



Sharing common assemblies between processes and domains

Article: <https://habrahabr.ru/post/341950/>

Source code: <https://github.com/sflusov/IISSharingAssemblies>

The presentation target

- Optimization path
- Tools for analyzing

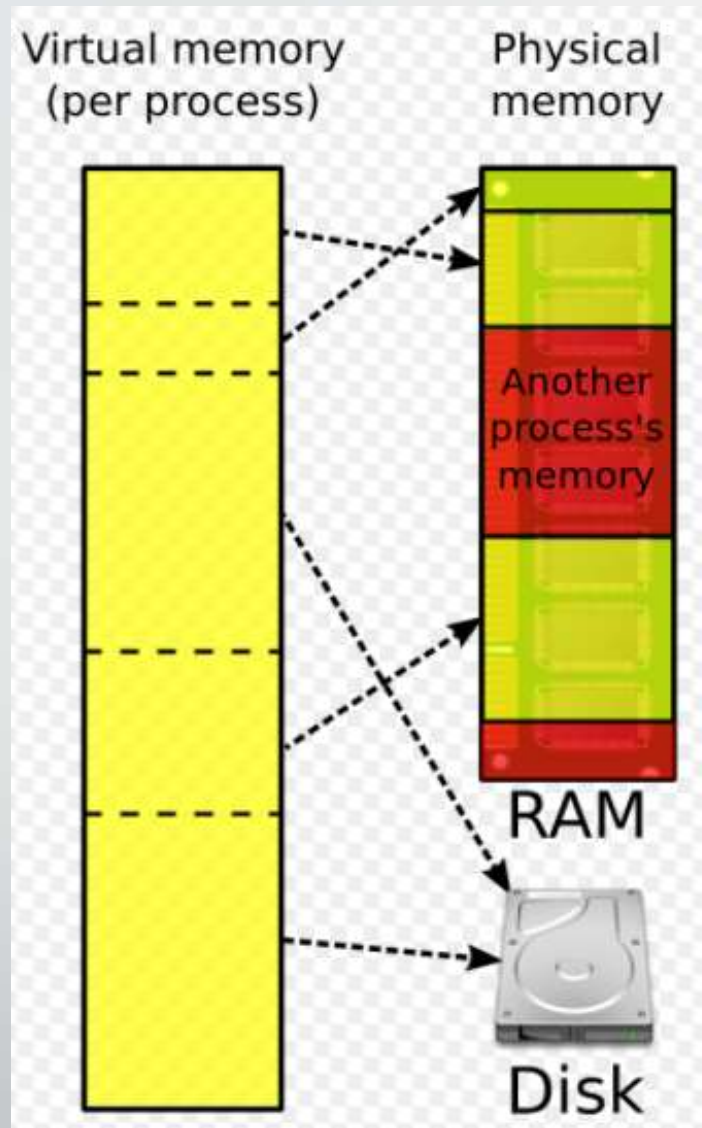
Used tools

- [Sysinternals Process Explorer v16.21](#)
- [Sysinternals VMMap v3.21](#)

Agenda

- Memory structure and types
- Sharing assemblies between application domains
- Sharing assemblies between processes
- Real example

What do you really mean by memory?



Virtual memory:

- 32-bit - 2GB per process
- 64-bit – 128TB per process

See also:

- <http://blogs.microsoft.co.il/sasha/2016/01/05/windows-process-memory-usage-demystified/>

What do you really mean by memory?

Task Manager

File Options View

Processes Performance App history Startup Users Details Services

Name	PID	Working set ...	Memory (private working s...	Memory (shared ...	Commit size
ctfmon.exe	15900	14,728 K	1,744 K	12,984 K	3,340 K
dasHost.exe	9580	428 K	16 K	412 K	860 K
devenv.exe	11312	344,996 K	164,036 K	180,960 K	307,124 K
dllhost.exe	9324	11,128 K	1,712 K	9,416 K	4,116 K
dllhost.exe	9656	20,076 K	1,828 K	18,248 K	3,668 K
dwantispam....	16136	3,580 K	640 K	2,940 K	1,056 K
dwarkdaemo...	5828	24,908 K	17,256 K	7,652 K	174,640 K
dwengine.exe	5664	78,244 K	74,820 K	3,424 K	334,956 K
dwm.exe	15800	128,428 K	61,408 K	67,020 K	148,608 K
dwnetfilter.exe	7924	106,780 K	36,688 K	70,092 K	94,092 K
dwservice.exe	2248	22,696 K	11,488 K	11,208 K	55,956 K
dwwatcher.exe	7420	456 K	168 K	288 K	796 K
explorer.exe	16260	123,716 K	35,488 K	88,228 K	82,792 K
Far.exe	1376	41,032 K	10,924 K	30,108 K	14,440 K
fontdrvhost.e...	920	616 K	80 K	536 K	2,448 K
fontdrvhost.e...	7344	10,244 K	1,980 K	8,264 K	4,720 K
GoogleCrash...	6436	1,088 K	444 K	644 K	1,848 K
GoogleCrash...	8276	12 K	8 K	4 K	1,668 K
iexplore.exe	6492	28,596 K	3,424 K	25,172 K	12,488 K
iexplore.exe	8760	31,128 K	1,048 K	30,080 K	21,964 K
igfxCUIServic...	1708	3,132 K	16 K	3,116 K	2,080 K

^ Fewer details End task

devenv.exe:11312 Properties

Security Environment Job .NET Assemblies .NET Performance Strings
Image Performance Performance Graph GPU Graph Threads TCP/IP

CPU

Priority	8
Kernel Time	0:00:59.250
User Time	0:03:09.906
Total Time	0:04:09.156
Cycles	692,460,119,106

I/O

I/O Priority	Normal
Reads	160,002
Read Delta	0
Read Bytes Delta	0
Writes	121,141
Write Delta	0
Write Bytes Delta	0
Other	302,029
Other Delta	0
Other Bytes Delta	0

Virtual Memory

Private Bytes	307,124 K
Peak Private Bytes	325,112 K
Virtual Size	1,002,856 K
Page Faults	419,224
Page Fault Delta	0

Physical Memory

Memory Priority	5
Working Set	344,996 K
WS Private	164,024 K
WS Shareable	180,960 K
WS Shared	76,156 K
Peak Working Set	418,760 K

