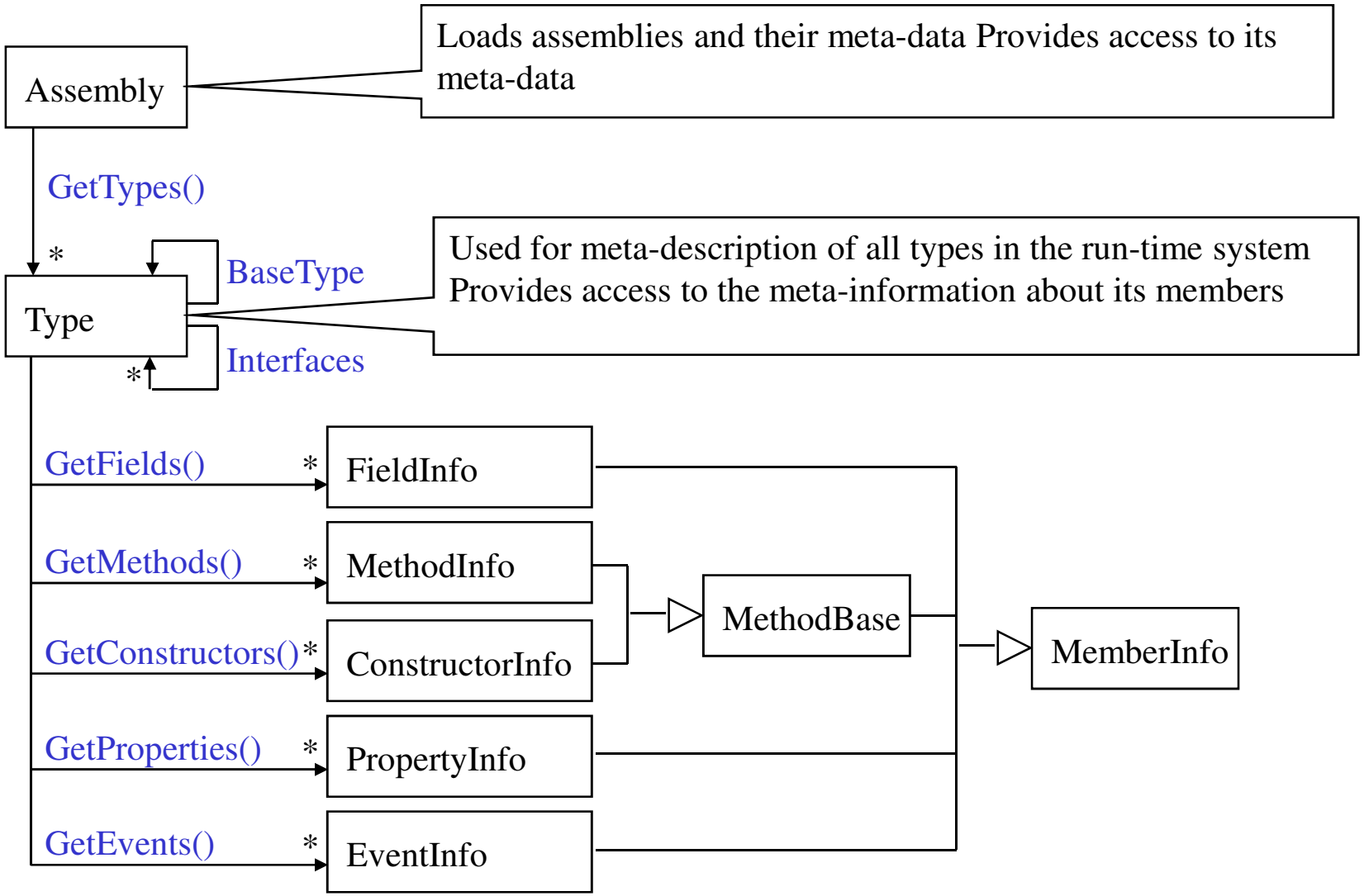


Reflection

- Permits access to meta-information of types at run-time
- System.Reflection allows:
  - Getting meta-information about assemblies, modules and types
  - Getting meta-information about the members of a type
  - Dynamic creation of instances of a type at run-time
  - Search for methods and their dynamic invocation at run-time
  - Accessing values of properties and fields of an object
  - Design of new types at run time

    ➔ namespace *System.Reflection.Emit*

Reflection Class Hierarchy



Example Reflection

- Loading the assembly "HelloWorld.exe":

```
Assembly a = Assembly.Load("HelloWorld");
```

```
namespace Hello {
    public class HelloWorld {
    public static void Main(string[] args)
    { ... }
    public override string ToString() {
    …  }
    }
}
```

- Print all existing types in a given assembly

```
Type[] types = a.GetTypes();
foreach (Type t in types)
    Console.WriteLine(t.FullName);
```

```
Hello.HelloWorld
```

- Print all existing methods of a given type

```
Type hw = a.GetType("Hello.HelloWorld");
MethodInfo[] methods = hw.GetMethods();
foreach (MethodInfo m in methods)
    Console.WriteLine(m.Name);
```

```
Main
ToString
```

Example Reflection (2)

- Create a new instance of a given type

```
Assembly a = Assembly.Load("HelloWorld");
object o = a.CreateInstance("Hello.HelloWorld");
```

- Get method ToString(), which has no parameters
- Invoke the method

```
Type hw = a.GetType("Hello.HelloWorld");
MethodInfo mi = hw.GetMethod("ToString");
object retVal = mi.Invoke(o, null);
```

Reflection.Emit

- Reflection.Emit allows creation of assemblies and types at run-time
  - creation of assemblies
  - creation of new modules
  - creation of new types
  - creation of symbolic meta-information of existing modules

- System.Reflection.Emit supports realization of .NET compilers und interpreters

- Important classes of Reflection.Emit are
  - AssemblyBuilder to define assemblies
  - ModuleBuilder to define modules
  - TypeBuilder to define types
  - MethodBuilder to define methods
  - ILGenerator to emit IL-code