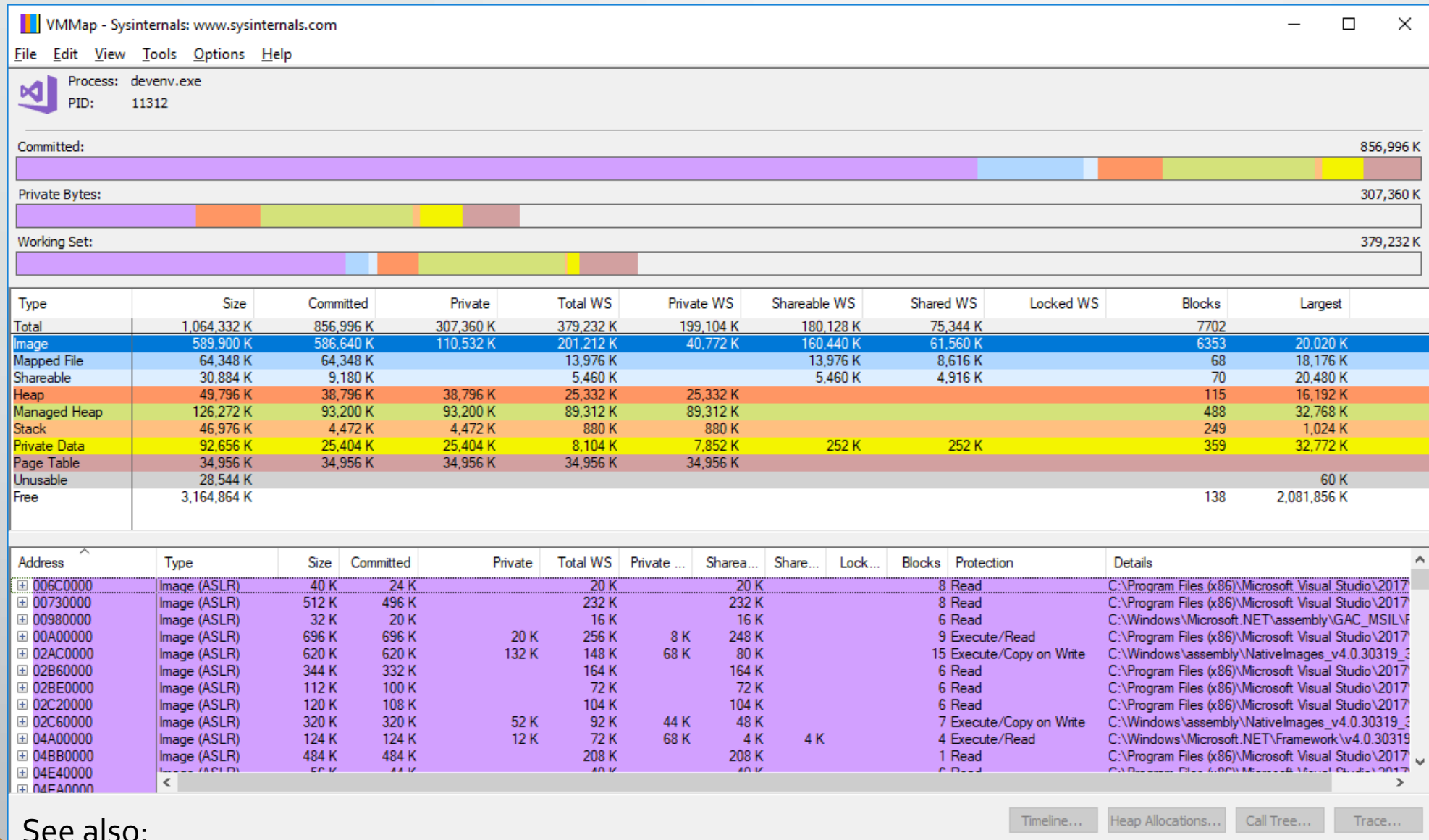
Handles

Handles	2,185
Peak Handles	2,185
GDI Handles	253
USER Handles	118

Working Set = WS Private + WS Shareable

OK Cancel

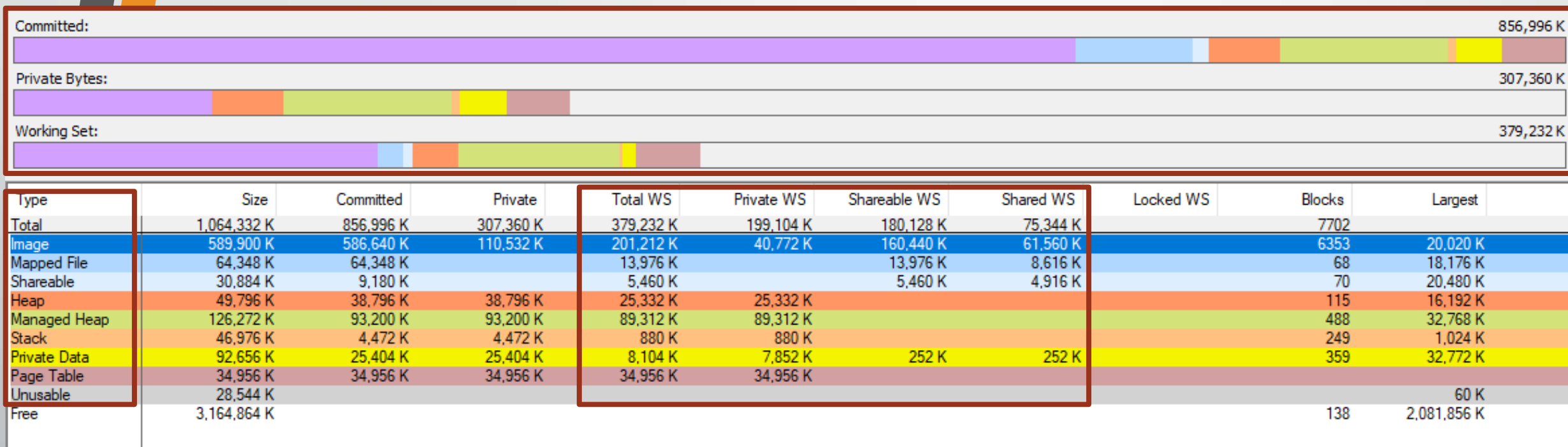
What do you really mean by memory?



See also:

- <http://blogs.microsoft.co.il/sasha/2016/01/05/windows-process-memory-usage-demystified/>
- Windows® Sysinternals Administrator's Reference. Pages 216-218

What do you really mean by memory?



See also:

- <http://blogs.microsoft.co.il/sasha/2016/01/05/windows-process-memory-usage-demystified/>
- Windows® Sysinternals Administrator's Reference. Pages 216-218

File Edit View Tools Options Help



Process: w3wp.exe

PID: 2612

Committed:

345,084 K

Private Bytes:

178,852 K

Working Set:

220,088 K

Type	Size	Committed	Private	Total WS	Private WS	Shareable WS	Shared WS	Locked WS	Blocks	Largest
Total	9,333,852 K	345,084 K	178,852 K	220,088 K	162,852 K	57,236 K	57,152 K		2365	
Managed Heap	8,953,216 K	73,644 K	73,644 K	73,436 K	73,436 K				664	8,912,896 K
Heap	75,824 K	65,732 K	65,668 K	60,072 K	60,068 K	4 K	4 K		73	16,192 K
Image	160,448 K	158,776 K	2,708 K	58,164 K	2,148 K	56,016 K	55,940 K		1407	21,664 K
Page Table	18,580 K	18,580 K	18,580 K	18,580 K	18,580 K					
Private Data	89,668 K	16,708 K	16,708 K	8,028 K	8,024 K	4 K	4 K		100	78,400 K
Mapped File	4,052 K	4,052 K		632 K		632 K	632 K		7	2,900 K
Stack	14,336 K	1,544 K	1,544 K	596 K	596 K				88	512 K
Shareable	9,420 K	6,048 K		580 K		580 K	572 K		26	3,820 K
Unusable	8,308 K									60 K
Free	137,429,638,136 K								75	136,878,830,968 K

Address	Type	Size	Committed	Private	Total WS	Private ...	Sharea...	Share...	Lock...	Blocks	Protection	Details
00000079C3FC0000	Managed Heap	8,912,8...	35,480 K	35,480 K	35,272 K	35,272 K				8	Read/Write	GC
00007FFB28B80000	Managed Heap	64 K	48 K	48 K	48 K	48 K				6	Execute/Read/Write	Shared Domain
00007FFB28B90000	Managed Heap	64 K	36 K	36 K	36 K	36 K				2	Read/Write	Domain 1
00007FFB28C30000	Managed Heap	448 K	192 K	192 K	192 K	192 K				5	Execute/Read/Write	Shared Domain Virtual Call Stub
00007FFB28CA0000	Managed Heap	384 K	384 K	384 K	384 K	384 K				1	Read/Write	Shared Domain Low Frequency Heap
00007FFB28D00000	Managed Heap	64 K	64 K	64 K	64 K	64 K				1	Read/Write	Shared Domain Low Frequency Heap
00007FFB28D10000	Managed Heap	64 K	64 K	64 K	64 K	64 K				1	Read/Write	Shared Domain High Frequency Heap
00007FFB28D20000	Managed Heap	64 K	28 K	28 K	28 K	28 K				2	Read/Write	Shared Domain
00007FFB28D30000	Managed Heap	64 K	64 K	64 K	64 K	64 K				1	Read/Write	Shared Domain Low Frequency Heap
00007FFB28D40000	Managed Heap	64 K	64 K	64 K	64 K	64 K				1	Read/Write	Shared Domain Low Frequency Heap
00007FFB28D90000	Managed Heap	64 K	64 K	64 K	64 K	64 K				1	Read/Write	Shared Domain High Frequency Heap
00007FFB28DA0000	Managed Heap	64 K	52 K	52 K	52 K	52 K				2	Read/Write	Shared Domain
00007FFB28DB0000	Managed Heap	64 K	12 K	12 K	12 K	12 K				2	Read/Write	Shared Domain
00007FFB28DC0000	Managed Heap	384 K	384 K	384 K	384 K	384 K				1	Read/Write	Shared Domain Low Frequency Heap
00007FFB28E20000	Managed Heap	64 K	64 K	64 K	64 K	64 K				1	Read/Write	Shared Domain Low Frequency Heap
00007FFB28E30000	Managed Heap	64 K	48 K	48 K	48 K	48 K				2	Read/Write	Shared Domain
00007FFB28E40000	Managed Heap	64 K	36 K	36 K	36 K	36 K				2	Read/Write	Shared Domain
00007FFB28E50000	Managed Heap	64 K	64 K	64 K	64 K	64 K				1	Read/Write	Shared Domain Low Frequency Heap

The structure of typical application



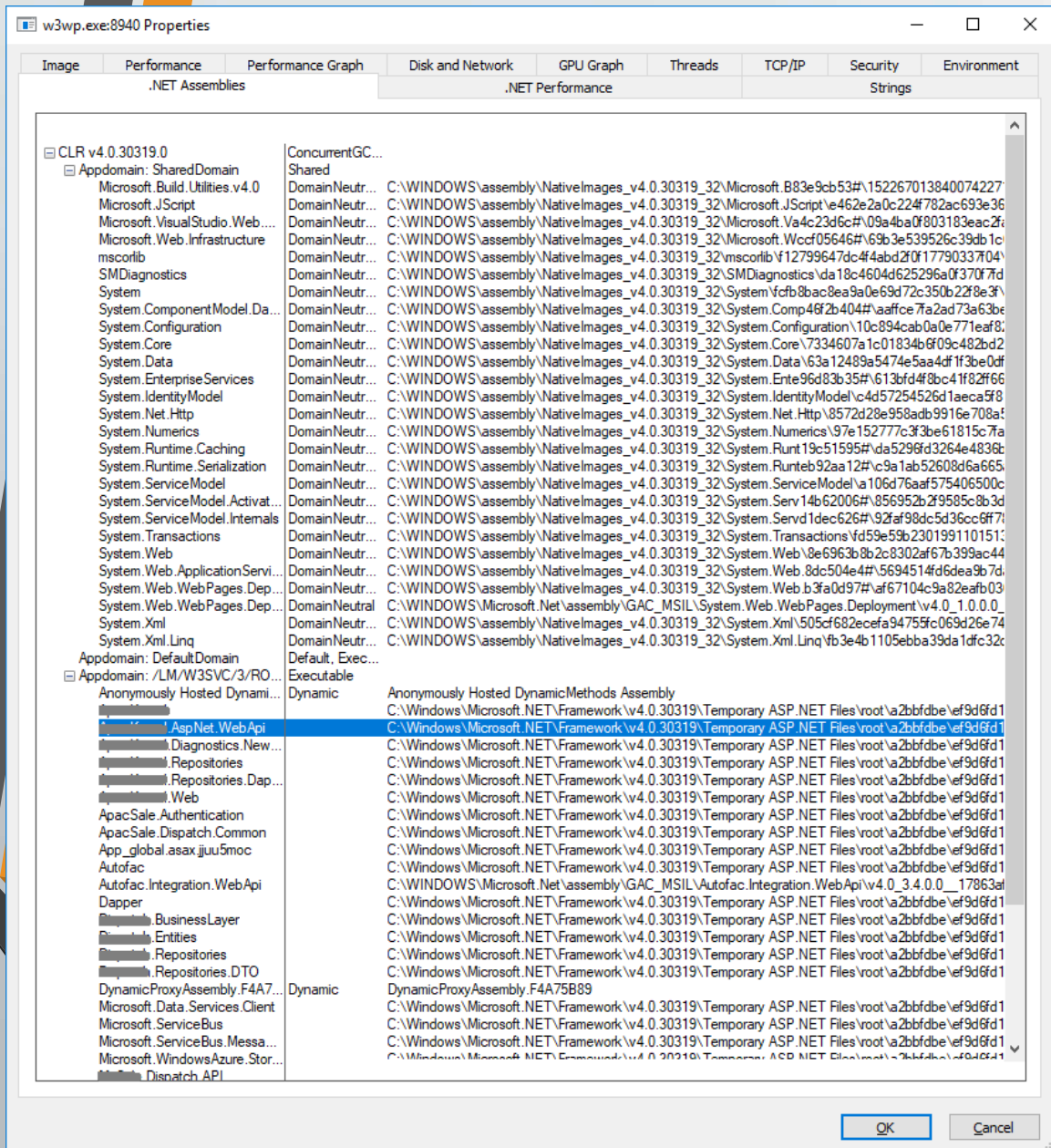
The screenshot displays the Visual Studio interface. The main editor window shows the `packages.config` file with the following XML content:

```
1 <?xml version="1.0" encoding="utf-8"?>
2 <packages>
3   <package id="Autofac" version="4.5.0" targetFramework="net462" />
4   <package id="Autofac.Owin" version="4.0.0" targetFramework="net462" />
5   <package id="Autofac.WebApi2" version="4.0.1" targetFramework="net462" />
6   <package id="AutoMapper" version="6.0.2" targetFramework="net462" />
7   <package id="Dapper" version="1.50.2" targetFramework="net462" />
8   <package id="Microsoft.AspNet.WebApi.Client" version="5.2.3" targetFramework="net451" />
9   <package id="Microsoft.AspNet.WebApi.Core" version="5.2.3" targetFramework="net451" />
10  <package id="Microsoft.AspNet.WebApi.Owin" version="5.2.3" targetFramework="net451" />
11  <package id="Microsoft.IdentityModel.Logging" version="1.1.4" targetFramework="net462" />
12  <package id="Microsoft.IdentityModel.Tokens" version="5.1.4" targetFramework="net462" />
13  <package id="Microsoft.Owin" version="3.1.0" targetFramework="net462" />
14  <package id="Microsoft.Owin.Host.SystemWeb" version="3.1.0" targetFramework="net462" />
15  <package id="Microsoft.Web.Infrastructure" version="1.0.0.0" targetFramework="net451" />
16  <package id="Newtonsoft.Json" version="9.0.1" targetFramework="net462" />
17  <package id="OctoPack" version="3.0.71" targetFramework="net451" developmentDependency="true" />
18  <package id="Owin" version="1.0" targetFramework="net451" />
19  <package id="System.IdentityModel.Tokens.Jwt" version="5.1.4" targetFramework="net462" />
20 </packages>
```

The Solution Explorer on the right shows the project structure for 'Solution 'Accounts' (7 projects):

- .nuget
- Tests
- Accounts.API
- Accounts.Business
- Accounts.DB
- Accounts.Repositories

Sharing assemblies between application domains



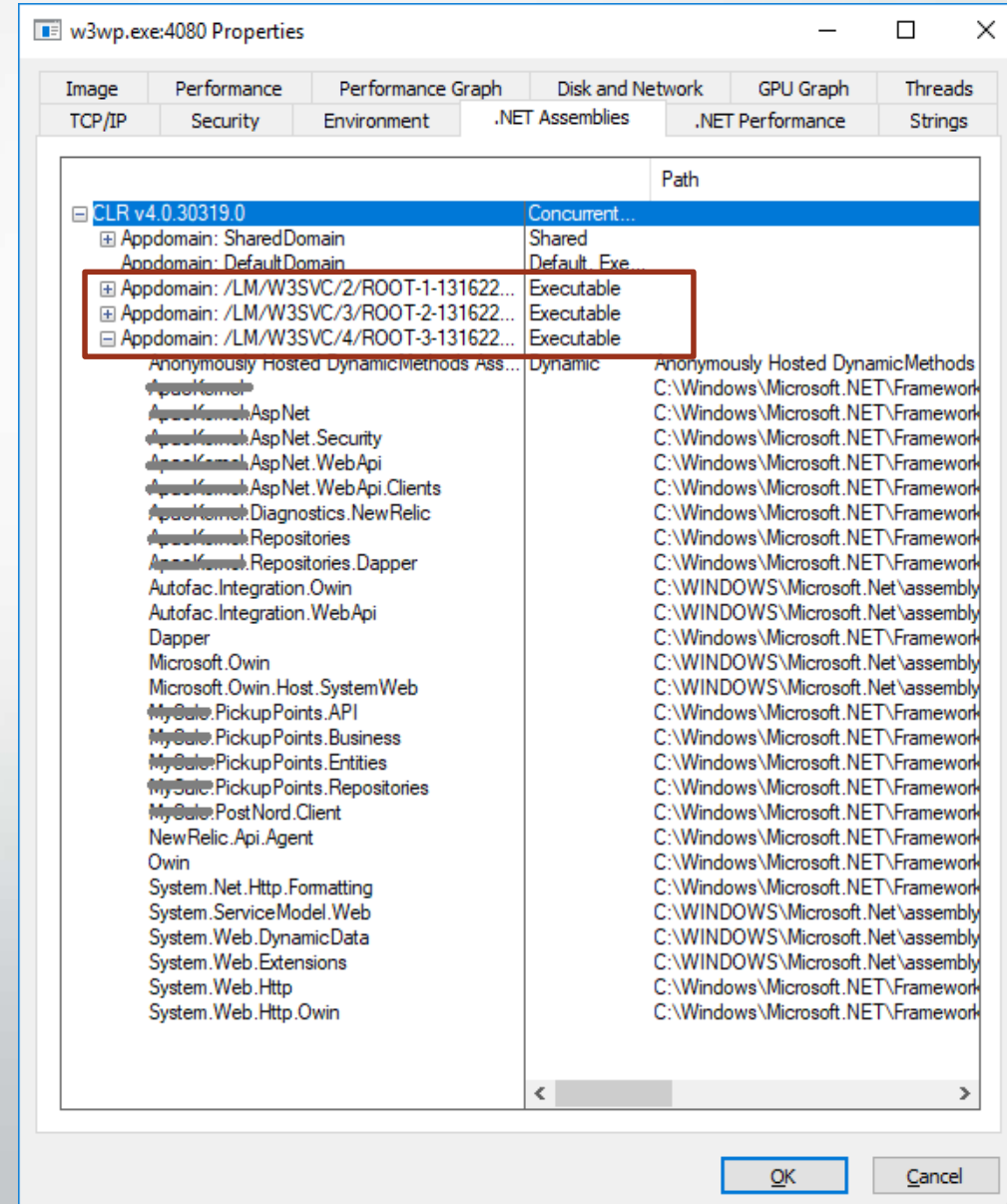
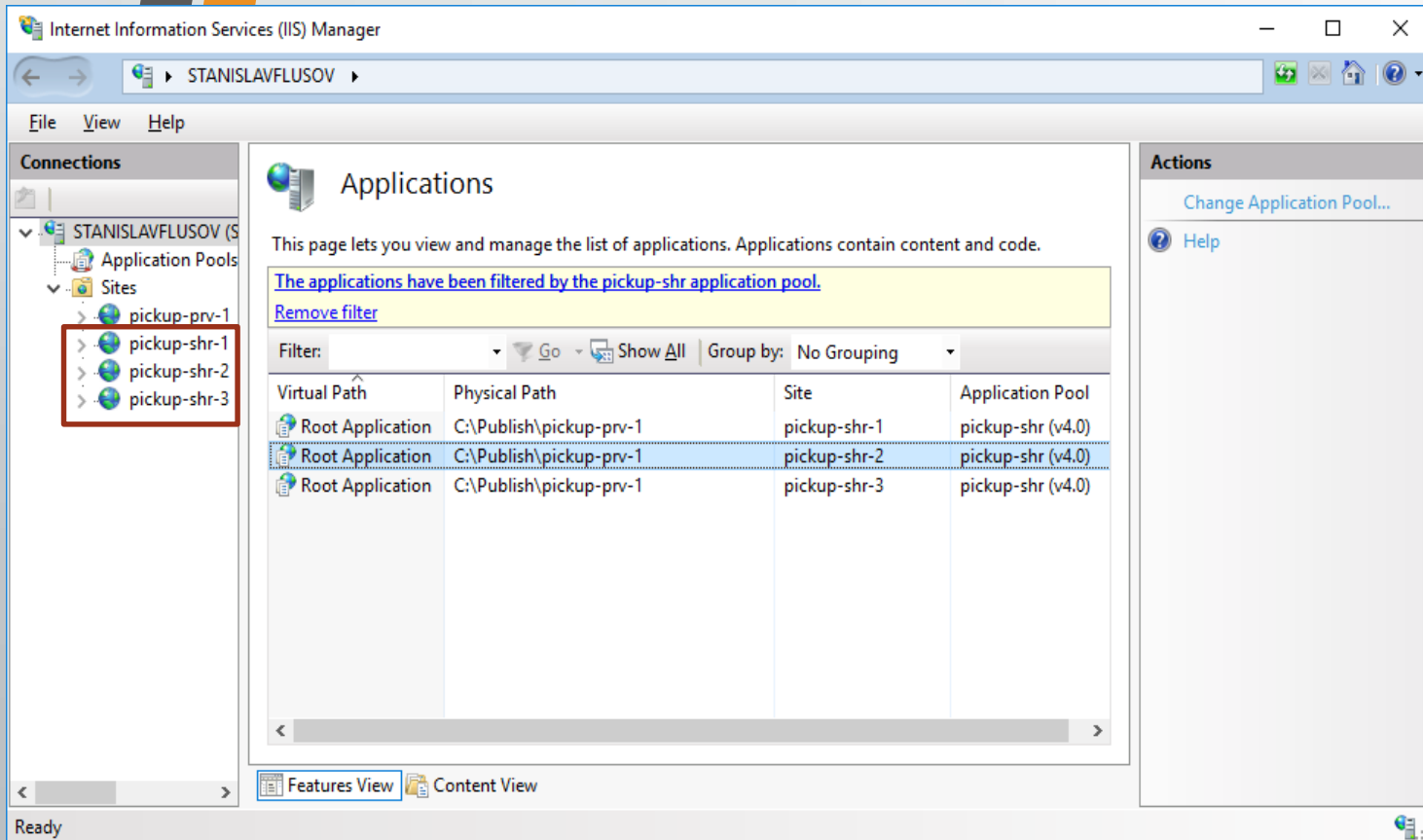
Domain neutral assembly

- It lives across multiple appdomains
- It will be jitted only once
- The jitted code will be shared across appdomains

See also:

<https://blogs.msdn.microsoft.com/junfeng/2004/08/05/domain-neutral-assemblies/>

Sharing assemblies between application domains



Sharing assemblies between application domains

w3wp.exe:4568 Properties

TCP/IP Security Environment .NET Assemblies .NET Performance Strings
Image Performance Performance Graph Disk and Network GPU Graph Threads

CPU		I/O	
Priority	8	I/O Priority	Normal
Kernel Time	0:00:00.296	Reads	592
User Time	0:00:01.015	Read Delta	3
Total Time	0:00:01.312	Read Bytes Delta	36 B
Cycles	3,647,440,642	Writes	206
Virtual Memory		Write Delta	3
Private Bytes	154,568 K	Write Bytes Delta	2.5 KB
Peak Private Bytes	154,792 K	Other	4,021
Virtual Size	2,166,958,448 K	Other Delta	0
Page Faults	41,087	Other Bytes Delta	0
Page Fault Delta	5	Handles	
Physical Memory		Handles	617
Memory Priority	5	Peak Handles	617
Working Set	87,792 K	GDI Handles	0
WS Private	33,764 K	USER Handles	0
WS Shareable	53,956 K		
WS Shared	51,992 K		
Peak Working Set	87,792 K		

OK Cancel

One site in appPool

w3wp.exe:9732 Properties

TCP/IP Security Environment .NET Assemblies .NET Performance Strings
Image Performance Performance Graph Disk and Network GPU Graph Threads

CPU		I/O	
Priority	8	I/O Priority	Normal
Kernel Time	0:00:00.578	Reads	1,069
User Time	0:00:02.140	Read Delta	3
Total Time	0:00:02.718	Read Bytes Delta	36 B
Cycles	7,349,228,846	Writes	266
Virtual Memory		Write Delta	3
Private Bytes	179,484 K	Write Bytes Delta	5.2 KB
Peak Private Bytes	181,584 K	Other	9,393
Virtual Size	2,166,978,288 K	Other Delta	0
Page Faults	77,687	Other Bytes Delta	0
Page Fault Delta	0	Handles	
Physical Memory		Handles	829
Memory Priority	5	Peak Handles	829
Working Set	114,144 K	GDI Handles	0
WS Private	58,160 K	USER Handles	0
WS Shareable	55,912 K		
WS Shared	51,900 K		
Peak Working Set	116,084 K		

OK Cancel

Three sites in appPool

Sharing assemblies between application domains

Installing assemblies to GAC

```
2  #gacutil.exe /i mydll.dll
3
4  $asm_path = 'C:\git\IISSharingAssemblies\common-assemblies-legacy'
5  $gac_path = "C:\Program Files (x86)\Microsoft SDKs\Windows\v10.0A\bin\NETFX 4.7 Tools\gacutil.exe"
6
7  #install assembly to GAC
8  Get-ChildItem -recurse $asm_path | where {$_.extension -eq ".dll"} | ForEach-Object {
9      Write-Host "Try to install assembly $_"
10     & $gac_path "/i", $_.FullName
11 }
```

Sharing assemblies between processes

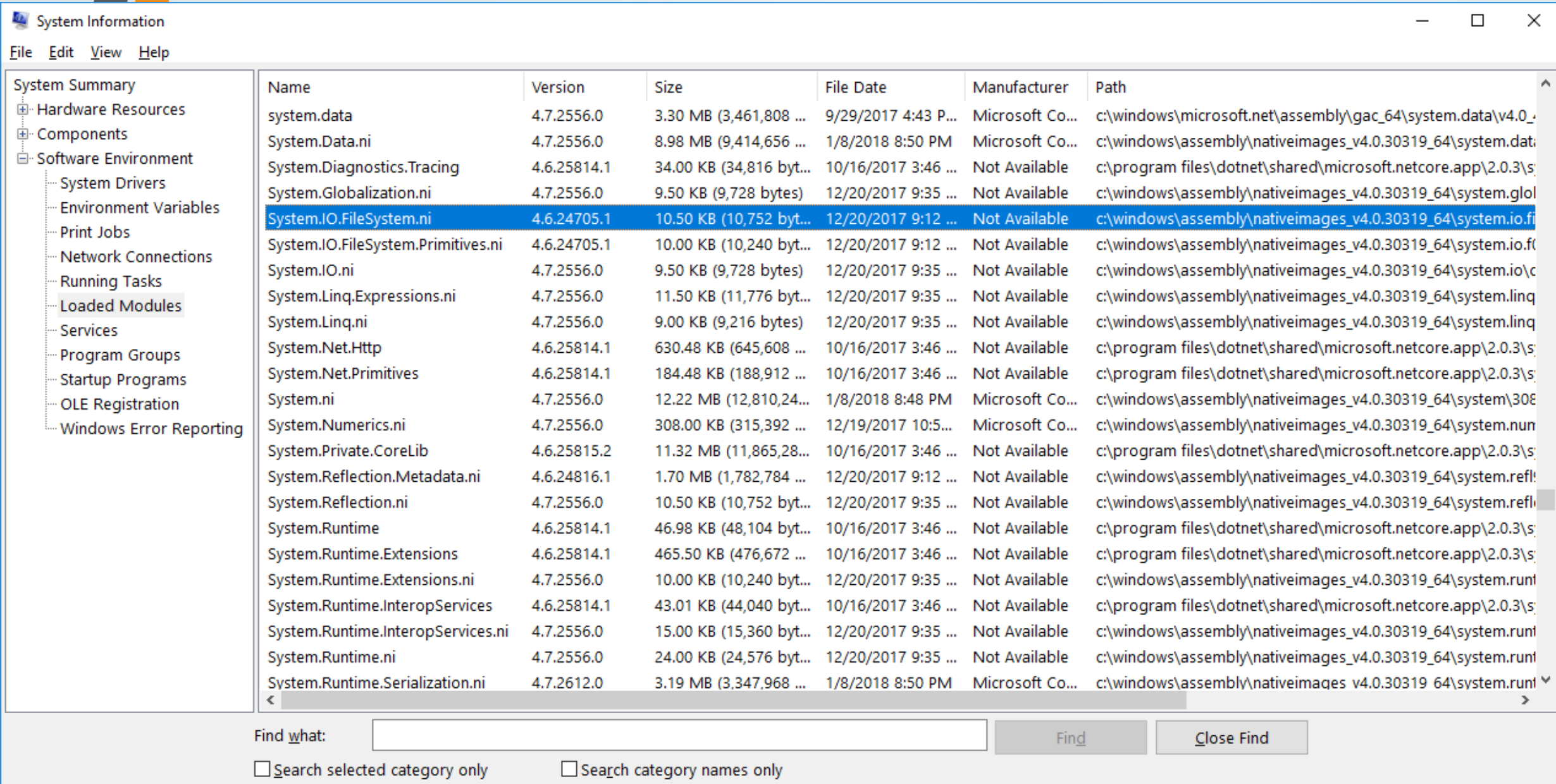
Summary of usage **NGEN**

- Enable code sharing between processes
- Require a smaller initial working set
- Load faster than MSIL

See also:

<https://docs.microsoft.com/en-us/dotnet/framework/tools/ngen-exe-native-image-generator>

Sharing assemblies between processes



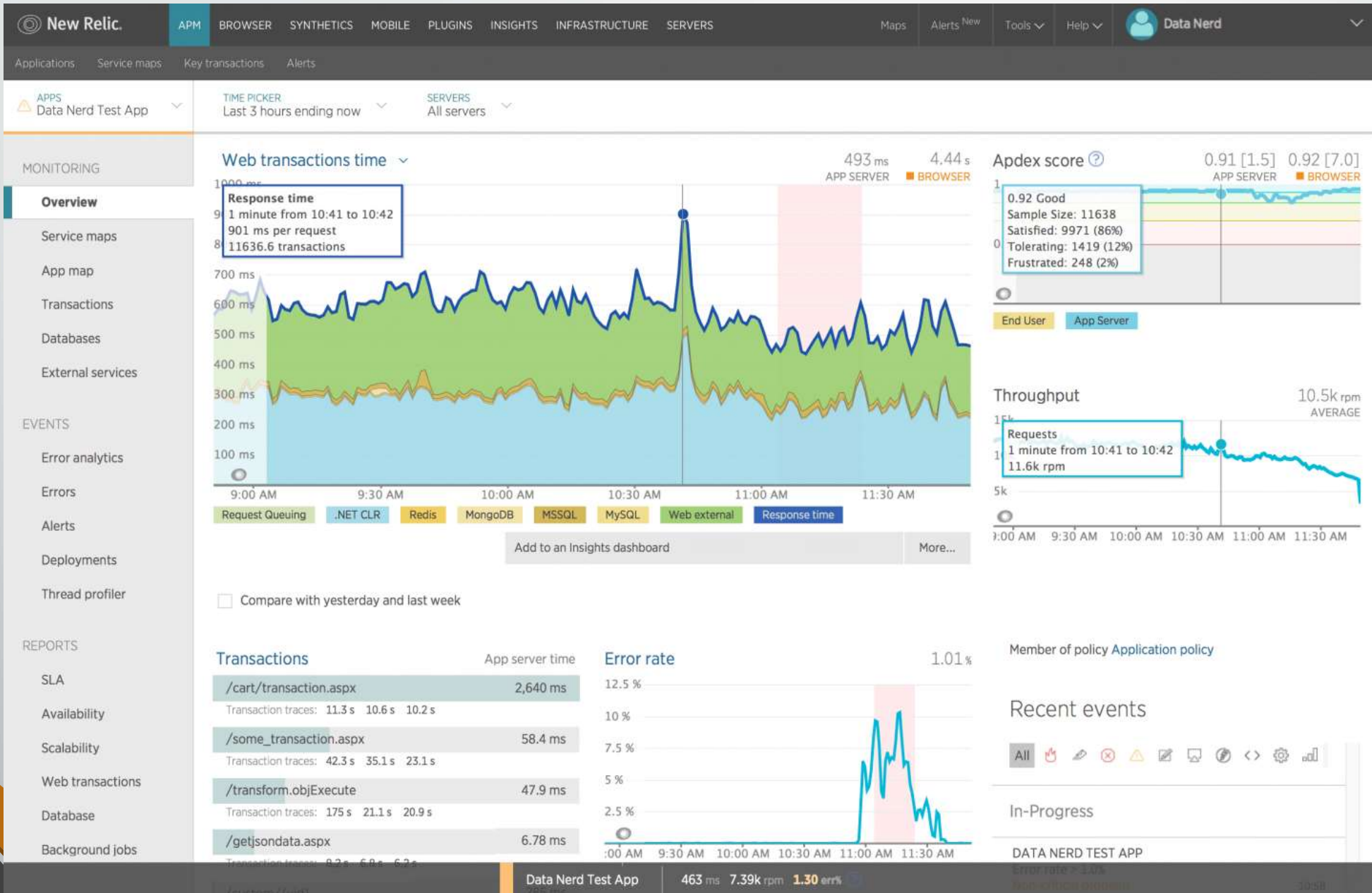
The screenshot shows the Windows System Information window, specifically the 'Loaded Modules' section. The window title is 'System Information'. The left sidebar shows a tree view with 'Loaded Modules' selected. The main pane displays a table of loaded modules. The table has columns: Name, Version, Size, File Date, Manufacturer, and Path. The row for 'System.IO.FileSystem.ni' is highlighted in blue. At the bottom, there is a search bar with the text 'Find what:' and two buttons: 'Find' and 'Close Find'. Below the search bar, there are two checkboxes: 'Search selected category only' and 'Search category names only'.

Name	Version	Size	File Date	Manufacturer	Path
system.data	4.7.2556.0	3.30 MB (3,461,808 ...)	9/29/2017 4:43 P...	Microsoft Co...	c:\windows\microsoft.net\assembly\gac_64\system.data\v4.0_...
System.Data.ni	4.7.2556.0	8.98 MB (9,414,656 ...)	1/8/2018 8:50 PM	Microsoft Co...	c:\windows\assembly\nativeimages_v4.0.30319_64\system.dat...
System.Diagnostics.Tracing	4.6.25814.1	34.00 KB (34,816 byt...	10/16/2017 3:46 ...	Not Available	c:\program files\dotnet\shared\microsoft.netcore.app\2.0.3\s...
System.Globalization.ni	4.7.2556.0	9.50 KB (9,728 bytes)	12/20/2017 9:35 ...	Not Available	c:\windows\assembly\nativeimages_v4.0.30319_64\system.glo...
System.IO.FileSystem.ni	4.6.24705.1	10.50 KB (10,752 byt...	12/20/2017 9:12 ...	Not Available	c:\windows\assembly\nativeimages_v4.0.30319_64\system.io.fi...
System.IO.FileSystem.Primitives.ni	4.6.24705.1	10.00 KB (10,240 byt...	12/20/2017 9:12 ...	Not Available	c:\windows\assembly\nativeimages_v4.0.30319_64\system.io.f...
System.IO.ni	4.7.2556.0	9.50 KB (9,728 bytes)	12/20/2017 9:35 ...	Not Available	c:\windows\assembly\nativeimages_v4.0.30319_64\system.io.c...
System.Linq.Expressions.ni	4.7.2556.0	11.50 KB (11,776 byt...	12/20/2017 9:35 ...	Not Available	c:\windows\assembly\nativeimages_v4.0.30319_64\system.linq...
System.Linq.ni	4.7.2556.0	9.00 KB (9,216 bytes)	12/20/2017 9:35 ...	Not Available	c:\windows\assembly\nativeimages_v4.0.30319_64\system.linq...
System.Net.Http	4.6.25814.1	630.48 KB (645,608 ...)	10/16/2017 3:46 ...	Not Available	c:\program files\dotnet\shared\microsoft.netcore.app\2.0.3\s...
System.Net.Primitives	4.6.25814.1	184.48 KB (188,912 ...)	10/16/2017 3:46 ...	Not Available	c:\program files\dotnet\shared\microsoft.netcore.app\2.0.3\s...
System.ni	4.7.2556.0	12.22 MB (12,810,24...	1/8/2018 8:48 PM	Microsoft Co...	c:\windows\assembly\nativeimages_v4.0.30319_64\system\308...
System.Numerics.ni	4.7.2556.0	308.00 KB (315,392 ...)	12/19/2017 10:5...	Microsoft Co...	c:\windows\assembly\nativeimages_v4.0.30319_64\system.nun...
System.Private.CoreLib	4.6.25815.2	11.32 MB (11,865,28...	10/16/2017 3:46 ...	Not Available	c:\program files\dotnet\shared\microsoft.netcore.app\2.0.3\s...
System.Reflection.Metadata.ni	4.6.24816.1	1.70 MB (1,782,784 ...)	12/20/2017 9:12 ...	Not Available	c:\windows\assembly\nativeimages_v4.0.30319_64\system.refl...
System.Reflection.ni	4.7.2556.0	10.50 KB (10,752 byt...	12/20/2017 9:35 ...	Not Available	c:\windows\assembly\nativeimages_v4.0.30319_64\system.refl...
System.Runtime	4.6.25814.1	46.98 KB (48,104 byt...	10/16/2017 3:46 ...	Not Available	c:\program files\dotnet\shared\microsoft.netcore.app\2.0.3\s...
System.Runtime.Extensions	4.6.25814.1	465.50 KB (476,672 ...)	10/16/2017 3:46 ...	Not Available	c:\program files\dotnet\shared\microsoft.netcore.app\2.0.3\s...
System.Runtime.Extensions.ni	4.7.2556.0	10.00 KB (10,240 byt...	12/20/2017 9:35 ...	Not Available	c:\windows\assembly\nativeimages_v4.0.30319_64\system.runt...
System.Runtime.InteropServices	4.6.25814.1	43.01 KB (44,040 byt...	10/16/2017 3:46 ...	Not Available	c:\program files\dotnet\shared\microsoft.netcore.app\2.0.3\s...
System.Runtime.InteropServices.ni	4.7.2556.0	15.00 KB (15,360 byt...	12/20/2017 9:35 ...	Not Available	c:\windows\assembly\nativeimages_v4.0.30319_64\system.runt...
System.Runtime.ni	4.7.2556.0	24.00 KB (24,576 byt...	12/20/2017 9:35 ...	Not Available	c:\windows\assembly\nativeimages_v4.0.30319_64\system.runt...
System.Runtime.Serialization.ni	4.7.2612.0	3.19 MB (3,347,968 ...)	1/8/2018 8:50 PM	Microsoft Co...	c:\windows\assembly\nativeimages_v4.0.30319_64\system.runt...

Sharing assemblies between processes

```
<runtime>
  <assemblyBinding xmlns="urn:schemas-microsoft-com:asm.v1">
    <dependentAssembly>
      <assemblyIdentity name="Autofac" publicKeyToken="17863AF14B0044DA" culture="neutral"/>
      <bindingRedirect oldVersion="0.0.0.0-3.5.0.0" newVersion="3.5.0.0"/>
    </dependentAssembly>
    <dependentAssembly>
      <assemblyIdentity name="Microsoft.Owin" publicKeyToken="31bf3856ad364e35" culture="neutral"/>
      <bindingRedirect oldVersion="0.0.0.0-3.1.0.0" newVersion="3.1.0.0"/>
    </dependentAssembly>
    <dependentAssembly>
      <assemblyIdentity name="Newtonsoft.Json" publicKeyToken="30ad4fe6b2a6aeed" culture="neutral"/>
      <bindingRedirect oldVersion="0.0.0.0-9.0.0.0" newVersion="9.0.0.0"/>
    </dependentAssembly>
    <dependentAssembly>
      <assemblyIdentity name="System.Web.Http" publicKeyToken="31bf3856ad364e35" culture="neutral"/>
      <bindingRedirect oldVersion="0.0.0.0-5.2.3.0" newVersion="5.2.3.0"/>
    </dependentAssembly>
    <dependentAssembly>
      <assemblyIdentity name="System.Net.Http.Formatting" publicKeyToken="31bf3856ad364e35" culture="neutral"/>
      <bindingRedirect oldVersion="0.0.0.0-5.2.3.0" newVersion="5.2.3.0"/>
    </dependentAssembly>
    <dependentAssembly>
      <assemblyIdentity name="System.IdentityModel.Tokens.Jwt" publicKeyToken="31bf3856ad364e35" culture="neutral"/>
      <bindingRedirect oldVersion="0.0.0.0-5.1.4.0" newVersion="5.1.4.0"/>
    </dependentAssembly>
    <dependentAssembly>
      <assemblyIdentity name="Microsoft.IdentityModel.Tokens" publicKeyToken="31bf3856ad364e35" culture="neutral"/>
      <bindingRedirect oldVersion="0.0.0.0-5.1.4.0" newVersion="5.1.4.0"/>
    </dependentAssembly>
  </assemblyBinding>
</runtime>
```

New Relic: Digital Performance Monitoring and Management



Summary

Step	Warming time	Total memory usage	Average memory usage per service
Initial conditions **	6 min 43 sec	8 GB	7 GB / 47 = 152 Mb
1. App pools combining 2. Load lib to GAC **	3 min 20 sec	3.5 GB	2.5 GB / 47 = 54 Mb
1. App pools combining 2. Load lib to GAC 3. Make native images	1 min 57 sec	2.0 GB	1.0 GB / 47 = 22 Mb

Remarks:

* *There are some deviations in values, because screenshot was made at different time*

** *NewRelic agent installed*

.NET Core & .NET Standard

```
<?xml version="1.0" encoding="utf-8"?>
<configuration>
  <system.webServer>
    <handlers>
      <add name="aspNetCore" path="*" verb="*" modules="AspNetCoreModule" resourceType="Unspecified" />
    </handlers>
    <aspNetCore processPath="dotnet" arguments=".\\Core.MyService.dll" stdoutLogEnabled="true" stdoutLogFile="C:\\tmp-files\\logs\\output" />
  </system.webServer>
</configuration>
```

svchost.exe		5,296 K	10,360 K	3400 Host Process for Windows S...	Microsoft Corporation	64-bit
w3wp.exe	0.01	5,356 K	14,000 K	18584 IIS Worker Process	Microsoft Corporation	64-bit
dotnet.exe	0.01	95,920 K	41,432 K	14156 dotnet	Microsoft Corporation	64-bit
conhost.exe		5,184 K	9,448 K	17372 Console Window Host	Microsoft Corporation	64-bit
svchost.exe		2,008 K	5,332 K	1324 Host Process for Windows S...	Microsoft Corporation	64-bit

See also:

- <https://github.com/dotnet/standard/blob/23ee76bbcd4997c199472a95a9d01f1a74f98e94/docs/faq.md>

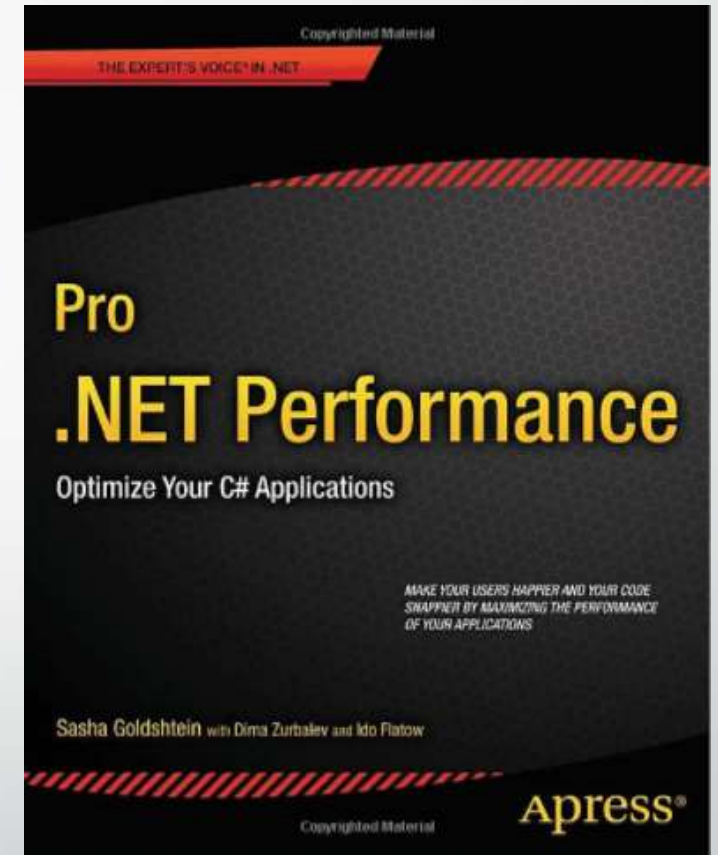
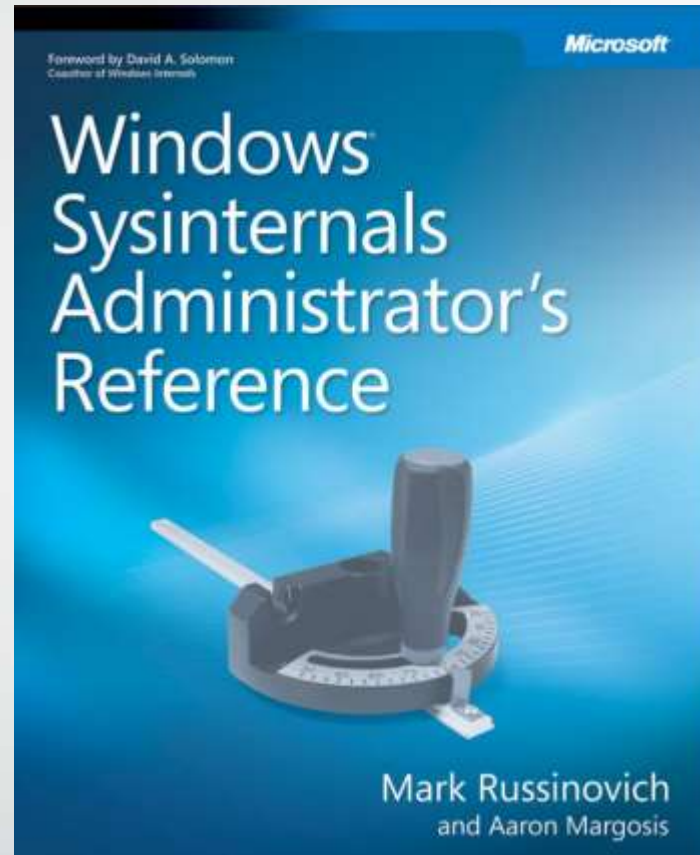
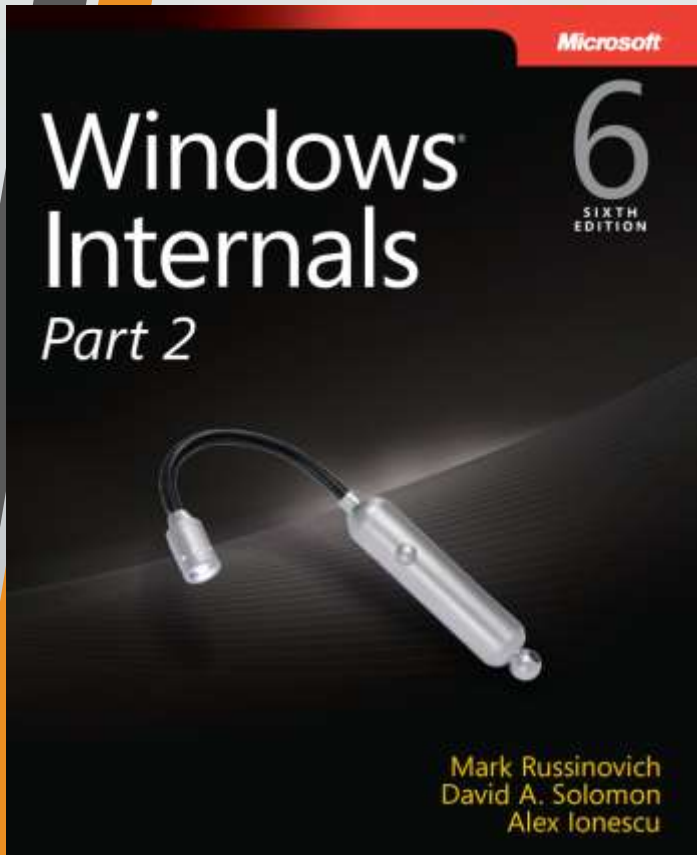
.NET Core & .NET Standard

```
83         if (assemblyName.Length == 0 || assemblyName[0] == '\0')
84         {
85             throw new ArgumentException(SR.ZeroLengthString);
86         }
87
88         return assemblyName;
89     }
90
91     public static AppDomain CreateDomain(string friendlyName)
92     {
93         if (friendlyName == null) throw new ArgumentNullException(nameof(friendlyName));
94         throw new PlatformNotSupportedException(SR.PlatformNotSupported_AppDomains);
95     }
96
97     public int ExecuteAssembly(string assemblyFile) => ExecuteAssembly(assemblyFile, null);
98
99     public int ExecuteAssembly(string assemblyFile, string[] args)
100    {
```

See also:

- <https://github.com/dotnet/standard/blob/23ee76bbcd4997c199472a95a9d01f1a74f98e94/docs/faq.md>

Books recommended for reading



References

- <https://www.microsoftpressstore.com/store/windows-internals-part-1-9780735648739>
- <https://www.microsoftpressstore.com/store/windows-sysinternals-administrators-reference-9780735656727>
- <http://www.apress.com/us/book/9781430244585>

Thank you

- Article: <https://habrahabr.ru/post/341950/>
- Source code: <https://github.com/sflusov/IISSharingAssemblies>
- VK: https://vk.com/stanislav_flusov